

July 7, 1942.

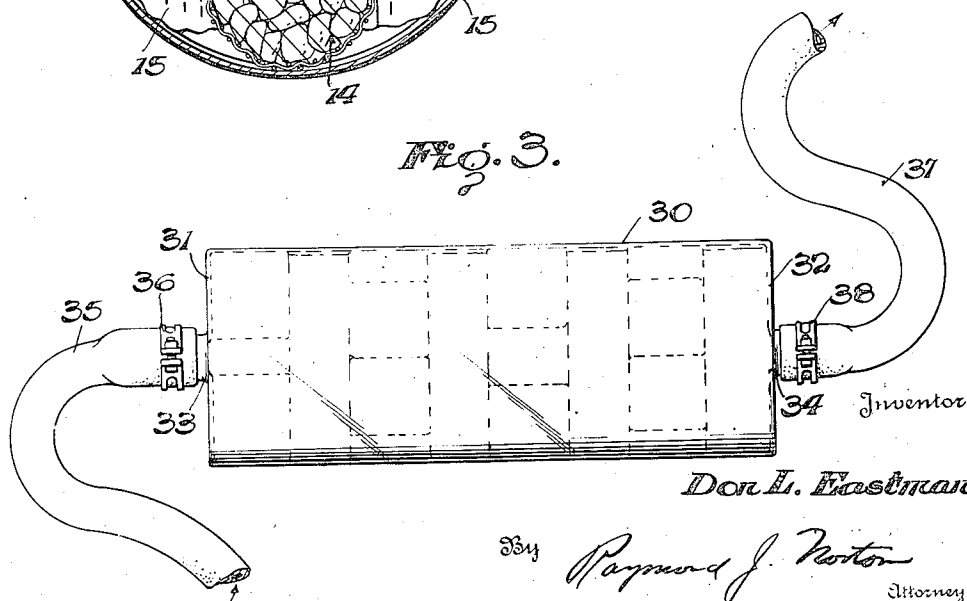
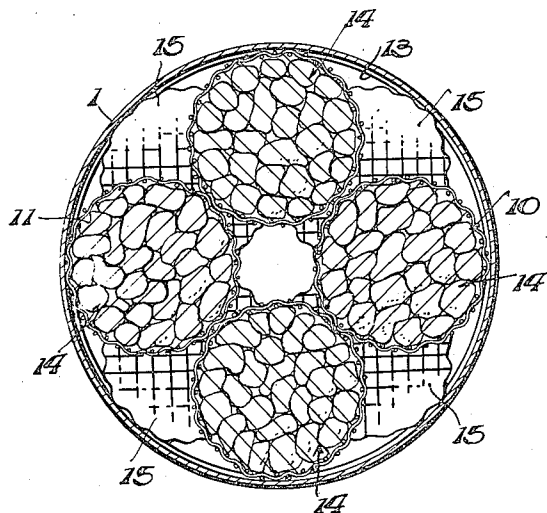
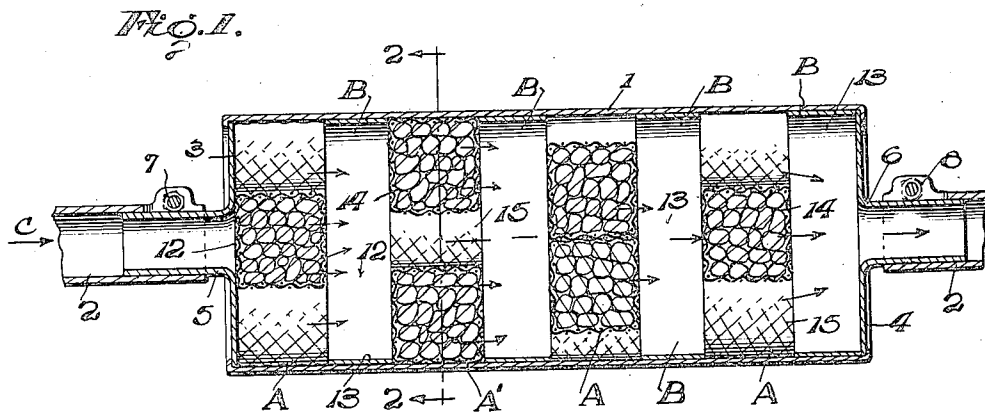
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2,288,943

APPARATUS FOR TREATING TOXIC GASES

Filed April 8, 1939

2 Sheets-Sheet 1



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FIG. 4.

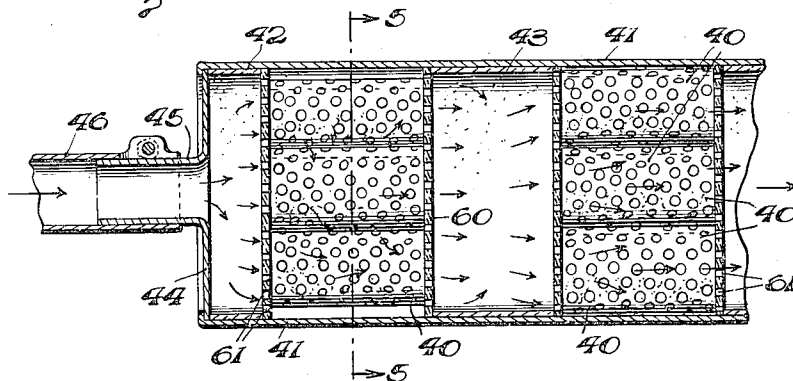


FIG. 5.

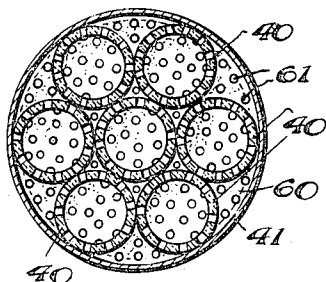


FIG. 7.

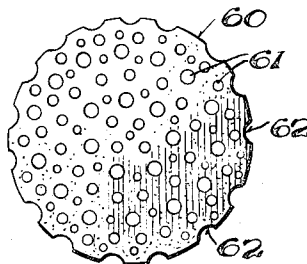
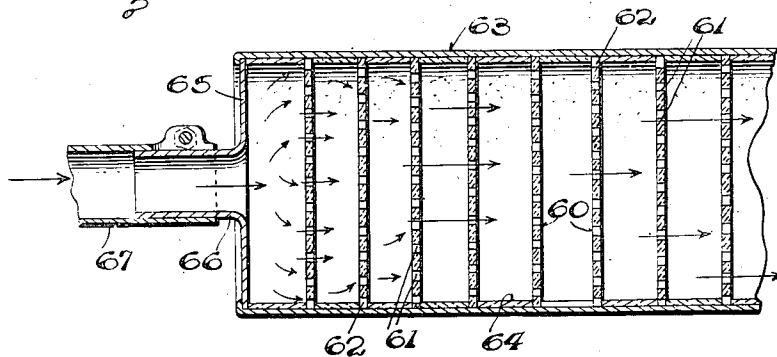


FIG. 6.



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APPARATUS FOR TREATING TOXIC GASES

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1 Claim. (Cl. 23—288)

This invention relates to an improved method and apparatus for treating toxic gases for the purpose of rendering them non-toxic. In a particular aspect the invention relates to a method of catalytically converting the carbon monoxide of exhaust gases of internal combustion motors.

As is known the exhaust gases of internal combustion motors contain carbon monoxide in substantial amounts. The quantity of this toxic gas can soon reach lethal proportions as for example when a motor is operated for a period in a closed garage. In crowded city thoroughfares the carbon monoxide content of the air is quite substantial and while it does not reach strictly toxic concentrations it nevertheless does constitute a distinct health menace.

A major object of the present invention is to associate a catalytic chamber with the exhaust of an internal combustion motor in which the toxic carbon monoxide is catalytically oxidized to the innocuous carbon dioxide.

Another object of the invention is to embody such catalytic chamber in the exhaust pipe of an automobile.

Yet another object of the invention is to devise a chamber of the type described which is catalytically efficient and yet does not substantially detract from the efficiency of the motor itself.

A further object is to provide as a garage accessory a device which may temporarily be attached to the exhaust line of a motor and which is operative to oxidize the carbon monoxide content of the gas flowing therethrough.

With these and other equally important and related objects in view the invention comprehends the concept of effectively oxidizing the carbon monoxide content of exhaust gases by an improved catalytic agency.

In order to enable a more ready comprehension of the principles of the invention there is shown in the accompanying drawings a preferred physical embodiment in which:

Figure 1 is a longitudinal section of the improved unit.

Figure 2 is an enlarged cross section taken on line 2—2 of Figure 1.

Figure 3 is a modified form of the device adapted particularly for garage use.

Figure 4 is a view, similar to Figure 1, showing a modified form of catalytic chamber.

Figure 5 is a cross section taken on line 5—5 of Figure 4.

Figure 6 is a longitudinal section of a further modification under the invention.

Figure 7 is a detail showing of the catalytic material employed in Figure 6.

As shown in the drawings, in the preferred method of effectuating the invention a catalytic chamber, designated generally by the numeral 1, is interposed in the exhaust pipe 2 of an internal combustion motor such as in an automobile. The chamber 1, as shown, may be constructed of a tube of any suitable metal and is provided with the end walls 3 and 4. These end walls, as will be appreciated, may be removable. Each of these walls is provided with a short pipe or tube section, shown at 5 and 6 respectively, by means of which the chamber is coupled in the exhaust line. The chamber may be locked in the exhaust line in any suitable manner, as for example by means of the clamps 7 and 8 which lock the tube sections 3 and 4 to the cooperating sections of the exhaust pipe. The chamber 1 may be mounted at any suitable place in the exhaust line between the exhaust manifold and the muffler preferably near the motor so that the catalysis is accelerated by utilizing the gases at an optimum high temperature. If desired the catalytic chamber may be interposed in the exhaust line after the muffler or may be embodied in the muffler structure itself.

As will be observed from an inspection of Figure 1, the chamber comprises essentially a spaced series of catalytic sections A and an adjacent and alternate series of expansion sections B.

The sections A contain catalytic material, to be more particularly described, which is effective to insure the oxidation of the carbon monoxide content of the gas to carbon dioxide. This catalytic material 10 which, as shown is in the form of hard porous granular masses may be retained in position in any desired manner. One effective and preferred method comprises the utilization of open mesh screen tubes 11 which, as shown are provided at each end with the wire mesh walls 12.

The screen units 11 preferably are made up of a standardized size so as to facilitate manufacture, installation and replacement. As shown, particularly in Figure 2 these units are of such size that a given number (four in the illustrative modification) may be arranged in each section A such that the respectively adjacent open mesh tube sections abut each other as well as the interior wall of the chamber. The tube units in each catalytic section may be restrained from longitudinal movement by suitable means

such as the removable split cylindrical spacer sleeves 13. Suitable means such as internally projecting lugs (not shown) engaging one or more of the tube units may be utilized to prevent circumferential movement of the tube units in the chamber.

As shown in Figures 1 and 2, the tube units 11 of each catalytic section A are displaced circumferentially with respect to the tube units of the adjacent sections. Thus the tube units 14 of the second catalytic section A' occupy a position which is circumferentially displaced from the corresponding tube units 15 of catalytic section A.

It will be observed that with this type of structure intimate contact of the gases with the catalytic material is insured without, however, imposing undue back pressure on the motor. The exhaust gases (indicated by the arrows) entering at one end of the unit C pass through the several tube units and between open spaces between the respectively adjacent tube units and the walls of the chamber. After passage there-through the gases enter the expansion chamber B where an intimate admixture is insured of the gas passing through the catalytic masses and that passing through the open spaces. Thereafter the gases again pass through a catalytic section in which, it will be observed, catalytic tube units are disposed in alignment with the open spaces of the first catalytic unit. In this manner a certain degree of free passage space for the gas is left in each catalytic section so that undue back pressure on the engine is not built up. However, by utilizing respectively circumferentially displaced tube units in adjacent sections in conjunction with the intermediate expansion and mixing chambers contact of substantially all of the exhaust gas with the catalytic masses is insured.

It will be observed also that the spaces between the adjacent tube units in each section establish free passages of restricted cross section. Flow of gas through these at relatively high velocity thus establishes an aspirating effect and tends to positively induce gas flow through the catalytic tube units.

As previously indicated the invention also contemplates the utilization of a catalytic chamber as a garage accessory. In large garages where many motors may be operating at the same time there is a real danger of a development of a dangerous high concentration of carbon monoxide, especially when the garage is not adequately ventilated. According to the invention, danger of this type may completely be avoided by providing a simple unit which may readily be attached temporarily to the exhaust pipe of a car. Such a unit is indicated in Figure 3. This comprises a catalytic chamber 30 of the same type as that disclosed in Figures 1 and 2, that is to say it comprehends a spaced series of catalytic sections and an alternate series of expansion chambers or spaces. The chamber is closed at the two ends 31 and 32 and at such ends are provided with the inlet and discharge pipes 33 and 34 respectively. A flexible tubing 35 of any suitable material is adapted to be attached at one end to the pipe 33 by suitable means such as the clamp 36. The opposite end of the tube 35 is properly conformed so as to fit over the tail section of the exhaust pipe. Such end may be provided with suitable clamping means (not shown) so that it may be detachably secured to the tail pipe. Similarly a second section of flexible tubing 37 of any desired

length may be attached to discharge pipe 34 by means of a clamp 38.

This unit may quickly be attached to the tail pipe of a car so that the motor may be operated in closed areas without any danger of carbon monoxide poisoning. Such a unit may similarly be employed in any other circumstances in which it is desired to remove carbon monoxide from discharge gases.

In effectuating the invention any catalytic material which is effective to oxidize carbon monoxide may be utilized. Preferably the catalytic material should be in the form of granular masses, as shown, which should be of sufficient strength to withstand the shocks and jars incident to car operation without disintegrating and powdering. Such catalyst, may, for example, comprise porous rigid mass of suitable catalytic material such as manganese dioxide, mixtures of manganese dioxide, copper oxide, cobaltic oxide and the like.

Porous, rigid, effective catalysts may be made up by fusing a metal oxide or mixture of metal oxides together with a binder material under temperature conditions which insure intumescence in the mass and may then be chilled to establish a porous or vesicular structure providing a large exposed surface of the catalytic material.

A catalytic material which is particularly effective comprises a rigid mass including cupric oxide, manganese dioxide and cobaltic oxide. This may be made up by first homogeneously mixing substantially equal parts of the three components in the dry powdered form. To this dry mixture there is then added a quantity of sodium silicate in the approximate proportions of three pounds of the oxide mixture to one quart of sodium silicate solution (40° Bé.). The mass is then stirred until it assumes a viscous, rubbery consistency, in which form it may be moulded into any desired shape such as sticks, granular masses and the like. With the mentioned proportion of ingredients the mass hardens to a solid upon air drying for a period of about 48 hours. The air dried product is then burned or heated to fusion or incipient fusion in a suitable furnace or in an open flame. By heating the mass to a cherry red, incipient fusion takes place and the mass intumesces or swells up to approximately twice its original volume. The mass is then quickly cooled to retain this expanded structure and the resulting product is characterized by a high degree of porosity and hardness. After such cooling the material may, if desired be broken up into pieces of the desired size which are then packed in the open mesh tubes previously described. This catalytic product apparently comprises a silicious skeletal porous unit in which the catalytic oxides are homogeneously dispersed. This high porosity coupled with the uniform dispersion of the oxides through the mass insures accelerated catalytic action.

The utilization of the described catalytic material, i. e. a catalytic mass which may readily be formed into any desired shape permits the employment of specifically different types of catalyst chambers. Thus as shown in Figures 4 and 5 a catalyst chamber operating on the same essential principle of that described may be constructed without utilizing the open mesh tubular container 11. In other words, the catalytic material may be moulded in the form of, so to speak self-sustaining members.

As shown in the modification illustrated in Figures 4 and 5, the catalytic material is moulded

in the form of porous rigid tubular units 40 of any desired length, internal and external diameter. A group of such tubular units may be mounted in a chamber 41 such that adjacent units respectively abut. Each section of such units may be maintained in position in the container 41 by means of the perforate retainer means 42 which preferably comprises open mesh wire units or perforated metal discs.

In accordance with the major principles of the invention the several catalytic sections are spaced apart so as to provide a free gas expansion space therebetween. Such spacing may be established by means of the spacer rings 43.

The container or tube 41 is provided with removable end members 44 (one being shown) which are provided with pipe sections 45 adapted to be connected in the exhaust line 46. The catalyst chamber may be connected in the exhaust line in any suitable manner as for example, by utilizing clamping means of the type shown in Figure 1.

As will be appreciated, the utilization of catalytic material of the self-sustaining type is not limited to the particular form of units shown in Figures 4 and 5. These may be made up in any desired effective shape as for example in the form of perforate disc-like members shown in Figures 6 and 7. In this form of the invention the catalytic units 60 are moulded or preformed in the general shape of a disc. As shown the disc is provided with a large number of perforations 61. The size and number of such perforations may be controlled so as to insure the desired gas velocity through the catalytic chamber. Such units are preferably formed with circumferential serrations or grooves 62 to permit the passage of gas around the circumferential edge.

These units may be assembled in a catalyst chamber in the manner previously described, that is to say at spaced distances so as to provide alternate catalytic and free gas expansion areas. As shown the units 60 are mounted within the catalytic chamber 63 such that the free edges abut the internal walls of the chamber. The units are maintained in the desired spaced relationship by means of the spacer rings 64. If desired the internal wall of the chamber may be provided with projecting lugs or one or more longitudinal ribs adapted to coact with the peripheral grooves of units 60 to prevent circumferential movement of the units in the chamber.

As in the other modifications described the catalytic chamber 63 is provided with the removable cover plates 65 (one being shown) which are formed with the pipe sections 66. These, as explained, may readily be connected to the exhaust line 67 by any suitable clamping means.

The catalytic chambers shown in Figures 4

and 6 operate in the same effective manner as that shown in Figure 1. The entering gas passes alternately through the catalytic sections and the expansion sections in such a manner as to insure optimum contact with the catalytic material and consequent effective oxidation of the carbon monoxide but with the minimum of back pressure on the motor.

It will be appreciated that within the broad concept of the invention a variety of specific structures are available. In the structures shown, the catalyst chamber comprises a series of catalytic sections or areas alternating with expansion spaces in which the catalytic sections are positioned normal to the flow of gas. If desired units may be constructed in which a catalytic tube is mounted concentrically within the casing. For example, catalytic material may be packed in a tubular member made up of open mesh wire or perforated metal. This may be fitted within the chamber such that a predetermined space is established between the wall of the casing or chamber and the elongated perforated catalytic tube. By use of suitable baffles the exhaust gas then passes from the exhaust pipe into the space between casing and the catalytic tube and flows through the granular catalytic material into the central open section of the perforated catalytic tube from which it is discharged to atmosphere. This type of structure thus serves effectively in the dual capacity of a muffler and catalyst chamber.

It is particularly to be observed that by invoking the concept of utilizing the catalyst packed unit tubes, spent catalyst units may readily be removed and replaced. Also, if desired the tube units may be treated so as to revivify the catalyst. By current replacement of several old or spent catalyst units the efficiency of the device may continuously be maintained.

It is to be understood that while a preferred embodiment of the invention has been described this is given didactically to illustrate the underlying principles involved and not as limiting the invention to the particular modification chosen for illustration.

I claim:

A device for association with the exhaust gas line of an internal combustion motor which comprises an elongated tubular metallic casing, a spaced series of catalytic sections arranged longitudinally of the casing and defining expansion chambers therebetween, each section comprising a group of laterally abutting open mesh tubular metallic containers having catalytic material packed therein, the containers of one section being circumferentially displaced relatively to the corresponding containers of an adjacent section.

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