

Jan. 10, 1928.

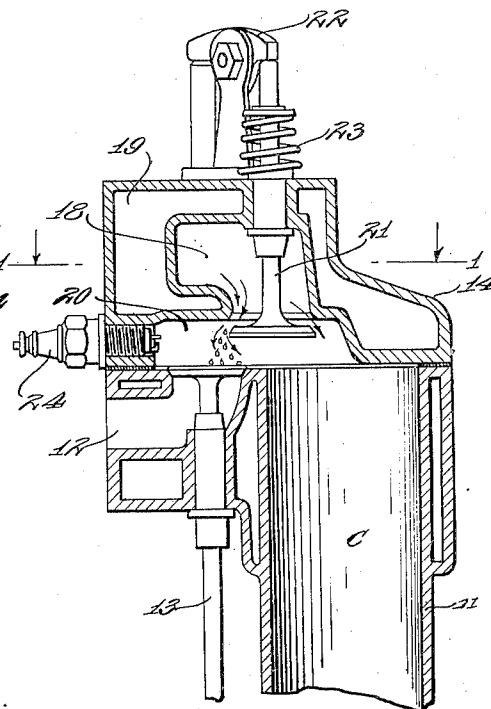
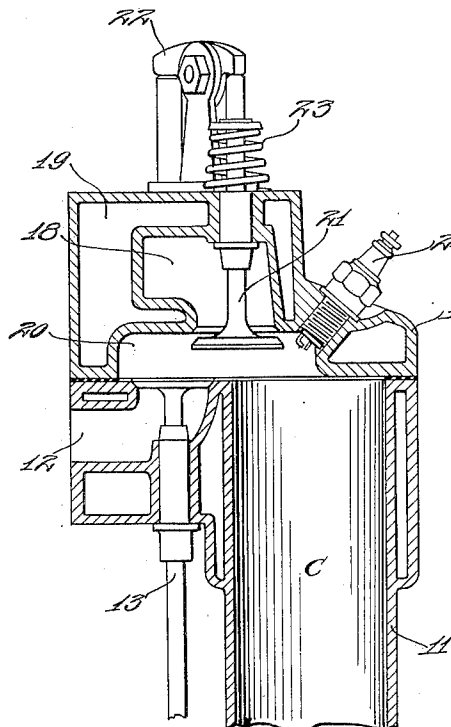
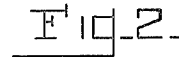
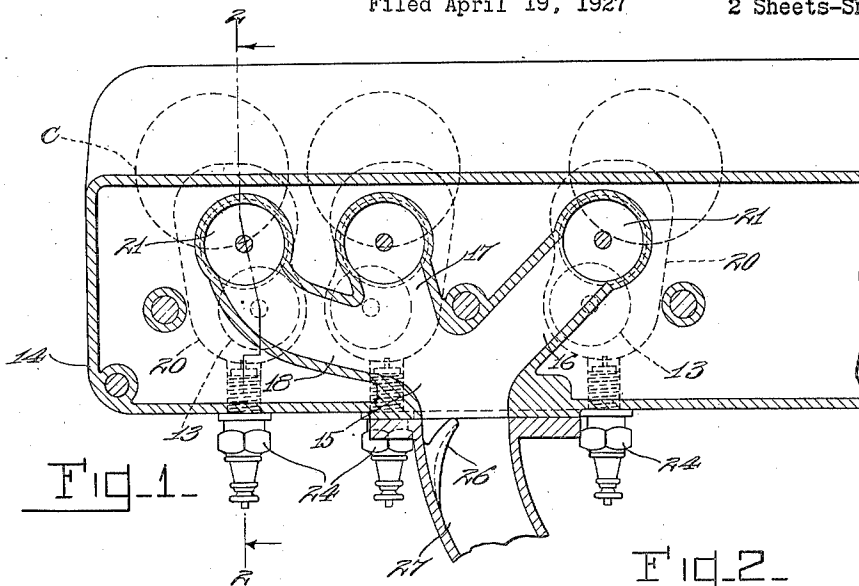
1,656,051

S. I. FEKETE

INTERNAL COMBUSTION ENGINE

Filed April 19, 1927.

2 Sheets-Sheet 1



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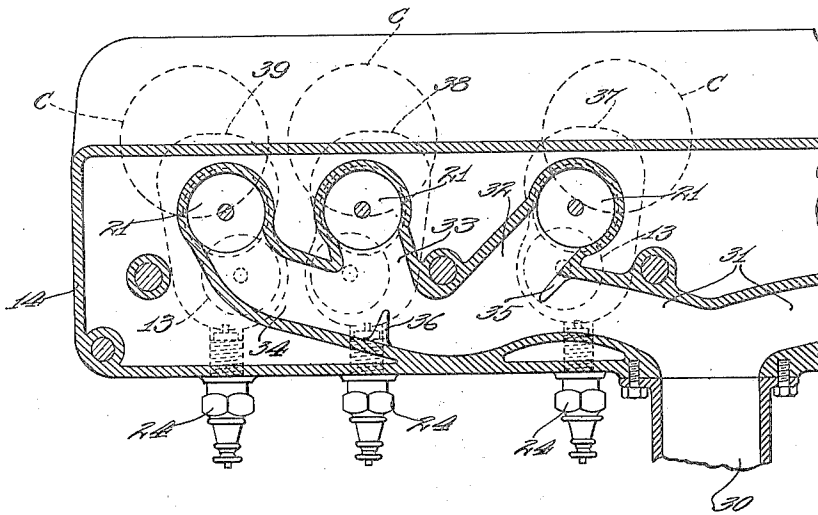
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S. I. FEKETE

INTERNAL COMBUSTION ENGINE

Filed April 19, 1927

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

STEPHEN I. FEKETE, OF DETROIT, MICHIGAN, ASSIGNOR TO HUDSON MOTOR CAR COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

Application filed April 19, 1927. Serial No. 184,982.

My present invention relates to improvements in four-cycle internal combustion engines for use in motor vehicles, and particularly to the parts which perform the working cycle of the engine, these being the cylinder and piston, valves, combustion chamber and spark plug.

The efficiency of internal combustion engines of this type depends in part on the ratio of compression, the higher the ratio the greater the power developed and the less the fuel consumption. Likewise, the more heat that is converted into work, the less heat there is to be carried off through the cooling system and the exhaust. Heretofore, increase in compression beyond definite limits has been prevented by "spark knock" so-called, although for reasons which need not be explained a higher compression ratio has been found possible in high speed engines having small cylinder bores than in the larger slower speed engines. Various schemes have been tried to eliminate spark knock, and to permit an increase in the efficiency of the engine. Examples of such schemes are the so-called anti-knock fuels, polished combustion chambers, catalytic agents in the cylinders, etc.; but these are all expensive, ineffective or unsatisfactory for one reason or another.

High compression is readily accomplished by reducing the volume of the combustion chamber, but this is ineffective unless the valves can be so arranged that the engine will breathe freely and the cylinder will be properly filled in the time permitted, and the valves can be properly cooled to prevent warping and burning, and the explosion softened so that the engine will not be harsh and rough. In small engines these conditions can be met fairly well by the L-head type, but in large engines the valves required are so large that they will not withstand the heat, the combustion space is exceedingly thin owing to the size of the valves and the engine must be considerably lengthened with attendant increase in weight and cost. The overhead valve type of engine is also unsuitable because, although the breathing is good, the valves cannot be made large enough and still be properly cooled. Furthermore, this type of engine is subject to another serious disadvantage, namely, that since the exhaust valve is above the piston the unvaporized fuel, which is always present, can escape only

by passing the piston rings into the oil pan where it dilutes the lubricating oil.

It has been appreciated for some time that the so-called F-head engine, that is, one having an overhead inlet valve and an exhaust valve on the side of the engine with its port opening downwardly, overcame some of the difficulties experienced with L-head and overhead valve engines. I have myself designed such engines which have been built in large quantities, but such engines and others of the F-head type have failed altogether to have the performance and efficiency of the engine embodying the present invention.

As a result of long study and experiment, I have found that by making certain changes in the arrangement and design of the F-head engine, which changes in themselves appear relatively insignificant, an engine is produced which is unapproached in efficiency, performance and smoothness by any comparable engines heretofore constructed. In the engine embodying my present invention, the inlet valve is placed in a position overlapping the exhaust valve and the cylinder, that is, with its axis between the axis of the cylinder and the axis of the exhaust valve, and the combustion space is extended over the cylinder no more than is necessary to provide for the passage of gas from the inlet valve to the engine. By this arrangement, the inlet and exhaust valves are so located that the blast of cool inlet gas blows directly onto the exhaust valve and cools it, thus keeping it from warping or reaching an excessive temperature which in turn will cause detonation. The cooling of the valve by the blast of cool incoming gas is so complete that exhaust valve troubles, due to excessive temperatures, are substantially eliminated. This arrangement also makes possible a very small compact combustion chamber even when using large valves. In the course of my experiments I found that in such an engine and with the spark plug placed over the cylinder, the breathing, by which is meant the freedom of flow of the mixture into the cylinder, was excellent, that the compression could be materially increased beyond the usual limiting figure, and that the performance and economy of the engine were greatly improved but that the engine was still somewhat rough and had a pronounced spark knock when the compression was raised still higher. In the course

of further study and experimentation with these still higher compression ratios, I found that if the spark plug was placed on the side of the exhaust valve farthest away from the cylinder, a complete change in the characteristics of the engine top place. Such an engine has no perceptible spark knock, even when the spark has been advanced beyond the point of maximum power; it is not prone to pre-ignition, and it is exceedingly smooth in performance, having lost all objectionable harshness. As a result, the compression can be increased to a point far beyond anything thought possible in engines of the same size, and consequently the engine has greatly increased efficiency and fuel economy. A further advantage is that since more of the potential energy of the fuel is converted into useful work and less into heat, there is less heat to be carried off by the cooling system and the exhaust. In fact, an engine embodying my invention has all the characteristics of an engine run on anti-knock fuel with none of its very serious drawbacks.

While it is impossible to state with certainty the reason why the peculiar location of the spark plug has such an effect on the characteristics of the engine, it may be because the explosion which, with high compression is most violent at the point where it begins and is less so at a greater distance from the starting point, has its starting point in the engine embodying my invention at a distance from the cylinder so that, by the time the piston is reached, it is softened and less violent. Perhaps also the direction of the explosion, which is at right angles to the direction of movement of the piston, has something to do with the effect observed. At any rate, the difference is unmistakable and is indisputably the result of the location of the spark plug with relation to the other parts of the engine.

Another beneficial feature of the invention is that the inlet and exhaust valves are so placed with relation to each other that any unvaporized fuel which passes the inlet valve falls directly onto the exhaust valve and is thus vaporized and burned or, if unvaporized, goes out through the exhaust without diluting the lubricating oil in the crank case.

As a whole, the engine embodying my invention shows an increased horsepower at all speeds and a large increase in horsepower at high speeds. This is accomplished by a decrease in fuel consumption, the motor is cooler and there is less difficulty in exhaust pipes, gaskets, mufflers, etc. The total result is that it is possible for the first time to produce a large engine of high efficiency, with an unprecedented performance, possessing the speed and economy of the high compression motor with the smoothness and complete absence of spark knock and the

wide range of flexibility heretofore associated only with a low compression engine.

The invention will be fully understood from the following description when taken in connection with the accompanying drawings and the novel features thereof will be pointed out and clearly defined in the claims at the close of this specification.

Referring now to the drawings:

Fig. 1 is a horizontal section taken on line 1—1 of Fig. 2 of an engine embodying my invention.

Fig. 2 is a section on the line 2—2, Fig. 1.

Fig. 3 is a view similar to Fig. 2, showing a slightly modified construction.

Fig. 4 is a horizontal section of an engine embodying my invention in modified form.

At 11 is shown a portion of the cylinder casting, at 12 the exhaust passage and at 13 one of the exhaust valves. At 14 is shown the cylinder head which in the form shown in the drawings is separate from the cylinder block. In the cylinder head the main inlet passage is shown at 15 and the several branches at 16, 17 and 18. There are two main inlet passages 15 only one of which is shown in Fig. 1 and each passage has three branches, the engine shown being a six cylinder engine. The water jacket for the cylinder head is shown at 19. At 20 is shown the combustion space of the engine being partly over the cylinder C and partly over the exhaust valve 13. At 21 is shown an inlet valve which is inverted and opens downwardly into the combustion space 20 thus connecting one of the branch inlet passages with the combustion space. It will be understood that the construction for each of the cylinders is identical except for the shape of the inlet passages and therefore only one is described. The valve rocker is shown at 22 and the valve spring at 23. At 24 is shown a spark plug by means of which the mixture is exploded.

As will be seen in the drawings, the relations of the exhaust valve, inlet valve and cylinder are quite different from the ordinary practice. In the engine embodying my invention the exhaust valve 13 is placed as close as practicable to the side of the cylinder C. The inlet valve 21 is placed with its axis between the axis of the cylinder and that of the exhaust valve and with its edge overlapping the edge both of the exhaust valve and of the cylinder. The combustion space 20 lies transversely of the cylinder block, and is made as small as possible. As will be seen from Figs. 2 and 3 it extends only to a point about over the middle of the cylinder and since its end is rounded and is in general concentric with the inlet valve, the total part of the area of the upper end of the cylinder which is exposed to the combustion space is exceedingly small. Likewise, the ratio of the combustion space to

the displacement is reduced. The branches 16, 17 and 18 of the inlet passage enter from the exhaust valve side of the engine, i. e., the side farthest from the cylinder and therefore pass over the portion of the combustion space over the exhaust valves.

This arrangement makes a great difference in the operation of the engine. The engine breathes well because the inlet valve is over
10 enough of the cylinder to accomplish this result. Heretofore when the valve has been placed over the exhaust valve the breathing of the engine has been bad and there has been a consequent failure to produce a maxi-
15 mum efficiency. In fact I find that there is no apparent difference in this respect between engines with my novel construction and engines having an inlet valve wholly over the cylinder. Furthermore a portion of
20 the incoming charge plays directly on the hot exhaust valve cooling it, and unvaporized liquid particles in the mixture fall directly onto the exhaust valve, as indicated by the arrows in Fig. 2. The mixture therefore helps
25 to cool the valve, prevents it from becoming so hot as to cause preignition, and keeps it from warping, and the hot exhaust valve serves to vaporize any unvaporized particles of fuel and therefore improves the combustion and the fuel economy of the engine and
30 prevents fouling of the combustion space, cylinder head, spark plug and valve stems.

While the advantages of my invention are achieved to a great extent by the arrangement already described, irrespective of the
35 location of the spark plug, the operation appears to be best when the spark plug is placed in a substantially horizontal position as remote as possible from the cylinder. Accordingly, in the preferred form of engine
40 the spark plugs 24 are placed, as shown in Figs. 1 and 2, on the sides of the cylinder head adjacent the exhaust valve, but if preferred they may be placed about centrally
45 of the cylinder as shown at 24 in Fig. 3.

The arrangement of valves and construction described is effectively employed in connection with a deflector 26 and the curved manifold 27 which is shown in Fig. 1, being
50 more fully described in a companion application Serial No. 170,115, filed February 23, 1927. This deflector helps to cause any particles of unvaporized fuel which normally
55 cling to the outer curved wall of the manifold to be drawn into the center of the air stream leading to whichever cylinder is breathing and thus the unvaporized particles of heavy fuel are distributed uniformly among the cylinders. These particles of un-
60 vaporized fuel being blown off the front edge of the deflector and being in the middle of the air stream are carried along in such a position that many of them will fall directly onto the hot exhaust valve thus insuring
65 the vaporization and combustion of these

particles. Thus by arranging the valves as stated herein, the vaporization of the heavy particles is improved.

In Fig. 4, there is shown an engine embodying my invention in modified form. In
70 this figure, the cylinder head is designated 14, the cylinders C, the inlet valves 21, the exhaust valves 13 and the spark plugs 24. In the form shown in the drawings, the inlet passage 30 leading from the carburetor
75 enters the side of the cylinder head casting and there branches into inlet passages 31 each of which branches into three inlet passages 32, 33 and 34 supplying three inlet
80 valves 21 respectively. At 35 is shown a deflector which serves to direct the unvaporized particles of fuel into the mixture stream and distribute them to the several cylinders. At
85 36 is shown a second deflector performing similar functions for the cylinders supplied by the inlet passages 33 and 34. It will be seen that the combustion spaces 37, 38 and 39 of the several cylinders are arranged with
90 relation to the respective cylinder and exhaust valve as in Fig. 2, substantially the only difference being that the manifold passage lies within the casting instead of on the outside thereof. Under certain conditions
95 of use and manufacture this arrangement has certain advantages.

The engine constructed as described has by reason of the relation of the parts a very small combustion chamber relative to the displacement, and a very small area of piston
100 exposed to the heat; consequently the combustion is comparable to that of a much smaller engine of standard design, more heat goes into work and less energy is wasted. The engine shows a marked increase in
105 efficiency, but this is not accompanied by preignition or overheating of the exhaust valves.

What I claim is:

1. In an internal combustion engine of the F-head type and in combination with the
110 cylinder and combustion space thereof, an exhaust valve in the combustion space at one side of the cylinder and an inverted inlet valve whose axis is about midway between
115 the axes of the cylinder and exhaust valve.

2. In an internal combustion engine of the F-head type and in combination with the cylinder and combustion space, an exhaust valve in the combustion space beside the
120 cylinder, and an inverted inlet valve opening downwardly into the combustion space, said inlet valve overlapping the exhaust valve and the cylinder.

3. In an internal combustion engine of the F-head type and in combination with a
125 cylinder and combustion space, an exhaust valve opening into the combustion space beside the cylinder, and an inverted inlet valve opening downwardly into the combustion space, said valve overlapping the exhaust
130

valve and the cylinder, and the portion of the combustion space over the cylinder being limited to that portion immediately around the inlet valve.

5 4. In an internal combustion engine of the F-head type and in combination with a cylinder and combustion space, an exhaust valve opening into the combustion space beside the cylinder, an inverted inlet valve opening
10 downwardly into the combustion space, said valve overlapping the exhaust valve and the cylinder, and the portion of the combustion space over the cylinder being limited to that portion immediately around the inlet valve,
15 and a spark plug adjacent the side of the exhaust valve and at a distance from the cylinder.

5 5. In an internal combustion engine of the F-head type and in combination with the cylinder and combustion space, an exhaust
20 valve opening into the combustion space, an inverted inlet valve overlapping the exhaust valve and the cylinder, the inlet passage leading to the intake valve entering from
25 the exhaust valve side of the cylinder and turning downwardly past the inlet valve so that the incoming mixture and particularly the heavy particles thereof will impart flow across the exhaust valve.

30 6. In an internal combustion engine of the F-head type and in combination with the cylinder, an exhaust valve beside the cylin-

der, and an inverted inlet valve overlapping the edge of the cylinder and of the exhaust valve, the combustion space of the engine being substantially merely sufficient to surround the two valves, and the under surface of the cylinder head being elsewhere substantially in the plane of the top of the cylinder, whereby the portion of the combustion space over to the cylinder is confined to a portion of a cylinder.

7. An internal combustion engine having a combustion space extending from a point above the cylinder to a point at one side thereof, an exhaust valve at the side of the cylinder opening upward into the combustion space, an inlet valve opening downward into the combustion space and overlapping the adjoining sides of the cylinder and exhaust valve and a spark plug adjacent the exhaust valve and remote from the cylinder.

8. An internal combustion engine having a combustion space located in part over only a portion of the cylinder and is in part at one side thereof, an exhaust valve at the side of the cylinder opening upward into the combustion space, an inlet valve opening downward into the combustion space and overlapping the adjoining sides of the cylinder and exhaust valve and a spark plug adjacent the exhaust valve and remote from the cylinder.

In testimony whereof I affix my signature.

STEPHEN I. FEKETE.