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INTERNAL COMBUSTION ENGINE

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Fig. 1.

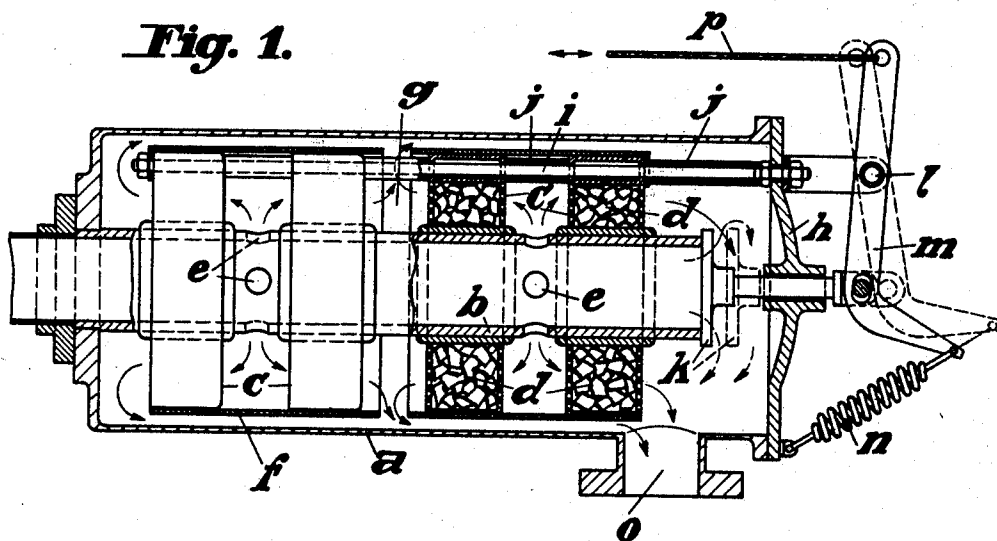
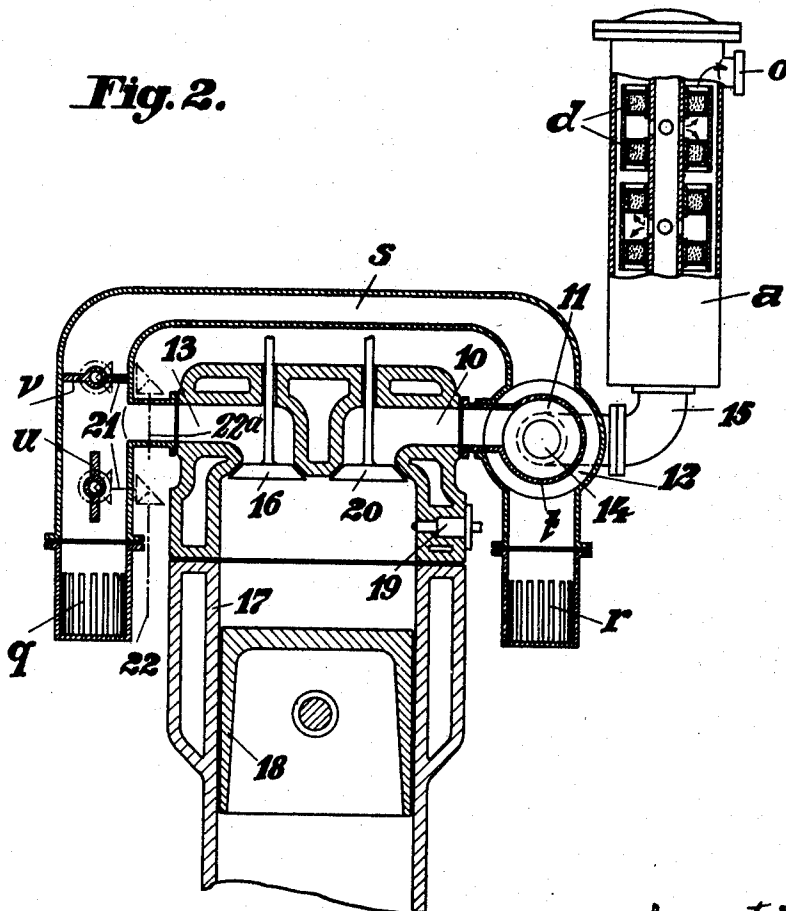


Fig. 2.



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UNITED STATES PATENT OFFICE

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INTERNAL COMBUSTION ENGINE

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Original application March 15, 1926, Serial No.
94,875, and in Germany February 5, 1926.
Divided and this application January 13, 1930.
Serial No. 420,591

11 Claims. (Cl. 60—29)

This invention relates to internal combustion engines, and more particularly to engines of the Diesel type.

In high speed combustion engines, especially engines for vehicles, which work according to the Diesel process and which are operated by heavy oils, there is frequently a poor combustion, which is due to the fact that there is not sufficient time for securing a complete combustion of the heavy hydrocarbons. In consequence thereof the exhaust will become of disagreeable odor, which will be objectionable to the public and eventually bring the owner of the vehicle in conflict with the laws.

This invention has for its object to avoid this drawback and to do away with the disagreeable odor of the exhaust gases. The invention consists essentially therein, that suitable catalyzers are arranged in the exhaust container, which bring about an after combustion of the exhaust gases. For this purpose catalyzers consisting, for instance, of iron-oxide are associated with the exhaust container in such a manner that the exhaust gases will have to pass through the same. The exhaust gases, in addition, thereby heat up the catalyzer to such an extent that an after combustion will be brought about, so that the still unburnt hydrocarbons will undergo combustion and the exhaust gases discharging from the exhaust container will become practically free of color and odor.

For the proper efficiency of the catalyzer it is absolutely required that the temperature is kept at a value as high as possible. It may, however, happen that during some longer time of operation at small loads or during zero load the temperature of the catalyzer by reason of the low temperature of the exhaust gases will become so low that a sufficiently quick after burning of the heavy hydrocarbons can no longer take place. In order to keep the catalyzers in such case in efficient condition, according to this invention, there are means provided which cause said catalyzers to be maintained at the required temperature. In order to accomplish this, for instance, the drawn-in combustion air is pre-heated before entering the working cylinder, which may be done by the exhaust gases themselves. Also, for this purpose the combustion air may be choked off, so that the drawn-in quantity of air will be decreased corresponding to the smaller charge of the fuel. In order to maintain the required temperature of the catalyzer, furthermore an exterior source of heat may be employed.

This is a division of the copending application

of Wilhelm Riehm, Serial No. 94,875, filed March 15, 1926, now Patent 1,766,945.

In the drawing an exhaust container according to this invention is shown, Fig. 1 being a longitudinal section of said exhaust container and Fig. 2 showing the exhaust container in connection with the combustion engine.

The device according to this invention consists of a cylindrical vessel or container *a*, which surrounds the end of the exhaust pipe *b*. The latter carries a number of closed screens or sieve-like bodies *c*, which are arranged in spaced relation to each other, said screens or foraminous bodies being filled with a catalyzer *d*, for instance iron-oxide. The several screens or sieve-like bodies are arranged in pairs and between the screens bores *e* are provided on the exhaust pipe *b* said bores serving for the discharge of the exhaust gases. The screens or sieve-like bodies *c* are again surrounded by jackets or sheet metal *f*, in such a manner that one of such jackets is provided for each pair of screens. The several jackets *f* surrounding the several pairs of screens *c* are so arranged with respect to each other, that a small interstice or gap *g* is formed between successive jackets. In order to secure the several screens in proper position with respect to the exhaust pipe *b*, a bolt *i* is employed by which said screens are fastened to the cover *h* of the exhaust container *a* and braced against one another by means of spacing members *j*.

The exhaust pipe *b* is closed up at its free end by a cover *k*, said cover being pivotally connected to a double lever *m* which is pivotally mounted at *l* and kept under tension by the spring *n*.

The exhaust gases will pass in closed condition of the cover *k* through the bores *e* into the free space between the screens *c*, and be carried thereupon through the catalyzers *d* which are heated thereby to such an extent that the unburnt hydrocarbons which are still contained in the subsequent exhaust gases will undergo combustion. The exhaust gases are thus freed of color and odor and will pass through the interstices or gaps *g* into the exhaust container *a*, whence they are discharged to the outside through the exhaust *o*.

In order to maintain the temperature of the exhaust gases, which is required for an efficient working of the catalyzers, at the proper value, as in case of smaller loads or some duration or in case of zero load, there are two suction inlets *q* and *r* provided on the cylinder of the engine, said suction inlets being connected with each

other by the conduit *s*. The exhaust conduit *t* passes through the suction inlet *r*, so that the air, which is drawn in by this inlet, will be preheated. Any suitable form of preheater may be used, and such a one is disclosed diagrammatically in the drawing in which the exhaust passage 10 from the cylinder discharges into the interior chamber 11 of a double-walled cylindrical container *t*, the space between the inner wall and the outer wall of the container *t* forming a passage 12 through which air entering through the inlet *r* passes to be heated, and thence passes by the passage *s* to the intake passage 13 of the cylinder. The exhaust gases escape from the interior chamber 11 of the preheater *t* through a centrally arranged pipe 14 which communicates with the chamber 11, the pipe 14 being connected with exhaust pipe 15 which in turn is connected to the exhaust container *a*. Throttle valves *u* and *v* are provided within the suction inlet *q* and the conduit *s*, said throttle valves being normally displaced relatively to each other by an angle of 90 degrees. The throttle valves *u* and *v* may be interconnected by suitable linkage indicated diagrammatically at 21, and provided with operating rods 22, 22a extending to a convenient point for manipulation by the operator at will. During normal load of the engine the throttle valves *u* and *v* being adjusted as shown in Fig. 2, the suction inlet *r* is inoperative and the engine will draw in cold exterior air through the suction inlet *q*. The air is drawn through intake passage 13 past inlet valve 16 into the combustion space of Diesel engine cylinder 17 on the suction stroke of the piston 18. This air is then compressed on the compression stroke of piston 18 to a high pressure and temperature such that spontaneous ignition of fuel injected through nozzle 19 is secured at substantially the end of the compression stroke. This produces a working stroke of piston 18, and on the succeeding up stroke of the piston the products of combustion escape past exhaust valve 20 into the exhaust passage 10. If the load of the engine drops or becomes zero, so that also the temperature of the exhaust gases will drop below the value required for the efficient working of the catalyzers *d*, the valves *u* and *v* are reversed so that now the suction inlet *q* will be closed, the combustion air entering the suction inlet *r*, thereby passing the exhaust conduit *t*, by which it will be preheated. If it is desired not to employ this last described adjustment, the average temperature of the cylinder may also be maintained at its normal value by closing the valve *v* and only partially opening valve *u*, so that a smaller quantity of air corresponding to the smaller quantity of fuel will enter the cylinder. The procedures of preheating and choking off the suction air may also be commonly employed in order to maintain the exhaust gases at a temperature which is necessary for the proper operation of the catalyzers *d*. In this case the valve *u* is completely closed and the valve *v* only partially opened.

If it is desired to put the exhaust container out of operation, which may for instance be the case outside of cities or other inhabited places, the cover *k* is lifted from its seat by adjusting the lever *m* by the aid of the adjusting rod *p*. By this the exhaust pipe *b* will be opened and the exhaust may immediately discharge through the outlet *o* provided on the exhaust container *a*, without being forced to first pass the catalyzers *d*.

While the method herein described, and the form of apparatus for carrying this method into

effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In an internal combustion engine of the Diesel type, and in combination, a suction air inlet, an exhaust passage, a catalyst within said exhaust passage to further a secondary combustion of the exhaust gases passing through said passage, means associated with said suction air inlet to preheat the suction air for said engine to assist in maintaining the temperature of said catalyst at a value required for the efficient operation thereof, and means for controlling the temperature of the suction air to thereby control the temperature of said catalyst.

2. In an internal combustion engine of the Diesel type, and in combination, a suction air inlet, an exhaust passage, a catalyst within said exhaust passage to further a secondary combustion of the exhaust gases passing through said passage, valve means to restrict or choke the suction air inlet for the engine to assist in maintaining the temperature of said catalyst at a value required for the efficient operation thereof, and means for controlling said restricting means to thereby control the temperature of said catalyst.

3. In an internal combustion engine of the Diesel type, and in combination, an exhaust passage, a catalyst interposed within said exhaust passage to further a secondary combustion of the exhaust gases passing through said passage, a combustion air intake passage for said engine, means associated with said combustion air intake passage for heating said combustion air as it is fed to the engine, a second air intake passage for supplying cold air to the engine, and means for controlling the flow of air through said passages thus varying the temperature of the air supplied to the engine to assist in maintaining said catalyst in a highly heated condition.

4. In an internal combustion engine of the Diesel type, and in combination, an exhaust passage, a catalyst interposed within said exhaust passage to further a secondary combustion of the exhaust gases within said passage, a combustion air intake pipe for said engine, a second combustion air intake pipe for said engine, a heater for one of said combustion air intake pipes, and means for causing said combustion air to be drawn into said engine through either the heated combustion air intake pipe or the unheated combustion air intake pipe or both to maintain said catalyst at a desired operating temperature.

5. In an internal combustion engine of the character described, and in combination, a cylinder, a combustion air inlet for said cylinder, an exhaust passage for said cylinder, a catalyst within said exhaust passage to further a secondary combustion of the exhaust gases passing through said passage without the addition of auxiliary air thereto, and controllable means for maintaining the exhaust gases leaving the cylinder at a temperature required for the efficient operation of said catalyst at varying loads of the engine.

6. In an internal combustion engine of the Diesel type, and in combination, an exhaust passage, a catalyst within said exhaust passage adapted to be maintained at a high operating temperature by contact with the hot exhaust

gases to secure a secondary and more complete combustion of the exhaust gases, means for supplying a cold air charge to the engine during normal loads, and controllable means for preheating the air charge drawn into the engine during small loads to assist in maintaining the catalyst at a high operating temperature.

7. In an internal combustion engine of the Diesel type, and in combination, an exhaust passage, a catalyst in said passage adapted to be maintained at a high operating temperature by contact with the hot exhaust gases to secure a secondary and more complete combustion of the exhaust gases, means for supplying a full charge of air to the engine during normal loads and controllable means for choking the air supply of the charge fed to said engine to assist in maintaining said catalyst at a high operating temperature.

8. In an internal combustion engine of the Diesel type, working with high pressure combustion air and fuel injection, in combination, means for supplying said engine with combustion air, an exhaust passage receiving the exhaust gases from said engine, a catalyst within said exhaust passage adapted to further a secondary and more complete combustion of the exhaust gases, and means for preheating the combustion air fed to said engine to assist in maintaining the catalyst at a high operating temperature.

9. The method in the operation of an internal combustion engine, comprising discharging hot exhaust gases from said engine, passing said hot gases in contact with a catalyst maintained at a high operating temperature by contact with said hot gases to secure a secondary and more com-

plete combustion of said exhaust gases, supplying a cold air charge to said engine during normal loads, and preheating the charge supplied to the engine during small loads to thereby assist in maintaining said catalyst at a high operating temperature.

10. The method in the operation of an internal combustion engine of the Diesel type, comprising discharging hot exhaust gases from said engine, passing said hot gases in contact with a catalyst maintained at a high operating temperature by contact with said hot gases to secure a secondary and more complete combustion of said exhaust gases, supplying a full charge of air to said engine during normal loads, and choking the air supply of the charge supplied to the engine during small loads to thereby maintain the temperature of the exhaust gases sufficiently high to assist in maintaining said catalyst at a high operating temperature.

11. The method in the operation of an internal combustion engine of the Diesel type working with high pressure combustion air and fuel injection, which comprises supplying said engine with combustion air, discharging hot exhaust gases from said engine, passing said hot gases in contact with a catalyst maintained at a high operating temperature by contact with said hot gases to secure a secondary and substantially complete combustion of said exhaust gases, and at small loads of the engine preheating the combustion air supplied to said engine to assist in maintaining said catalyst at a high operating temperature.

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