June 10, 1947. H. A. LEVEY ET AL 2,422,024

APPARATUS FOR PRODUCING SMOKE SCREENS

Filed May 4, 1942

Fig. 1.

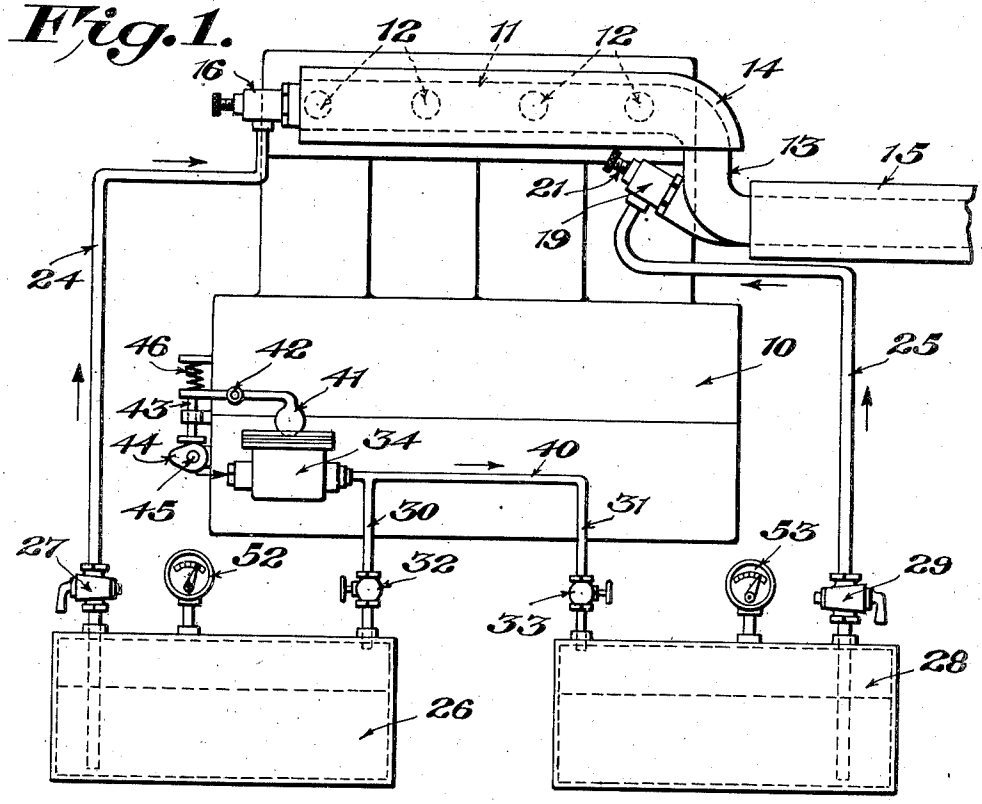


Fig. 2.

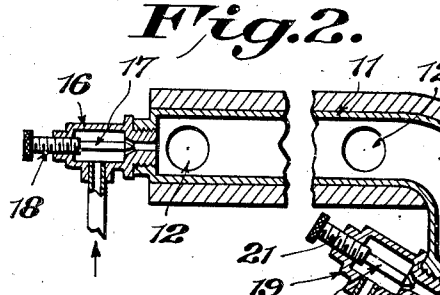


Fig. 4.

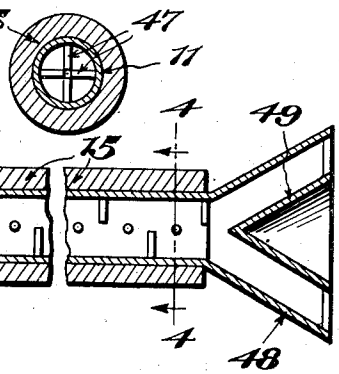


Fig. 3.

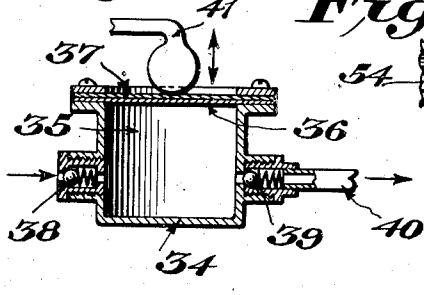


Fig. 5.



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APPARATUS FOR PRODUCING SMOKE SCREENS

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Application May 4, 1942, Serial No. 441,724

4 Claims. (Cl. 252—359)

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The present invention relates to a method and apparatus for producing smoke screens or the like. More particularly the present invention relates to a smoke producer which is particularly adapted for use with an internal combustion engine, Diesel engine or other type of engine wherein substantial heat and substantial quantities of exhaust gases are normally produced.

The apparatus of the present invention is particularly designed for use with an ordinary internal combustion engine such as that incorporated in a vehicle or boat, and is particularly capable of effiicently producing in conjunction with the exhaust gases thereof a large volume of dense smoke which is capable of screening the movements of men or equipment and of stationary or moving objects.

One of the objects of the present invention is the provision of a novel apparatus which utilizes a substantial proportion of the sensible heat of the exhaust gases flowing from an internal combustion engine, Diesel engine, or the like to vaporize and/or atomize a smoke producing composition.

A second object of the present invention is the provision of an apparatus including storage tanks so connected to the exhaust manifold of an engine that substantially all of the heat of the exhaust gases is utilized in vaporizing the fluid fed from the tanks.

A third object of the present invention is the provision of a pump adapted to be driven from a moving portion of an internal combustion engine to supply compressed air for feeding a suitable fluid into the exhaust manifold of an engine for vaporizing the same in order to produce a dense volume of smoke:

A fourth object of the present invention is to provide means to conserve the heat of exhaust gases and utilize the heat thereof for vaporizing various types of smoke producing compositions.

A fifth object of the present invention is to provide a novel process for the production of a dense smoke which comprises flowing high temperature relatively inert gases in a heat insulated path, feeding a smoke producing composition to said gases, and thoroughly mixing the same while imparting the heat of said gases to the composition to thoroughly volatilize and/or atomize the composition.

A sixth object of the present invention is to provide a novel process which comprises flowing high temperature relatively inert gas in a heat insulated path, feeding smoke producing composition to the gases, and passing both the gases

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and the composition to successive turbulent and high temperature zones to thoroughly mix the gases with the smoke composition and thoroughly volatilize the smoke composition.

Other objects and advantages of the invention will be apparent from the subsequent description and figures of the drawing, wherein:

Figure 1 is a partly diagrammatic view of an apparatus according to the present invention;

Figure 2 is a section of an exhaust manifold and exhaust pipe showing the disposition of the fedeing valves according to the present invention;

Figure 3 is a section of a diaphragm pump;

Figure 4 is a section taken on the line 4—4 of Fig. 2; and

Figure 5 is a detail of a modified form of feeding orifice or jet.

Referring to the figures of the drawing, and particularly Fig. 1 thereof, an internal combustion engine is indicated in general at 10 and includes an exhaust manifold 11, provided with the usual exhaust ports indicated in dotted lines at 12. Connected to the exhaust manifold in any suitable manner is an exhaust pipe 13. The exhaust manifold 11 and the exhaust pipe 13 is preferably insulated in order to conserve the heat of the gases passing therethrough, this insulation being indicated at 14 and 15. Obviously, any suitable insulation capable of withstanding temperatures in the neighborhood of 600 to 700° F. is suitable, such as asbestos, magnesium oxide, or magnesium carbonate, and it is to be understood that this insulation may be housed in a suitable housing or utilized in the form of premolded sections.

As shown in Fig. 2, a needle valve structure indicated in general at 16 is threaded into one end of the exhaust manifold. This needle valve includes a suitable valve stem 17 and adjusting screw 18. The valve stem 17 is provided with the usual conical shaped end and the valve casing with the usual seat. As shown, the needle valve structure 16 feeds into the exhaust manifold at the very beginning thereof. This positioning of the needle valve is preferable, since it is desirable in most instances that the smoke producing composition be fed into the exhaust manifold ahead of any of the ports so that the full heat of the exhaust gases will be utilized.

A second needle valve structure is indicated in general at 19, and is positioned at the outlet of the exhaust manifold so that additional smoke producing composition may be fed at this point. The needle valve structure 19 also includes a

suitable valve stem 20 and an adjusting screw 21. It will be noted that the outlet of this second needle valve projects into the exhaust pipe at an angle of approximately 45°. It is important that the outlet of this second valve so projects that the outlet will be subjected to the sweeping action of the exhaust gases, and considerable turbulence will be created. Since the heat of the gases is somewhat less at this point, it is important that a complete atomization of the fluid fed into the exhaust pipe take place at this point and the angular positioning of the outlet of the needle valve 19 produces this effect. This outlet is indicated at 22. It will be noted that the outlet projects into the casing in this valve structure, as indicated at 23, and this projection insures the heating of the outlet, inasmuch as it is surrounded by flowing hot gases.

Referring once again to Fig. 1, it will be noted that the needle valves 16 and 19 are fed with fluid through the conduits 24 and 25. The conduit 24 communicates with the bottom of a tank 26. Interposed in the conduit 24 is a valve 27 which, in conjunction with the needle valve 16 serves to control the flow of fluid through the conduit 24 into the exhaust manifold. The conduit 25 similarly opens into the bottom of a tank 28 and a valve 29 is interposed in the conduit 25 to regulate the flow therethrough. The tanks 26 and 28 are each adapted to contain a suitable smoke producing composition. This composition may be made from a lubricating oil carrying in suspension inorganic salts which volatilize at relatively low temperatures. Preferably also the composition contains a viscosity increasing agent such as suitable metallic soaps exemplified by sodium stearate, calcium palmitate, etc. A more complete disclosure of the particular compositions which may be used will be found in copending application, Serial No. 441,550, filed May 2, 1942. The same composition may be also used in tank 28 or some other composition. Thus the type of equipment described is capable of effectively utilizing two different compositions of smoke forming products with different vaporizing properties. If the screen forming composition requires elevated temperatures of high values in order to vaporize them, such a composition would preferably be admitted through needle valve 16 and stored in the tank 26. On the other hand, if a composition requires less heat for its vaporization, it would then be preferable to admit it through the needle valve and nozzle 19, and to store the composition in the tank 28. It is to be noted that the temperatures in the manifold itself, if an ordinary internal combustion engine is used, would run between 500 to 600° F., and the temperatures at the point of outlet of the needle valve 19 would run between 300 and 400° F.

It is to be noted that the apparatus shown permits the utilization for the development of smoke screens of two different types of composition, as well as permitting the addition of successive increments of the same composition at different points. By so providing different points of admission, complete vaporization of the first composition prior to the second addition is effected. This phenomena is more completely discussed, disclosed and claimed in the copending application of Harold A. Levey, Serial No. 441,989, filed May 6, 1942, now Patent No. 2,408,429, issued October 1, 1946.

The feed of liquid from the tanks 26 and 28 is effected under the influence of compressed air which is supplied to the tanks 26 and 28 through the conduits 30 and 31. Valves 32 and 33 are provided to vary the amount of compressed air fed. The two conduits 30 and 31 are connected to the outlet of a diaphragm type pump indicated in general at 34. As shown in Fig. 3, this pump includes a main chamber 35 covered by a leather diaphragm 36 and a flexible metal diaphragm 37. As the composite diaphragm structure is flexed inwardly and outwardly, air within the chamber 35 is compressed. Ball valves 38 and 39 are also provided which produce a flow of air out of the chamber 35 in the direction as indicated by the arrow 40. The metal diaphragm 37 is moved inwardly and outwardly by rocker arm 41. As shown in Fig. 1, the rocker arm 41 is pivoted at 42 on the engine block and rests on a push rod 43 at one end. A cam 44 reciprocates the push rod, said cam being rotatable with a suitable shaft 45 which may be driven from the engine crank shaft or any other moving portion of the engine 10. A spring 46 is also provided to move the rocker arm 41 back after the cam 44 and push rod 43 have moved the same in one direction.

As shown in Figs. 2 and 4, a straight portion of the exhaust pipe 13 is provided with projecting pins 47 which form a network through which the smoke composition is vented. These pins or network are made of metal or other heat conducting substance, and serve to transmit the heat of the exhaust pipe to the smoke screen mixture flowing through the interior of the pipe. It is to be understood that in place of the metal pins, fins or plates of metal may be fastened on the interior of the pipe in order to admix and heat the gases flowing therethrough. It is to be noted further that this section of pipe is insulated, as indicated at 15 in order to conserve the heat therein. The outlet of the exhaust pipe is flared, as shown at 48, and an interior cone is provided, as indicated at 49 in order to form an outlet capable of distributing the smoke over the widest possible area. In place of the flared orifice shown, a series of concentric rings or funnels may be used to more evenly distribute the smoke formed.

Referring to Fig. 5, there is here shown a modified orifice which is adapted to be substituted at the outlet of the needle valve 19 and to project substantially into the exhaust pipe. This outlet is formed of a suitable length of relatively small pipe indicated at 50, having a conical or pointed end indicated at 51. This type of outlet has been found to be particularly advantageous where large engines discharging considerable volumes of gases are used. It will also be noted that the nozzle or outlet in this modification is provided with a spring member 54 which extends the full length of the nozzle. This spring member is so mounted that it may be reciprocated along the axis of the nozzle or even removed therefrom from the exterior of the apparatus. This enables the nozzle to be cleaned out if it becomes clogged with deposit material from the smoke composition. A similar spring member may be provided for the outlet of the needle valve 16 as well as the needle valve 19.

It will be noted further that by utilizing the diaphragm type pump of the character described, a constant air pressure is maintained in the tanks of a relatively low order, as for example, four to five pounds, this pressure being indicated by the respective gauges 52 and 53. This is due to the strength of the spring 46 which moves the rocker arm 41 back. Obviously, this spring can be strengthened or weakened so that any desired

maximum air pressure will be supplied to the tanks. It is important that this air pressure be limited since if this pressure were very large, there would be some danger of the smoke producing composition being sprayed through the needle valve 16 at too great a velocity so as to prevent complete vaporization, and some possibility of some of the smoke producing composition being introduced into the exhaust ports. It has been found in actual practice, however, that even though the smoke producing composition is fed at the beginning of the exhaust manifold, none of this composition finds its way into the exhaust ports. By feeding the smoke producing composition through the needle valve 16 into the exhaust manifold at a point before the opening of the exhaust ports, a very complete vaporization and development of a mist of finer particle size completely dispersed in the exhaust gases is produced due to the turbulence resulting from the passage of the mixture past the open faces of successive exhaust ports. This phenomenon is particularly advantageous when the composition includes a hydrocarbon oil which requires a considerable amount of heat and turbulence for complete atomization. In other words, there is here disclosed a process for the production of a dense smoke which includes not only the mixing or introduction of the smoke producing composition into high temperature inert gases, but also includes the subsequent passage of such a mixture past successive zones of high turbulence and relatively high heat.

What is claimed is:

1. In a smoke producer in combination, an internal combustion engine having an exhaust manifold, exhaust ports opening into said manifold, an exhaust pipe leading from said exhaust manifold, means opening into said exhaust manifold in front of the exhaust ports to feed a smoke producing composition thereto, and a second means opening into said exhaust pipe beyond said manifold to feed smoke producing composition thereto, said second means having an outlet positioned at an angle to the flow of gases in said exhaust pipe so that said gases will sweep smoke producing fluid from said outlet.

2. In a smoke producer in combination, an internal combustion engine having an exhaust manifold, exhaust ports opening into said manifold, an exhaust pipe leading from said exhaust manifold, means opening into said exhaust manifold in front of the exhaust ports to feed a smoke producing composition thereto, a second means opening into said exhaust pipe beyond said manifold to feed smoke producing composition thereto, said second means having an outlet positioned at an angle to the flow of gases in said exhaust pipe so that said gases will sweep smoke producing fluid from said outlet, and means in a portion of said exhaust pipe to conduct heat from the exhaust pipe to the gaseous mixture flowing therethrough.

3. In a smoke producer in combination, an internal combustion engine having an exhaust manifold, exhaust ports opening into said manifold, an exhaust pipe leading from said exhaust manifold, means opening into said exhaust manifold in front of the exhaust ports to feed a smoke producing composition thereto, a second means opening into said exhaust pipe beyond said manifold to feed smoke producing composition thereto, said second means having an outlet positioned at an angle to the flow of gases in said exhaust pipe so that said gases will sweep smoke producing fluid from said outlet, and projecting pins in a portion of said exhaust pipe to conduct heat from the exhaust pipe to the gaseous mixture flowing therethrough.

4. In a smoke producer in combination, an internal combustion engine having an exhaust manifold, exhaust ports opening into said manifold, an exhaust pipe leading from said exhaust manifold, means opening into said exhaust manifold in front of the exhaust ports to feed a smoke producing composition thereto, a second means opening into said exhaust pipe beyond said manifold to feed smoke producing composition thereto, said second means having an outlet positioned at an angle to the flow of gases in said exhaust pipe so that said gases will sweep smoke producing fluid from said outlet, the outlet end of said exhaust pipe being flared outwardly and forming an outer cone, and an inner cone within and spaced from said outer cone.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,514,106	Savage	Nov. 4, 1924
1,972,600	Reboul	Sept. 4, 1934
2,173,756	Kronenberg	Sept. 19, 1939
2,045,865	Morey	June 30, 1936
2,070,038	Batt	Feb. 9, 1937