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CHARGE FORMING MEANS FOR INTERNAL COMBUSTION ENGINES

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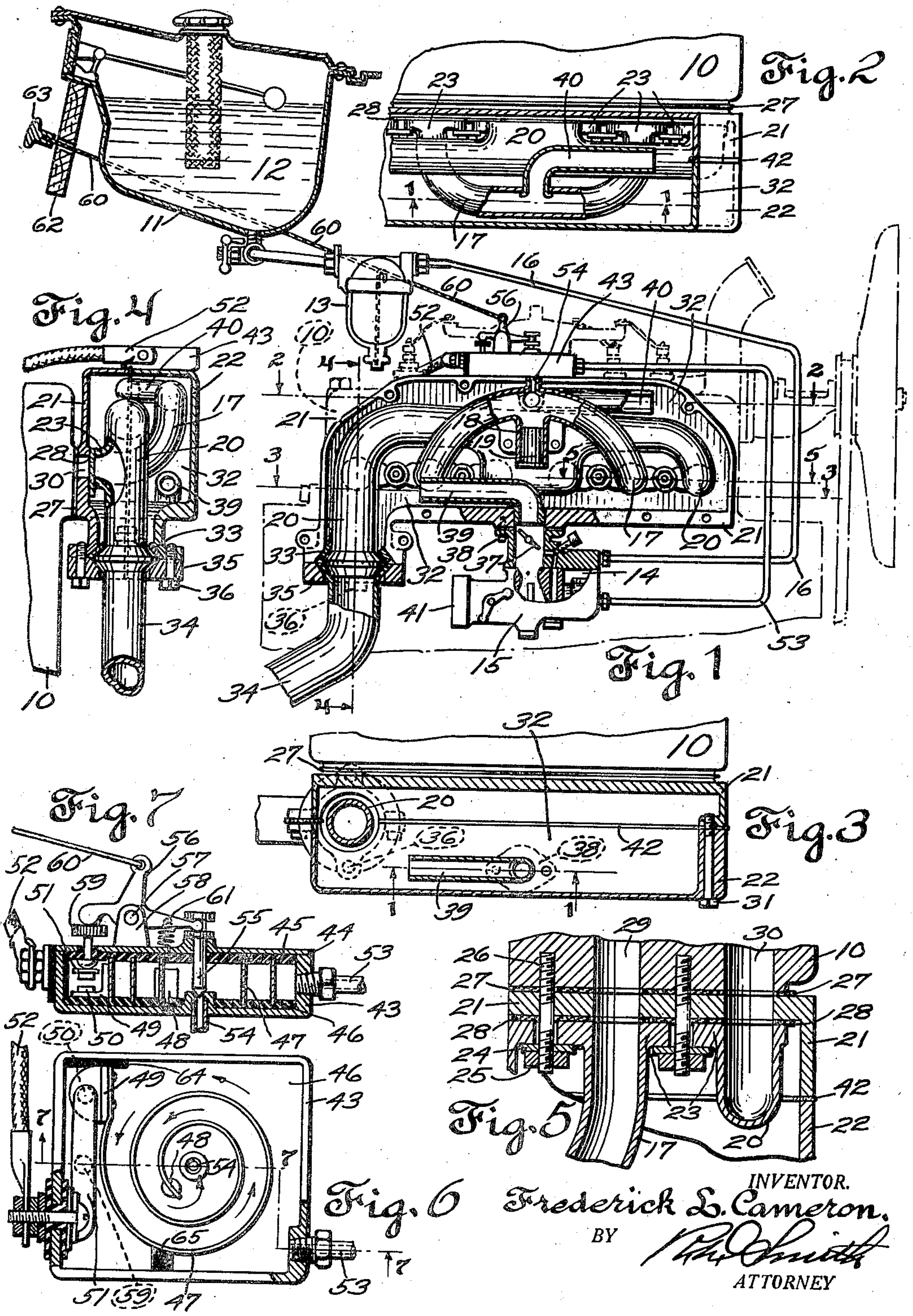

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CHARGE-FORMING MEANS FOR INTERNAL COMBUSTION ENGINES

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This invention relates to an improved process or method for forming a fuel charge for internal combustion engines, and to means and apparatus for practising this process particularly with respect to the types of construction which are common to gasoline engines.

In past attempts to handle distillates of petroleum substantially heavier than kerosene through the conventional carbureting system of gasoline engines the belief appears to have prevailed that danger of explosion exists if a stream of air equal in volume to all the air commonly admitted through a gasoline carburetor be charged with a spray of petroleum distillate heavier than kerosene in the carburetor and the mixture thus formed thereafter heated before reaching the explosion chambers of the engine sufficiently to gasify the wet mixture and make it suitably dry to be used as an explosive charge for the engine. Other handicaps to past attempts have been that the intensity of heat heretofore considered necessary to be applied to such mixture during its passage from the carburetor to the engine to properly gasify the mixture is found to precipitate solid particles from the liquid contents of the mixture and deposit them on the walls of the passageway where they will accumulate and finally clog the passage. If less heat is employed to prevent this condition, insufficient gasification of the mixture has been found to result so that a wet charge enters the explosion chambers of the engine causing incomplete combustion, fouled spark plugs and dilution of the engine lubricant.

Examples of past attempts to solve these problems include the idea of admitting through the carburetor only a small proportion of the total air which will finally reach the explosion chambers of the engine, the balance of this air being admixed, it has been proposed, at some point between the butterfly valve of the carburetor and the explosion chamber. It has been found difficult and impracticable to secure satisfactory engine performance through the proposed admixture of air in this manner.

I have discovered a process by which all the foregoing troubles are eliminated and by which I am enabled to make use of the lower cost and more power-productive, heavy distillates of petroleum by merely substituting these heavier fuel oils for the gasoline commonly employed as fuel in many kinds of explosive engines including the conventional types of gasoline engines for automobiles. This improved process and an example of one mechanical means by which it may be practised is described hereinafter with particular reference to the accompanying drawing in which:

Fig. 1 is a view, partly diagrammatic, looking at the manifold side of a conventional type of gasoline engine suitable for use in automobiles or elsewhere, and showing the application to such engine of one, out of many means, which may be resorted to for practising my improved charge-forming process. This view includes a showing of a fuel storage tank and fuel strainer positioned relative to the engine in a manner common to automobile construction. It also shows the gasifying chamber with its side cover removed to expose the arrangement of manifold pipes and other parts therein. It also shows a part of the intake manifold and the wet-mixture delivery pipe in section on the plane 1—1 of Fig. 2 and of Fig. 3.

Fig. 2 is a plan view of certain parts in the gasifying chamber looking down on the section plane 2—2 in Fig. 1.

Fig. 3 is a view looking downward on the section plane 3—3 of Fig. 1.

Fig. 4 is a view looking from the left at Fig. 1, the housing which forms the gasifying chamber being shown in section on the plane 4—4 in Fig. 1.

Fig. 5 is a sectional view looking downward on the plane 5—5 of Fig. 1 showing the manifold connection to the engine cylinder block on an enlarged scale.

Fig. 6 is a plan view with cover removed, of the heater box by which the engine may be started in the absence of sufficient heat in the regular gasifying chamber.

Fig. 7 is a section through the heater box of Fig. 6 on the planes 7—7—7 in Fig. 6 showing the cover in place and certain valve and electric switch controls, this view showing the heater box on a larger scale than it appears in Fig. 1.

I shall first describe my invention as a process consisting of a novel series of steps in the treatment of a flowing stream of air and liquid fuel mixture from the point of the formation of such mixture to its point of admittance to the explosive chamber of an internal combustion engine, in connection with which any mechanical means to which I shall refer or which are illustrated in the drawing will be understood as explanative of the principles of the novel process involved.

In general, I propose to cause the fast flowing stream of wet fuel mixture delivered by the carburetor to, at some point in its flow, form itself into a relatively stagnant reservoir before being taken into the explosion chambers of the engine. Because of the relatively enlarged volume and decreased speed of movement which characterizes the presence of any fluid in a reservoir as compared with the stream of that fluid entering and leaving the reservoir, I am able to accomplish a substantially thorough gasification of the liquid contents of the mixture by the widespread application of a degree of heat to the large volume of stagnant mixture which is substantially below the degree of heat that would have to be applied to that same mixture as a fast flowing stream to accomplish an equivalent gasification. The process involves a sufficient stagnation or arresting of the flowing movement of the mixture to afford time and opportunity for gravity to cause a precipitation of the liquid and solid particles which can not be gasified and before the mixture moves on to the engine.

By extensive experiment I have determined favorable methods of delivering the heat to different portions of the said reservoir of fuel mixture and of delivering this mixture itself to its reservoir portion and removing it therefrom to avoid the precipitation of solid particles out of the fuel mixture while it is being gasified and to insure the withdrawal of only such portions of the fuel mixture in said reservoir as have been most thoroughly gasified.

Other aspects of the invention will be found to reside in certain apparatus and construction which I may utilize for practising the above indicated process by mechanical means that may be readily applied to the exterior of a gasoline engine as commonly constructed which means will now be described with reference to the drawing.

In Fig. 1 there is indicated in broken lines the cylinder block **10** and other parts of a gasoline engine suitable for automobiles, tractors, or any other mobile or stationary use whatever. The fuel tank **11**, which may be located under the cowl of an automobile or elsewhere delivers the liquid fuel **12** by gravity or otherwise to a fuel strainer **13** and thence by gravity feed or otherwise to the float chamber **14** of the carburetor **15** through the tube **16**.

Fig. 1 further shows a conventional type of intake manifold **17** which as commonly constructed in engines burning gasoline has a downwardly extended intake branch **18** to which a carburetor may be connected and deliver its mixture of air and gasoline spray. In my present improvements, however, I do not connect the carburetor **15** directly to this or any other branch of the intake manifold for which reason I have shown this usual intake branch sealed by a plug **19**.

The usual exhaust manifold appears at **20** and surrounding and completely enclosing the exhaust manifold **20** together with the intake manifold **17** (for convenience of construction) I provide a cast metal shell split lengthwise in a vertical plane to comprise the inner section **21** and the outer section **22**,—the latter being removed in Fig. 1. The vertical wall of the inner section **21** is best shown in Fig. 5 to be clamped between the cylinder block **10** and the manifold flanges **23** by the usual washer **24** and nut **25** engaging the studs **26** which are fast in the cylinder block. A gasket **27** acts as a seal between the shell section **21** and the cylinder block **10** while a similar gasket **28** acts in the usual way as a seal between the manifold flanges **23** and the wall of shell section **21**. Openings through the interposed wall of shell section **21** register with the manifold openings into the cylinder block to provide through inlet passages **29** and exhaust passages **30**.

Since my purpose is to make a substantially sealed chamber of the interior of shell sections **21** and **22** when assembled together by the bolts **31** as shown in Figs. 2, 3, and 4, I provide for the outlet of the exhaust manifold **20** from the shell enclosed chamber **32** by a formation of the casting best shown in Figs. 1, 3, and 4 wherein all space between the shell sections **21** and **22** relative to the exhaust manifold is effectively closed by a conical gasket **33**,—the continuation of the exhaust pipe being provided by a conically flanged tube clamped in place by the retaining ring **35** held by the bolts **36**.

The chamber **32** is the gasifying compartment of my improved process which defines and accommodates the reservoir of fuel mixture required to be formed according to the novel principles of the process and any substitute for this chamber or for the exact construction of the shell sections **21** and **22** which form it will be understood as immaterial to the practising of the process concerned and hereinafter claimed.

From the viewpoint of the novel principles underlying my process it is further my purpose to admit the stream of wet fuel mixture delivered by the carburetor **15** through its throttle or butterfly valve **37** to the hottest portion of the reservoir of fuel mixture defined by the chamber **32** and at a low point therein for the purpose of most quickly gasifying the wet fuel mixture as it enters its reservoir which otherwise would have difficulty in continuing its suspension of its liquid contents particularly when such liquid contents are comprised of a spray of any distillate of petroleum heavier than kerosene. Structurally, I bolt the regular carburetor flange **38** to the bottom of the shell section **22** and provide the wet mixture pipe **39** disposed to deliver the wet mixture near the hottest point in the exhaust manifold **20** which therefore becomes the hottest portion of the mixture reservoir within the chamber **32**.

The other part of my problem is to withdraw from the reservoir of fuel mixture in chamber **32** only the most thoroughly gasified portions of that mixture, and this I do by providing the dry mixture pipe **40** connecting with the intake manifold **17** at the junction of its branches as illustrated in Figs. 1, 2, and 4, and opening into the chamber **32** at a remote point from that portion of the chamber toward which the wet mixture pipe **39** directs its flow of wet fuel mixture, and preferably at a high and relatively cool portion of said chamber if such exists.

It will be understood that my invention is not limited to any exact points at which the pipes **39** and **40** shall open into the gasifying chamber **32**, but I have indicated in the foregoing what I have found to be an efficient disposition of these points in a chamber shaped to rather closely confine the manifolds of an internal combustion engine in which it is natural that the end of the exhaust manifold through which passes the exhaust discharge from all the cylinders of the engine shall be hotter than other parts of the same manifold.

I wish to emphasize at this point that in the normal running of the engine no air is admitted to the gasifying chamber **32** other than that air which enters the carburetor **15** at its air intake **41** as opposed to any former theories that it would not be safe against premature explosion of the fuel mixture to gasify such mixture by the application of heat while containing its full air content prior to its admittance to the cylinders of the engine. To this end I provide a gasket 42 between the shell sections 21 and 22 to seal their joint when bolted together and it is clear that all other openings in chamber 32 exterior to the manifolds 17 and 20 are sealed with equal effectiveness excepting only the fuel mixture inlet 39 and the fuel mixture outlet 40.

Thus the gasifying chamber 32 may be regarded as merely an enlargement of a continuous conduit for the fuel mixture flowing from the carburetor 15 to the engine cylinders for which many other forms of enlargement of such conduit might be substituted, the distinctive feature of which, as affecting the flow of the fuel mixture, is to form an accumulated volume of such flow into a relatively stagnant reservoir of the mixture whereby large surface contact between the mixture and a heating element may be attained permitting of the delivering of enough heat to the mixture to effectively gasify the same without resorting to excessively high temperatures in the heating element which have heretofore been considered necessary. While I find the temperature of the exterior surface of an ordinary exhaust manifold suitable for conveniently practising this improved process of preparing the explosive charge for the engine, any other convenient source of heat might be employed for a similar purpose, as for instance, heat derived from some portion of the walls of the explosion chambers within the cylinder block or the cylinder head of the engine, or I may generate the necessary heat by electricity furnished by a storage battery, or in other ways.

My present improvements also provide means to form an explosive charge for starting the engine on the same fuel 12 that is used in its normal running. If the exhaust manifold 20 has become cold and the gasifying chamber 32 is therefore inoperative to form an explosive charge which will start the engine, I may resort to the heater box 43 shown in Figs. 1, 6, and 7 to form the initial explosive charge capable of starting the engine. This box as shown in Figs. 6 and 7 may comprise a metal casting secured to the top exterior surface of the gasifying chamber shell 21—22.

The cover 44 of the box 43 is surfaced on the interior with insulating material 45 as is likewise the floor of the box by the insulating material 46, and imbedded to a slight extent in both the insulating material 45 and 46 are the edges of a spiral metallic ribbon 47 of electrically resistive material conductively anchored to the metal of box 43 by the post 48 at its inner end and mounted in insulated relation to the metal of box 43 by the contact bracket 49 at its outer end. Bracket 49 carries the electric contact 50 with which the flexible contact member 51 cooperates to make and break a circuit from a lead wire 52 running from the positive pole of a storage battery through the heater element 47 to the metal of box 43 which is "grounded" thereby to complete the circuit back to the negative terminal of the electric storage battery (not shown). Baffle partitions of insulating material appear at 64 and 65 to preclude access of fuel to the electric contact chamber.

Liquid fuel is then drawn from the float chamber of the carburetor, or other suitable point, through the tubing 53 to the interior of the heater box 43 by the partial vacuum created in that box through its connection 54 to the intake manifold 17, which connection as shown in Fig. 1 and Fig. 7, may consist of a small tube running through the wall of the shell section 22 without thereby permitting opening from the gasifying chamber 32 to the exterior. The liquid fuel entering heater box 43 traverses the path indicated by arrows in Fig. 6 during which travel it becomes so heated by the spiral element 47 that it enters the intake manifold 17 in gasified form at a suitable point to mix with the air entering the same manifold through the pipe 40 whereby a successful explosive charge is formed capable of starting and maintaining the running of the engine until the exhaust manifold 20 has become sufficiently heated to properly gasify the fuel mixture in the chamber 32, whereupon the outlet 54 from heater box 43 may be closed by the valve 55 and the flow of liquid fuel through the heater box 53 stopped.

As a convenient means to simultaneously close the contacts 50 and 51 and open the valve 55 I show the double bell crank lever 56 pivoted at 57 to a bracket 58 carried by the cover 44 of the heater box, the left end of this lever being adapted to thrust down on the contact operating plunger 59 and the right end of this lever being adapted to lift up on the valve 55 when the manual operating cord or wire 60 is pulled to the left in Fig. 7. When released the parts are restored to their position shown in Fig. 7 by the spring 61 normally opening the contacts 50—51 and closing the valve 55 to render the heater box 43 inoperative for normal engine running. For convenience I have shown in Fig. 1 that the operating wire 60 may extend to the instrument board 62 and thereat be provided with a pull handle 63 to be used by the driver of an automobile in starting a cold engine much as the "choke" is used as a common part of present day automobile starting equipment.

I claim:

1. A heat exchange appliance for assemblage with the conventional external parts of an internal combustion engine for conditioning the fuel mixture passing to said engine, including in combination with the cylinder block and exhaust manifold of said engine, a multi-sectional housing including one section shaped and arranged to be interposed between said block and said manifold and perforated to give passage communication therebetween, and another section shaped and arranged to join with the first said section to complete the enclosure of a substantially gas tight space around said manifold and to permit the removal of said manifold from said space when removed from the first said section, and conduit means for leading the intake charge of the engine into and out of said space.

2. In a heat exchange appliance as described in claim 1 the construction of said conduit means wherein a portion thereof is contained within the gas tight space and comprises in part an intake manifold opening at its trunk portion to a single point within said space and giving through its branch portions to the exterior of said space through a plurality of perforations in said housing.

3. In combination, the cylinder block of an internal combustion engine, a detachable plate adapted to be clamped against the side of said block which contains the inlet and exhaust ports, said plate being perforated to provide openings registering respectively with said ports, an ex-

haust manifold with branch terminals spaced to register with said openings and said ports, means to clamp said branch terminals and said plate together and to clamp said plate against the engine block, an intake manifold with branch terminals registering respectively with different corresponding openings and ports, means to clamp said branch terminals of the intake manifold against said plate and said plate against said engine block, and a shell structure shaped and arranged to comprise a closure for both of said manifolds and to join with the edges of said plate to seal said closure, and provided with openings for the intake of a fuel charge for the engine and for the discharge of exhaust gases by said exhaust manifold.

4. In a gasifier for conditioning the wet fuel mixture of a multi-cylinder combustion engine in combination with a carburetor for forming said mixture, an engine exhaust manifold comprising a trunk portion and branches extending therefrom to all of the engine cylinders, said trunk portion being thereby caused to conduct all the engine exhaust gases through said trunk portion, means to lead the fuel mixture from said carburetor and to confine it to a space surrounding said trunk portion of the exhaust manifold and its said branches, and means to lead the fuel mixture away from said space at a high point therein for use as an explosive charge for the engine.

5. In combination with the discharge manifold of a multi-cylinder internal combustion engine comprising a trunk portion and branches leading therefrom to all the combustion cylinders of the engine respectively, thereby to conduct all the engine exhaust gases through said trunk portion toward a discharge end thereof, a housing constructed to enclose a space surrounding said trunk portion and said branches of the exhaust manifold, means to deliver a wet fuel mixture at a relatively low point within said housing and proximate the said discharge end of the manifold trunk portion, and means to remove gasified portions of said mixture at a relatively elevated point within said housing remote from said discharge end of the trunk portion of the exhaust manifold.

6. In combination with the exhaust manifold of a multi-cylinder internal combustion engine comprising a trunk portion and branches leading therefrom respectively to all the combustion cylinders of the engine thereby to conduct all the engine exhaust gases through said trunk portion toward a discharge end thereof and produce a substantially higher temperature at said discharge end than in other portions of the manifold, a housing constructed to enclose a relatively voluminous space surrounding and containing said trunk portion and said branches of the exhaust manifold, a wet fuel delivery conduit arranged to deliver unheated fuel mixture to the interior of said housing at a relatively low point in said space exterior of and proximate the hottest portion of the exhaust manifold, and means to lead gasified portions of said mixture from said space at a point therein which is relatively cool and elevated in relation to the said point of fuel mixture delivery to said space and which is remote from said point of delivery.

7. A gasifier for the wet fuel mixture prepared by carburetion for a multi-cylinder internal combustion engine including a box-like structure having walls containing conduit openings and enclosing a relatively voluminous space, an engine exhaust manifold comprising a trunk portion located in said space and discharging to the exterior of said box-like structure through a single one of said conduit openings and having branches communicating respectively with all the combustion cylinders of the engine through respectively different ones of said conduit openings, means to deliver a carbureted wet fuel mixture at a relatively low point in said space through a still different conduit opening in said structure, and means to lead gasified portions of said mixture out of said space at a relatively high point therein through still different ones of said conduit openings.

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