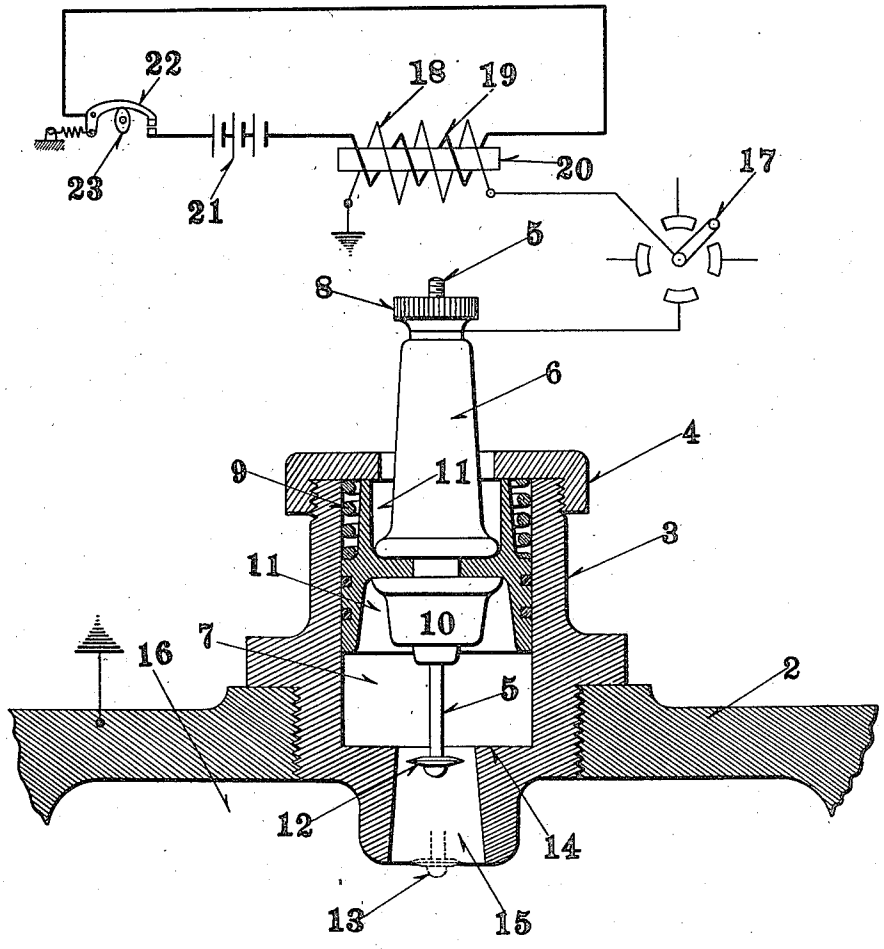
B. DICK & V. A. FYNN.

IGNITION DEVICE.

APPLICATION FILED JULY 19, 1915.

1,208,926. Patented Dec. 19, 1916.



WITNESS.

Charles A. Becker.

INVENTOR

Burns Dick

Valien A. Fynn

BY

E. E. Hoffman

ATTORNEY

UNITED STATES PATENT OFFICE.

BURNS DICK AND VALÈRE ALFRED FYNN, OF ST. LOUIS, MISSOURI, ASSIGNORS TO WAGNER ELECTRIC MANUFACTURING COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

IGNITION DEVICE.

1,208,926. Specification of Letters Patent. Patented Dec. 19, 1916.

Application filed July 19, 1915. Serial No. 40,602.

To all whom it may concern:

Be it known that we, BURNS DICK and VALÈRE A. FYNN, subjects of the King of England, residing at the city of St. Louis, Missouri, United States of America, have invented a certain new and useful Ignition Device, of which the following is such a full, clear, and exact description as will enable any one skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

Our invention relates to internal combustion engines, and more particularly to improved means for causing the maximum explosion pressure to occur at the most efficient points of the crank revolution for all torque conditions.

It is well known that an engine running at a given number of revolutions and developing little power, ought to operate with a certain setting of the spark in order to utilize the fuel to the best possible advantage, and that this spark setting must be altered in order to obtain the best results if the load is changed while the speed is kept constant. Thus, if a combustion engine working at a given speed and maximum load requires a 15 degree lead or advance of the spark, then it will require a greater spark advance when the load is thrown off but the speed is kept constant.

The greater the torque developed by the engine at a given speed, that is, the greater the load on the engine, the greater also will be the degree to which the charge will be mechanically compressed in any cylinder at the end of the compression stroke, because an increase in torque requires an increase in air and fuel. The time which elapses between the occurrence of the ignition spark within the combustion chamber and the development of the maximum explosion pressure, also varies to a marked extent and depends on the rate of flame propagation, and this rate itself depends on a number of factors, one of which is the location of the spark gap with reference to the main body of the compression chamber. The nearer the spark to the main body of the compression chamber, the more rapid the flame propagation and the shorter the time interval between the occurrence of the ignition spark and of the maximum explosion pressure.

In carrying out our invention we make use of the fact that the degree of mechanical compression changes with the engine torque or load, and also of the fact that the location of the spark gap with reference to the main body of the compression chamber has an influence on the time interval between the occurrence of the ignition spark and of the maximum explosion pressure, in order to cause this maximum explosion pressure to occur at that point of the revolution at which it will be most efficient under the prevailing load conditions.

Our invention will be better understood by reference to the accompanying drawing, which shows one embodiment thereof.

The figure illustrates a spark plug adapted to be screwed into the wall 2 of the cylinder of a combustion engine, in the ordinary way. This improved spark plug comprises a body 3 within the cylindrical chamber 7 of which slides a spring-controlled piston 11. This chamber communicates with the cylinder of the engine by means of a circular opening 15 of smaller diameter than the chamber 7, whereby a shoulder 14 is formed in the lower part of said chamber. This shoulder limits the downward travel of the piston in the direction in which it is impelled by the spring 9 controlling same. The travel of the piston 11 is limited in the opposite direction by means of a cap 4 screwed on the body 3 of the spark plug, a suitable annular projection of the piston coming into contact with this cap in time to prevent the spring 9 from being crushed. The rod 5 is attached to the piston 11 but insulated therefrom by means of suitably shaped bodies of insulating material, 6 and 10. The rod 5 is so held as to be compelled to follow each movement of the piston 11. A milled head nut, coöperating with a suitable washer, makes it possible to readily connect this rod to the distributer 17 or high tension side of the ignition system. At its lower end, the rod 5 carries a sharp edged disk 12 of somewhat smaller diameter than the circular opening 15 in the lower end of the spark plug. This disk, which forms the insulated terminal of the spark plug, may have a serrated edge, if desired. In the

figure, the piston 11 is shown in its highest position, with the spring 9 fully compressed. With fully extended spring, the lower part of the piston 11 would rest on the shoulder 14, and the terminal disk 12 would be in the position indicated by dotted lines at 13. In this spark plug the spark would occur between some part of the circumference of the disk 12 and some part of the inner wall of the circular opening 15. With the piston in the position shown in the figure, the ignition spark would occur deep in the pocket, or ignition chamber, formed by the opening 15 at a point removed a considerable distance from the body of the combustion chamber 16. With the spring 9 fully extended, the spark would be produced at the lower edge of the pocket 15 and in closest proximity to the combustion chamber 16.

In the figure the spark plug is shown connected to a battery ignition system, the primary circuit of which comprises the interrupter 22 actuated by the cam 23, the storage battery 21 and the primary 19 of the spark coil. The secondary ignition circuit comprises the secondary spark coil winding 18, the high tension distributer 17 and the spark gap in the pocket 15.

The mode of operation of our improved ignition system is somewhat as follows: Normally, and with no pressure in the combustion chamber 16, the spring 9 will be in control of the piston 11 and hold same in that position in which it rests on the shoulder 14, in which case the terminal disk 12 will occupy the position indicated by the dotted lines at 13. When the engine is started, a certain pressure will be developed in the combustion chamber 16, at the end of each compression stroke, and this pressure, acting on the piston 11, will force same upward, away from the shoulder 14 against the effort of the spring 9 and thus push the terminal disk 12, and therefore the location of the ignition spark, farther and farther away from the main body of the combustion chamber and higher into the pocket 15 as the fuel pressure increases. The mechanically produced pressures at the end of the compression stroke vary over a wide range; beginning with a few pounds whenever the torque exerted by the engine is small, and reaching values of about 60 or more pounds when the engine is developing its maximum torque. The spring 9 is so adjusted that, when the maximum compression occurs, the piston 11 is forced into the position shown in the figure. Since the ignition spark must always occur between some part of the terminal disk 12 and some part of the inner wall of the pocket 15, then, with low compression values, that is, when the engine is developing a small torque, the spark will occur close to the main body of the compression or explosion chamber 16, gradually receding into the depths of the pocket 15 and therefore away from the main body of the compression chamber as the mechanically produced pressure in the cylinder is increased, that is, as the engine develops more and more torque. When the ignition spark occurs close to the main body of the combustion chamber, then the rate of flame propagation will be rapid and the time interval between the occurrence of the spark and of the maximum explosion pressure will be short. As the point at which the ignition spark occurs recedes from the main body of the combustion chamber 16 and from the lower opening of the pocket 15, so will the rate of flame propagation decrease, thus causing the time interval between the occurrence of the ignition spark and of the maximum explosion pressure to increase. We, thus achieve, by the means described, an effect equivalent to that usually secured by causing the spark to always occur at the same point but changing the timing thereof. This indirect method of timing the spark, of course, also takes care of the change in compression pressure due to a change in the engine speed. With most carbureters, the compression pressure decreases with increasing speed, for a constant opening of the fuel valve, which is controlled from the driver's seat. This decrease of compression pressure with increasing speed, is due to the fact that as the speed increases the amount of mixture sucked into the cylinder diminishes, although the opening of the fuel valve is kept constant. As the compression pressure decreases with increasing speed, so does the time interval diminish which elapses between the production of the spark in our improved ignition system and the occurrence of the maximum explosion pressure, thus producing the effect of a spark advance with increasing speed for a constant fuel valve opening.

Because the explosion pressure developed in the cylinder reaches values greatly in excess of the pressures mechanically produced at the end of each compression stroke, we have made provision for positively limiting the upward stroke of the piston 11. Without this precaution, the spring 9 would have to be made strong enough to withstand the maximum explosion pressure, which may reach 200 pounds per square inch, and could not be made sufficiently sensitive to the changes in the pressure occurring at the end of the compression stroke, on which the operation of this device depends, and which usually vary from about 5 to about 60 pounds per square inch.

The pocket, or ignition chamber, 15 affording communication between the chambers 7 and 16, is preferably made conical in shape, in order to compensate for the increase in resistance of a given spark gap

with rising compression values. Experiments have shown that the voltage necessary in order to force a spark across a spark gap of a given length increases rapidly, although not quite proportionately with increasing compression pressure. It is therefore clear that if the ignition voltage and the spark gap length remain constant, then the intensity of the spark must decrease with increasing compression pressure. In fact, the spark may, under those conditions, fail altogether. In order to take care of these conditions, the pocket 15 is so arranged that the distance between the terminal disk 12 and the wall of the pocket, diminishes as the piston 11 rises.

Having fully described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In an internal combustion engine, an explosion chamber, fuel igniting means, and means governed by the pressure of the fuel in the explosion chamber for varying the position of the point of initial ignition of the fuel to vary the time between the said ignition and the development of maximum explosive pressure.

2. In an internal combustion engine, the combination of an explosion chamber, a movable spark electrode, and means operated by the pressure to which the fuel is subjected in the explosion chamber for moving said spark electrode to change the point at which the ignition spark is produced.

3. In an internal combustion engine, an explosion chamber, an ignition chamber in communication with the explosion chamber, ignition means in the ignition chamber, and means governed by the pressure of the fuel in said chambers for varying the distance of the point of ignition thereof from the main body of fuel in the explosion chamber.

4. In an internal combustion engine, the combination of an explosion chamber, a fuel ignition chamber communicating therewith, a spark electrode in said ignition chamber, and means operated by the pressure of the fuel in said chambers for varying the position at which the ignition spark is produced.

5. In an internal combustion engine, the combination of an explosion chamber, a sparking plug having a chambered body and a piston movable therein, the movement of said piston being governed by the pressure of the fuel in the explosion chamber, a movable electrode controlled by the piston, and a second electrode having a plurality of sparking points adjacent to the path of movement of the movable electrode whereby the position at which the ignition sparks occur will vary with the different fuel pressures in the explosion chamber.

6. In an internal combustion engine, the combination of an explosion chamber, a sparking plug having a chambered body and a piston movable therein, the movement of said piston being governed by the pressure of the fuel in the explosion chamber, a movable electrode controlled by the piston, and a second electrode having a plurality of sparking points at different distances from the path of movement of the sparking point of the movable electrode.

7. A spark plug comprising a chambered body forming an electrode, a piston movable therein, a movable electrode operated by said piston, the movement of said piston and electrode being controlled by the pressure of the fuel charges to be ignited to produce ignition sparks at different points within the chambered body for different pressures.

8. A spark plug comprising a chambered body forming an electrode, a piston movable therein, a movable electrode operated by said piston, resilient means for opposing the movement of piston in one direction, means limiting the movement of piston in said direction, the movement of said piston and electrode being controlled by the pressure of the fuel charges to be ignited to produce ignition sparks at different points within the chambered body for different pressures.

9. In an internal combustion engine an explosion chamber and piston therein, fuel igniting means and means controlling the igniting means to cause the time of occurrence of maximum explosion pressure with reference to piston position to vary with variations in maximum fuel pressure in the explosion chamber.

In testimony whereof, we have hereunto set our hands and affixed our seals in the presence of the two subscribing witnesses.

BURNS DICK. [L. S.]
VALÈRE ALFRED FYNN. [L. S.]

Witnesses:
CARL C. ADAMS,
H. HENZE.