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MUFFLER FOR INTERNAL COMBUSTION ENGINES

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Fig. 1.

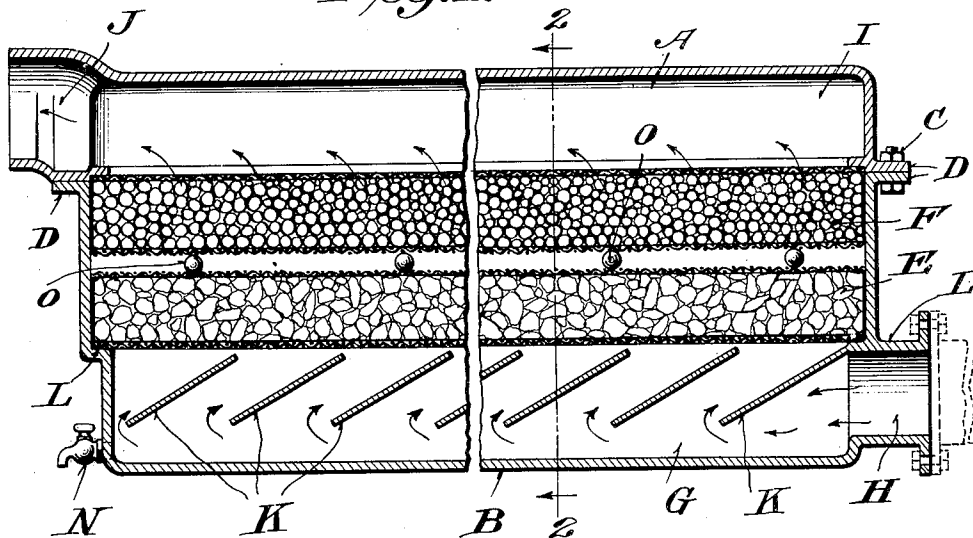


Fig. 2.

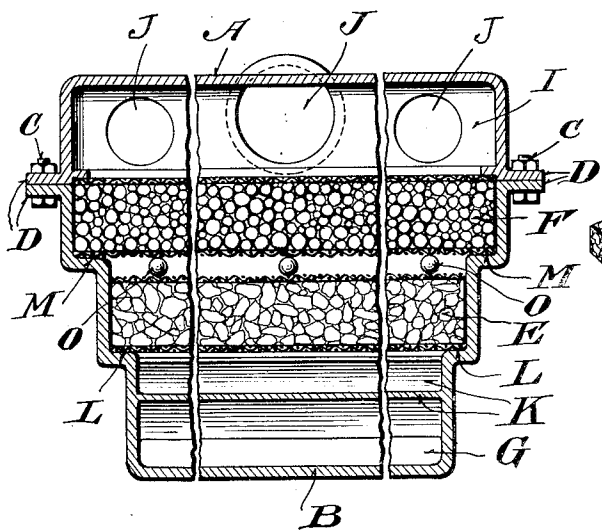
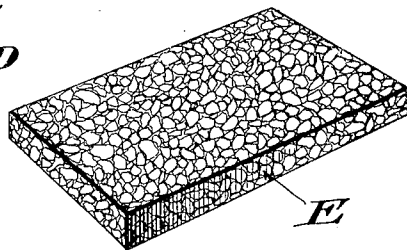


Fig. 3.



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MUFFLER FOR INTERNAL-COMBUSTION ENGINES.

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To all whom it may concern:

Be it known that I, AXEL FRANCK-PHILIPSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Mufflers for Internal-Combustion Engines, of which the following is a specification.

This invention has for its object to provide simple, practical and efficient means for subjecting the exhaust gases of the internal combustion engines of automobiles in particular, to the action of a mass of material adapted to convert the carbon-monoxide thereof into carbon-dioxide in such manner and under such conditions as to cause the mass of said material or materials to constitute a readily permeable resistant medium functioning as the noise muffling element without creating a back-pressure tending to interfere with the efficient operation of the motor while at the same time said mass of material is so disposed as to be subjected to the substantially maximum heat of the freshly exhausted gases to thereby promote rapid reaction to effect the conversion aforesaid, and thus enable a comparatively small quantity of the active reagent, employed for said conversion purposes, to be used.

A further object of the invention is to provide means, as aforesaid, in such relation to the source of supply of the exhaust gases as to cause the latter to promote and maintain the degree of permeability of said mass as is essential to the prevention of the accumulation of appreciable engine-deterrent back-pressure of said exhaust gases; to prevent penetration of water and oil to the active reagent of the mass to thereby preserve the activity of the latter; to so dispose said mass in the path of the exhaust gases as to present the maximum area per unit of weight or volume of the mass, to the gases; to provide a suitable volume of free space for the reception of the gases prior to their passage through the mass to promote uniform distribution of said gases over the whole area of said mass to thereby prevent localization of gas-penetration through some parts of the mass in excess of other parts thereof; to embody the mass in such form as is best adapted to insure uniform penetration of gases therethrough and obtain the maximum advantage of the expo-

sure of fresh areas, by attrition, to direct contact with the gases; to provide means for readily and quickly renewing the mass or any part thereof, and generally to provide a means adapted to the purposes aforesaid which will meet all and severally the practical requirements involved in the successful operation of internal combustion engines.

A suitable embodiment of a means for carrying out the several purposes and obtaining the advantages of the invention, is illustrated in the accompanying drawings, wherein:—

Figure 1 is a vertical longitudinal section of a device adapted to the purposes of the invention.

Figure 2 is a vertical transverse section of the same on the line 2—2 of Fig. 1.

Figure 3 is a perspective view of a removable container or cartridge for the ready removal and replacement of the mass of material employed or of any portion thereof.

The embodiment illustrated in the drawings is intended solely to represent an exemplary device containing the essential elements of a commercially practicable muffler capable of functioning as aforesaid.

Thus the embodiment illustrated comprises a relatively long and narrow casing consisting of an upper or cover portion A and a lower or body portion B which are suitably detachably associated by means of any kind of fastening devices C adaptable to the purpose and associated with, for example, the peripheral flanges D of said portions A and B, it being understood that any means whereby access may be had to the interior of the casing for the removal and replacement of masses of materials adapted to the purposes of the invention, may be substituted for the particular means and arrangement shown and described.

The materials employed are preferably disposed in bodily removable containers E and F, having foraminous walls and constituting cartridges. The latter are intended and adapted to be so disposed in the casing as to provide a relatively large free space G, associated with the intake H for hot exhaust gases to be passed through the cartridges, and a sufficiently large chamber I communicating with the discharge pipe J to prevent accumulation of gases in said cham-

ber I to effect back-pressure. In said chamber G are mounted one or more inclined baffle or deflecting plates K extending from substantially the level of the bottom of a lower cartridge E to a level spaced from the bottom of the said chamber G so as to permit free travel of the entering gases throughout the length of said chamber for effecting thorough distribution of said gases. As the entering gases are deflected toward the bottom of said chamber G, oil and water carried thereby will be quite efficiently separated therefrom.

The cartridges E and F, which are intended to exemplify a plurality of such devices in the event that it shall be desirable to employ more than two thereof, are of lateral and longitudinal dimensions corresponding substantially to the inner length and width of the lower portion B of the casing at the respective levels intended for the reception thereof. The lower cartridge E is intended to contain coke, charcoal or any similar, preferably light, porous mass in a coarse granular or small lump form which is very readily permeable by the gases and will take up from the same oil and water carried thereby and will, to a large extent, filter out smoke and soot, the main function of this mass being to protect the material contained in the cartridge F from contact with oil and water to thereby preserve it in the condition most advantageous to its reaction upon the exhaust gases for the purposes aforesaid.

The upper cartridge contains a catalyst such as manganese dioxide in such a physical state from the standpoint of size of particles thereof as is adapted to permit easy permeation of gases therethrough while presenting sufficient surface to said gases in passage to insure efficient reaction for the aforesaid purposes. This may be most advantageously accomplished by introducing the catalyst in the form of small spheres or the like or in an approximately similar form, the size of the spheres or the like being dependent more or less upon the available depth of the mass and the total surface necessary to be exposed to the passing gases to efficiently perform the aforesaid function of converting the carbon-monoxide into carbon-dioxide.

Obviously the rapidity of reaction of a catalyst of the type above mentioned is promoted by heat in direct ratio of its intensity up to the point at which disintegration occurs. It is quite essential in practice to limit both the volume and weight of the catalyst as far as possible without sacrifice of sufficiency to function continuously for such maximum periods of continuing motor operation as commonly occur in cities, the function of conversion aforesaid being essential only in confined areas such as build-

ings, sheds, streets and alleys where practically instant diffusion of said exhaust gases cannot ordinarily take place.

The arrangement illustrated provides a very large area of mass or masses of relatively little depth for the easy permeation of the exhaust gases to thereby prevent accumulation of the latter in the chamber G to an extent sufficient to effect back-pressure of a degree which will tend to interfere with the efficient operation of the motor. Under the influence of vibration due to travel of the vehicle, the masses in the several cartridges tend to settle and pack closely in the bottom portions of the latter. The upward passage of the gases tends to neutralize or prevent such close packing and maintains the necessary degree of permeability. Attrition results from this vibration as well as by frictional contact of the gases with the particles. In the case of the catalyst this is advantageous in that fresh surfaces are being constantly presented to the action of the gases.

Preferably the cartridges E and F are of respectively different dimensions in order that proper relative disposition thereof may be assured and to this end the walls of the portion B of said casing are stepped to provide supporting shoulders L and M at different elevations, the distances between said shoulders being such that a cartridge F cannot occupy the place intended for a cartridge E, and vice versa.

The cartridges may include a deodorizing agent and a dehydrating agent, if desired, the number of said cartridges and their contents being a matter of choice and involving entirely obvious modification of the embodiment shown and described to accommodate the same.

Positioning the casing closely proximate to the discharge end of the exhaust manifold of the motor in order that gases entering said casing may be at their maximum temperatures is very advantageous for reasons above pointed out.

A sludge-cock N or equivalent device may be provided for draining water and oil from the chamber G.

In this embodiment of the invention, the mass or masses of material employed effect a multiplicity of functions simultaneously, including that of efficient muffling of noise without creating an undesirable degree of back-pressure. Preferably some free space is provided between the cartridges E and F and flexible separating or spacing devices O are disposed between them to prevent the cartridges from jumping up and down during travel of the vehicle. It will be noted that the edge portions of the cover member A bear upon the edge portions of the cartridge F to hold same firmly upon its support.

The said cartridges may also be regarded in the light of foraminous cakes of materials of the character indicated.

The total area of the surface of the mass 5 opposed to the free flow of the exhaust gases must necessarily bear a distinct relation to the size and shape of the particles composing the mass as well as the depth of the latter. That is to say that the coarser the 10 particles the larger will be the irregular passages for the gases, whereas smaller particles will provide a larger number of smaller passages. Intimacy of contact between 15 the particles and the gases becomes greater as the particles become smaller. Total depth of the mass in the direction of flow of the gases therethrough must necessarily increase in direct ratio to the size of the particles to effect the equivalent intimacy of 20 surface contact between the gases and said particles. In order that accumulation of back-pressure in the chamber G may be avoided, the total area of passages through the mass should be approximately equal to 25 the cross-sectional area of the discharge end of the exhaust manifold of the motor.

The area aforesaid will be determined in much the same manner as is that of the filter-bed of a sand filter for water-purification, this being determined by the depth of 30 the bed, the mesh of the sand thereof, and the maximum rate of flow of water therethrough expressed in gallons per minute at a predetermined pressure. Thus the area 35 of surface of the mass may be defined only in terms of comparison with filter practice, and in the appended claims, the expression "large area" will be understood to mean such an area in proportion to depth and the 40 mesh of the component particles, with relation to the cross sectional area of the discharge end of the exhaust pipe of the motor as will permit a sufficiently free flow of gases through the mass to prevent accumulation of deterrent back-pressure in excess of 45 that afforded by the mufflers commonly employed.

Shrinkage of the mass by attrition and erosion will, in the course of time, result in 50 a freedom of permeation of gases therethrough to an extent capable of defeating the muffling function to an extent that will become aurally appreciable and give notice of the necessity of renewing the mass, this 55 being a distinct advantage and constituting an object of the invention.

In order to effect uniform distribution of the gases over the entire area of the mass, it is preferable to dispose the face of the 60 latter parallel with the normal direction of flow of said gases into the chamber G instead of transversely thereto.

It is to be understood that the precise relative arrangements illustrated and described 65 shall not act to limit the appended

claims inconsistently with the broadest construction of the language thereof.

The engine P and its exhaust pipe Q connected with the intake pipe H serves to indicate the preferred proximity of the gas 70 treating device to the source of supply of the exhaust gases in order that the latter may be received and treated while at maximum temperature.

It is well known that the catalyst, such as 75 manganese dioxide, will react on gases containing moisture when said catalyst is heated to a relatively high degree, approximating 300° F. and over. It is, however, deleteriously effected by surface deposits of oil 80 or oily soot in that the latter prevents contact with the gases. Hence, the rubbing together of surface resulting in attrition of the particles of catalyst is very advantageous to effect cleansing of said surfaces and preserving their reactive properties. 85

Reference to discharge opening or the like in the claims will be construed to mean one or more openings presenting a sufficient area to prevent accumulation of back-pressure in 90 the upper chamber of the device.

By "maximum temperature" as used herein is meant the highest temperature practicable to promote reaction of the catalyst 85 upon the gases without effecting disintegration of said catalyst, it being understood that the highest temperature of said exhaust gases of an automobile engine is ordinarily far below that at which disintegration of 95 the catalyst occurs.

The employment of the catalyst for the conversion of carbon-monoxide into carbon dioxide being well-known and being therefore, per se, not of any invention, it will 100 be understood that while a catalyst is preferable to any other substance known to me for use as herein described, any other substance, capable of substitution for the catalyst, may be so substituted without affecting the scope of the invention as defined in 105 and by the appended claims.

I claim as my invention:

1. An apparatus for removing carbon-monoxide from the exhaust gases of internal combustion engines comprising a casing having 115 an expansion chamber adapted for communication with the exhaust pipe of an engine, and having an outlet for free communication with atmosphere, said outlet being of an area sufficient to prevent accumulation of pressure in said casing, means 120 interposed between the inlet and exhaust ends of said casing for mechanically separating liquids from the exhaust gases, a readily permeable foraminous body of loose 125 particles of a catalytic material disposed between said means and the exhaust gases to pass therethrough in a direction to cause said gases to prevent compaction of said particles to thereby maintain the perme- 130

ability of the body thereof, said body presenting a sufficiently large area opposed to the direction of flow of gases therethrough in proportion to the area of the exhaust pipe of the engine as to offer no substantial resistance to passage of said gases therethrough, thereby preventing accumulation of engine-deterrent back pressure within said casing.

2. A muffler for internal combustion engines comprising a casing having a lower expansion chamber for receiving the hot products of combustion, means within said chamber for mechanically separating liquids from said products without substantial resistance to free passage of said products therethrough, a layer of a coarse, readily permeable filtering material constituting the upper wall of said chamber, a similar layer of a catalytic material disposed above said first-named layer, there being a substantial expansion chamber above said layer of catalytic material communicating freely with atmosphere, said chambers and layers adapted for substantially free passage of products of combustion, to thereby avoid accumulation of engine deterrent back-pressure within said casing while effecting efficient muffling of noise, the products of combustion serving to resist compaction of said layers.

3. A muffler for internal combustion engines comprising a casing have a lower expansion chamber equipped with an intake opening for gases at one end, means within said chamber for effecting mechanical separation of liquids from said gases without substantial resistance to free passage of the latter, a layer of loose granules of a filtering material constituting the upper wall of said chamber, the area of the top and bottom faces of said layer being of such area and the size and nature of said granules such that said layer is readily permeable by said gases, a similar layer of a catalytic material

disposed above said filtering layer, and a substantial expansion chamber communicating freely with atmosphere, disposed above said catalytic layer.

4. A muffler for internal combustion engines including a casing having inlet and discharge openings, the latter of greater area than the former, confined layers of loose compactible granular material disposed within the casing between the inlet and discharge openings, there being substantial expansion chambers on opposite sides of said layers, the latter arranged for passage of exhaust gases therethrough in a direction adapted to oppose compaction of said layers, means in the gas receiving chamber for mechanically separating liquids from the gases without substantial resistance to the free passage of said gases, the areas of said layers opposed to the direction of travel of said gases and the permeability thereof being such as to obviate substantial resistance to free passage of said gases.

5. A muffler for internal combustion engines including a casing having inlet and discharge openings, the latter of greater area than the former, confined bodily removable layers of loose compactible granular material disposed within the casing between the inlet and discharge openings, there being substantial expansion chambers on opposite sides of said layers, the latter arranged for passage of exhaust gases therethrough in a direction adapted to oppose compaction of said layers, means in the gas receiving chamber for mechanically separating liquids from the gases without substantial resistance to the free passage of said gases, the areas of said layers opposed to the direction of travel of said gases and the permeability thereof being such as to obviate substantial resistance to free passage of said gases.

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