

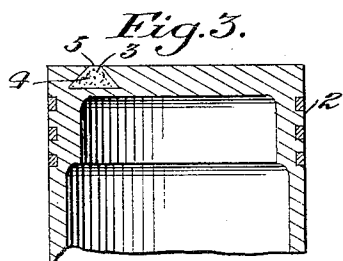
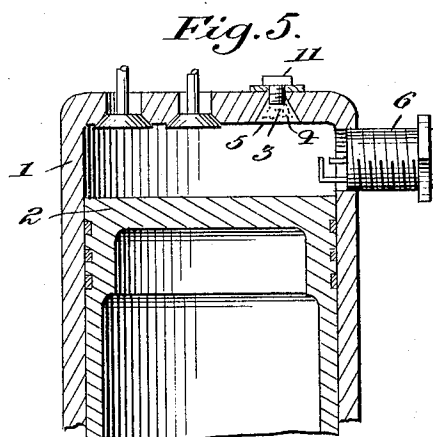
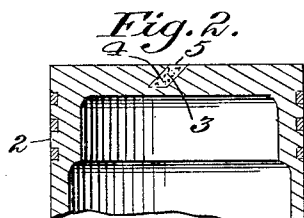
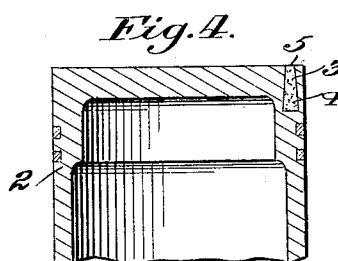
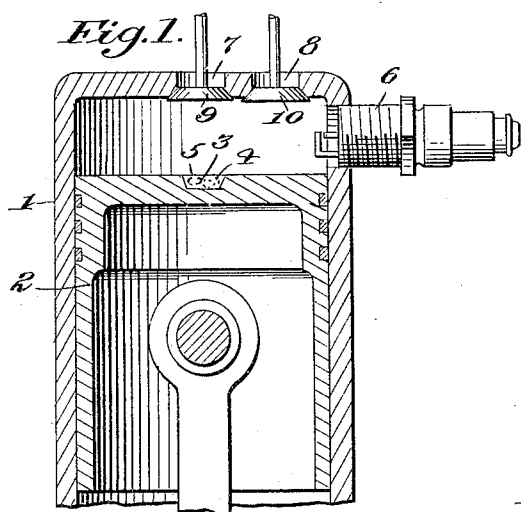
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ENGINE AND THE LIKE AND METHOD OF OPERATION

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## UNITED STATES PATENT OFFICE

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## ENGINE AND THE LIKE AND METHOD OF OPERATION

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This invention relates generally to internal combustion engines, and particularly to those of the automobile type wherein high compression is desirable for effecting economy of fuel per unit of power produced and per unit of distance travelled.

The ordinary high compression engine running on present day ordinary or so called "straight" gasoline has a tendency to knock, and the same is true of lower compression engines when an attempt is made to run them under a heavy load. This tendency has been overcome to some extent by intermixing various materials in various proportions with the gasoline, and certain of these reduce the tendency to knock. According to some theories, the knock is due to too speedy a propagation of the explosion reaction which begins at the igniting means, for example the spark plug electrodes, and such added materials are considered to have a de-accelerating effect on such propagation, whereby the explosion is less sudden and either produces no knock at all or reduces the knock considerably, depending of course on the conditions of operation, although knocks may result even when a blended gasoline is used.

The great disadvantage of specially blended fuels is that they are not as available as the straight gasoline and are more expensive. The present invention seeks to overcome these knocking conditions within the engine whereby either a knock-reducing or non-knock-reducing fuel may be used with a total or at least a substantial decrease of knock.

My invention comprises having an adsorbent in adsorbing relation with the combustion chamber or chambers of an automobile or other internal combustion engine.

The phenomenon of adsorption is discussed in *The Recovery of Volatile Solvents*, Robinson, 1922; *Colloidal Chemistry*, Alexander, Second Edition, 1924; *Applied Colloidal Chemistry*, Bancroft, 1921; as well as in many other text books, literature articles, and patents; and according to the theories advanced it includes the condensation, or some kind of concentration, of the gas, vapor, liquid or other adsorbed matter upon the interior and exterior surfaces of the adsorbent

or within the pores thereof. Whatever the action is, the result is that the adsorbent takes up and retains more or less large quantities of the adsorbate, and retains it therein until subjected to certain conditions which again permit or cause liberation.

Adsorbents are known to have the capability of concentrating various gases and vapors within themselves and liberating these again, under proper conditions. The generally accepted laws of gas or vapor adsorption, and these may perhaps be applied to liquids as well, is that the amount of substance adsorbed, that is the adsorbate, generally increases with lowering of temperature, and increases with increasing pressure of the substance being adsorbed in contact with the adsorbent, and even increases with the partial pressure of the component or components of the gas or vapor mixture. Accordingly there may be a cycle of adsorption at a lower temperature and liberation at a higher temperature, or adsorption at a higher pressure and liberation at a lower pressure, or there may be a combination of these factors.

Various adsorbents and the methods for making them have been described in patents and in the literature, and it is believed that those most commonly in use are the various activated carbons, and the porous silicas or silica gels made by special processes. These generally have a high adsorptive power which naturally makes them valuable for adsorption purposes and they may be used in the practice of my invention, although it is to be understood that other high power adsorbents may likewise be used, such for example as properly prepared ferric hydroxide, as well as other materials. The adsorbents used may be either organic or inorganic, the inorganic adsorbents having the great advantage of incombustibility, while some of the various activated carbons now on the market seem to have greater affinity for the hydrocarbons. and especially in the presence of moisture.

Without limiting this application and the protection sought therein to any particular theory, the apparent effect of the adsorbent seems to be to take up and remove from the

combustion chamber a substantial proportion of the gas therein or components thereof before explosion, and especially while under compression, and then to release or liberate the adsorbed gas or gases as the explosion reaction decreases the partial pressure or proportion thereof in the combustion chamber, by chemically converting it into something else. According to this theory the adsorbent therefore actually has the ultimate effect of lowering the pressure with respect to knocking although the same amount of fuel is burned during the expansion or explosion stroke of the piston, since the adsorbent, although it causes a decrease in pressure or partial pressure at the beginning of the explosion period, supplies additional fuel for explosion as the explosion progresses. In other words the pressure may be decreased below the knocking point without decreasing the amount of fuel to be exploded within a given space.

The quantity of adsorbent to be used to produce a given result will vary to a great extent with the characteristics thereof and of the fuel, and with the characteristics of the engine, and with the conditions under which it operates, and it is therefore impossible to state quantitatively the best and preferred quantity to use. This amount must be determined separately for each individual type of engine and of adsorbent, and for the various conditions of operation and types of fuel used; and they are best determined by actual trial. Since the kind of result desired will be obtained whether the quantity of adsorbent used be comparatively large or small, no special proportions are given here as the invention is applicable to many types of internal combustion engines with respect to each of which a different quantity of adsorbent may be required to produce the best results.

The adsorbent may be applied to the cylinder in any desired manner, for example it may be carried by the piston or by the cylinder wall or head, the only essential feature being that it be in active adsorbing relation with the combustion or explosion chamber. It may be located on various parts of the piston head or of the cylinder itself, such location being immaterial with respect to the broad nature of the invention, and the method of supporting the adsorbent is likewise immaterial with respect to the broad nature of the invention.

Referring to the drawing Fig. 1 is a diagrammatic longitudinal sectional view showing the cylinder and piston within the same and illustrating the adsorbent.

Figs. 2, 3, and 4 are each a diagrammatic longitudinal sectional view showing modified means for carrying the adsorbent.

Fig. 5 is a diagrammatic longitudinal sectional view of a piston and cylinder illustrating

how the adsorbent carrier may be in the cylinder wall with provision to secure a more easy access thereto.

Fig. 6 is a more or less diagrammatic plan view of a reticulated sheet from which the cover 5 may be cut.

Any engine having a cylinder 1 and a piston 2, may have my invention applied thereto. While this invention is intended primarily for internal combustion engines it may also be applied to internal expansion engines where there is no internal combustion, as for example steam and compressed air engines of all types even including the multiple expansion type.

In the modification illustrated on Fig. 1, 1 designates the cylinder wall and there is a cavity 3 in the piston 2 in which the adsorbent is located, this cavity being of such a shape that a large surface area is exposed to the material in the explosion chamber. The adsorbent 4 in the chamber 3 may be in block or granular form and may be held in place by a reticulated cover 5 or by other suitable means. A suitable ignition means 6 of any desired type is provided in accordance with common practice, as are inlet and exhaust ports 7, 8, alternately opened and closed at the proper points of the engine cycle by valves 9 and 10. Either of the valves shown on Fig. 1 may be the inlet valve and the other the exhaust valve, but certain advantages are to be gained by having the explosive vapors play during the intake stroke as directly as possible upon the adsorbent.

In the modification illustrated in Fig. 2, the adsorption chamber 3 is of a different shape and presents less surface to the material in the combustion chamber.

This figure also illustrates a different location for the adsorbent, it being understood that there is no particular relation between the shape of the cavity for the adsorbent and its location.

Figs. 3 and 4 each illustrate two variables, that is they illustrate a different shape of chamber 3 as well as a different position thereof on the piston, it being understood again that the position of the adsorbent is independent of its shape, and that any desired shape may be used in any desired position, not only on the piston but also on the cylinder.

Fig. 5 illustrates a modification wherein the adsorption chamber is in the cylinder, and specifically in the cylinder head. Here again a reticulated cover or other suitable means may be used to hold the adsorbent 4 within the chamber 3, and a removable sealing plug 11 having a gastight connection may be provided whereby easier access to the adsorbent may be had.

It is, of course, within the scope of the invention to locate the adsorbent in the cylinder itself otherwise than and in a different location than as shown on the drawing.

The drawing does not show all the details of engines such as valve parts, means to seal the spaces between the piston and the cylinder, for example, piston rings, and other well known parts, since while they may be necessary or useful to engines having the present invention applied thereto, yet these details are well known and do not form a part of the present invention.

The invention is, of course, also applicable to sleeve-valve type engines and in fact to almost any type of engine wherein an adsorbable expansion means is used or wherein adsorbable matter capable of being converted into an expansion means is used, no matter whether the driven means be reciprocating, as a piston, or whether it have rotary or other motion.

The relationship of valves, ignition means, piston, and cylinder may be determined by well known practice, and the adsorbent matter may stand in any relationship to any of the engine parts according to the broad aspect of the invention, as may the type of carrier for the adsorbent and the shape and size of the cavity for containing it shown on the drawing. It is immaterial with respect to the broad aspects of the invention how or when the highly adsorbent material is placed within the chamber or how it is held therein, if at all. The various modifications show a cut in the chamber to hold the adsorbent material, this being rather convenient but obviously no such chamber need be cut in since the adsorbent material may be otherwise placed or held in adsorbing relation in such chamber.

What I claim is:

1. An engine comprising a cylinder and a piston therewithin, a substantially tight expansion chamber between them, and highly adsorbent material in active adsorbing relation to said chamber.

2. An engine comprising a cylinder and a piston therewithin, a substantially tight expansion chamber between them, and highly adsorbent material within said chamber.

3. In an internal combustion engine, highly adsorbent material in the combustion chamber.

4. In an internal combustion engine, highly adsorbent material in active adsorbing relation with the expansion chamber.

5. The method of operating an internal combustion engine, comprising charging the engine with an explosive mixture in the presence of highly adsorbent material and exploding said mixture in the presence of said material.

6. The method of operating in internal combustion engine, comprising charging the engine with an explosive mixture in the presence of highly adsorbent material, diminishing the volume of said mixture in the pres-

ence of said material, and exploding said mixture in the presence of said material.

7. The method of operating an internal combustion engine, comprising diminishing the volume of the explosive mixture within the same in the presence of highly adsorbent material and exploding such mixture therein in the presence of said material.

8. An engine comprising relatively movable parts forming an expansion chamber and highly adsorbent material in active adsorbent relation to said chamber.

9. An engine comprising relatively movable parts forming an expansion chamber and highly adsorbent material in said chamber.

10. A device comprising a hollow member and a member fitting and movable therein, said members forming an expansion chamber and highly adsorbent material within said chamber.

11. A device comprising a hollow member and a member fitting and movable therein, said members forming an explosion chamber and highly adsorbent material within said chamber.

12. The method of making less sudden the effect of an explosion, which comprises causing an explosion to occur in the presence of highly adsorbent material.

13. The method of making less sudden the effect of expansion of an expandable, adsorbable, gasiform agent, which comprises permitting expansion of said agent to occur in the presence of highly adsorbent material.

14. A device comprising a hollow member and a member fitting and movable therein, said members forming an expansion chamber and highly adsorbent material in adsorbing relation to said chamber.

15. A device comprising a hollow member and a member fitting and movable therein, said members forming an explosion chamber, and highly adsorbent material in adsorbing relation to said chamber.

16. The method of operating an expansion device, which comprises developing therein an expandant under pressure, a substantial part of which is free and a substantial part of which is adsorbed, and then permitting said expandant to expand.

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