C. F. KETTERING.

IGNITION SYSTEM.

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1,301,851.

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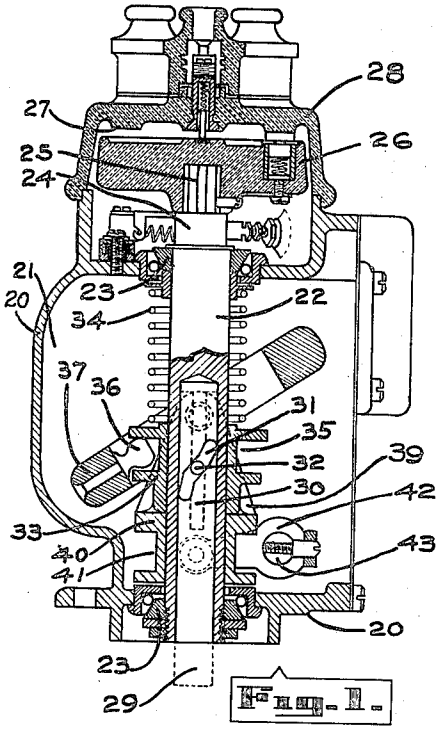

Fig. 1.

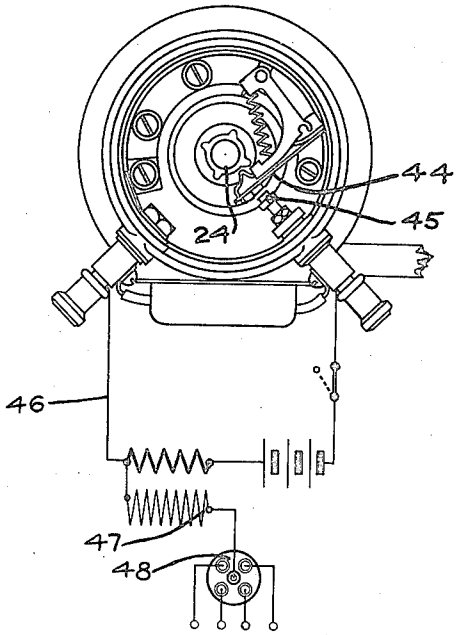

Fig. 2.

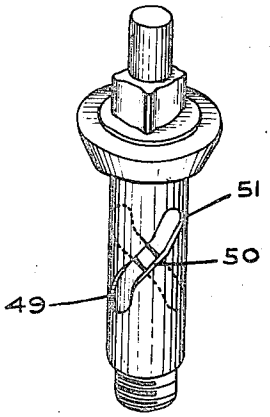

Fig. 3.

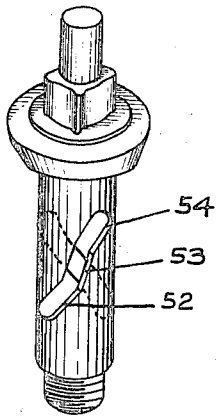

Fig. 4.

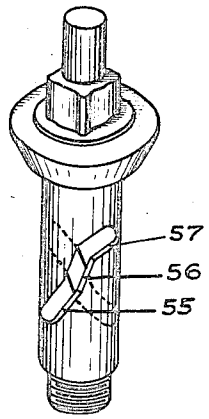

Fig. 5.

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UNITED STATES PATENT OFFICE.

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IGNITION SYSTEM.

1,301,851. Specification of Letters Patent. Patented Apr. 29, 1919.

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To all whom it may concern:

Be it known that I, CHARLES F. KETTERING, a citizen of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Ignition Systems, of which the following is a full, clear, and exact description.

This invention relates to improvements in ignition systems, and more particularly to that class of devices, wherein mechanism is provided for advancing and retarding the spark of the ignition system.

In ignition systems of the class referred to, a timing device is usually provided, which is capable of adjustment through a given range of advance and retard, so that the time of occurrence of the sparking impulse may be varied, whereby to increase the efficiency of the engine operation.

It is among the objects of the present improvements to provide controlling mechanism which is automatically actuated, either directly or indirectly by the engine for advancing and retarding the spark in accordance with the power curve of the engine.

One manner of securing the above objects is to provide an ignition system, wherein a governor device, which is automatically operable in accordance with the speed of the engine, is associated with devices which include means adapted to effect the advancing and retarding of sparking impulses in the ignition circuit different degrees, upon equal increments of movement of the automatic governor.

These devices which include the means for effecting this variation in the advancing and retarding of the sparking impulses in the ignition circuit, are so constructed that the degree of variation in the advancing and retarding of the sparking impulses is directly in accordance with the power curve of the engine, so that the ignition may be supplied to the engine at such times as may be found to be most advantageous, in accordance with the speed at which the engine is running, and also in accordance with the power curve of the engine.

Further objects and advantages of the present invention will appear from the following description, reference being had to the accompanying drawings, wherein one form of the preferred embodiment of the present invention is clearly illustrated.

In the drawings:

Figure 1 is a view in vertical section of an ignition unit embodying the present improvements.

Fig. 2 is a top plan view of the device shown in Fig. 1, with the distributer head and rotor removed.

Fig. 3 is a detail view of the cam carrying sleeve or shaft embodied in the structural showing in Fig. 1.

Figs. 4 and 5 are views similar to Fig. 3, except that they disclose variations in the angularity of the spiral slot.

It is well known in the engine art, particularly of the combustion and explosion type, that engines of different makes have different power characteristics. That is, what is known as the power curve of the engine, is affected by a great many different conditions, such as dimensions of the fuel intake and exhaust manifolds, the area in the combustion chamber, piston displacement and many others.

Due to these various conditions which are present in different makes and types of engines, it has been found that the time of occurrence of the sparking impulses during different ranges of engine speeds, should vary substantially in accordance with the power curve of the particular type of engine to which the ignition system is to be applied. That is, in certain types of engines, it may be that only a slight advance in the time occurrence of the sparking impulses will be required for engine speeds from 1 to 10 miles per hour, while for speeds from 10 to 20 miles per hour, a much greater degree of advance of the sparking impulses will be required to give a corresponding equal efficiency from a power stand-point.

Then again, this same type of engine may require a less amount of advance for speeds from 25 miles on up.

However, a different make or a different type of engine may require a comparatively large amount of advance for speeds up to 10 miles an hour, while a comparatively small

advance of the spark will take care of the speeds from 10 to 20 miles per hour, and then for speeds upward of 20 miles per hour, a much greater degree of advance may be required.

In the present improvements, the power curve of the engine is first ascertained by suitable dynamometer or other appropriate tests by which data is obtained showing the setting of the timer which is required in order that the engine will give the maximum of power at a given speed. The curve of maximum power, showing the setting of the timer corresponding to the speed is plotted on coördinate paper from the data obtained, and this power curve is used so as to enable the mechanism, which will be described hereinafter, to be constructed in accordance with the requirements of the particular type of engine in order that the maximum power may be produced for any given speed.

This mechanism is combined with a governor, which is controlled by the speed of the engine, and this governor will tend to actuate the aforesaid mechanism in such a manner as to provide ignition at the time it will accomplish the most effective combustion of the engine charge, both in accordance with the speed of the engine, and the power curve of the engine.

Referring to the drawings:

In Fig. 1, there is disclosed what may be termed a distributing unit, which comprises a casing 20, having a relatively large chamber 21, in the end walls of which is supported the sleeve 22, upon suitable bearing members 23. This sleeve member carries a cam 24, which may be secured to the sleeve in any suitable manner. This cam 24 is formed with a projecting end portion 25, which carries a rotor 26, adapted to cooperate with contacts 27, carried by the distributer head 28.

The sleeve 22 is adapted to be driven by the engine through the medium of the shaft 29, said shaft fitting within the hollow end of said sleeve. This shaft is slotted adjacent to the end thereof, as at 30. The sleeve 22 is provided with a slot 31 of varying angularity, the difference in this angularity being pre-determined in a manner described hereinafter. A suitable pin or connecting member 32 passes through the straight slot 30 and the slots of varying angularity formed in the sleeve 22, and is secured to the collar member 33. This collar is slidably arranged upon the sleeve 22, but is held in normal position by means of the coil spring 34. The collar 33 is provided with a circumferential groove 35, which receives a projection 36, carried by the weight or governor 37. This governor 37 is pivoted to the arms 39 which are formed integral or secured to the collar 40 in any suitable manner. Directly beneath the collar 33 is another collar 40, provided with a circumferential groove 41, which receives the ends of the yoke 42. This yoke is pivoted as at 43, and is connected to any suitable manually operated lever.

From the above description, it will be apparent that as the engine actuates, the shaft 29 tends to drive the sleeve 22 and its associated parts, including the cam 24, rotor 26, and that the contacts 44 and 45, shown in Fig. 3, will be made and broken, thereby opening and closing the primary circuit 46, and that the respective branches of the secordary circuit 47 will be made and broken through the effect of the distributer 48.

Now, as the speed of the engine increases, there will be a corresponding increase in the speed of the sleeve 22 and its associated parts, and as this speed increases, the weight member 37 will swing on its pivot, due to centrifugal force. As the weight member moves, the collar 33 will be raised, and will consequently carry the pin 32 with it through the straight slot 30, formed in the shaft 29 and the angular slot 31, formed in the sleeve 22. Due to the angularity of the slots 31, the sleeve 22 will be turned or actuated relative to the shaft 29 and thereby advance the cam 24 and the rotor 26, to effect the advance in the time occurence of the sparking impulses.

Now, as has been explained heretofore, various types of engines have different power curves or characteristics, and it is therefore one of the objects of the present improvements to follow this power curve in the respective types of engines as closely as possible in the advancing and retarding of the time of occurence of the sparking impulses.

By referring to Figs. 1 and 3, the sleeve 22 is shown as including a slot of varying angularity, the first or lower part 49 of said slot being only a small angle, while the intermediate or central portion 50 of said slot is of a more decided angle, and the upper portion 51 of said slot being of a still different degree of angularity, from either of the heretofore described portions.

When the sleeve 22 is provided with a slot of the conformation similar to that shown in Fig. 1 and Fig. 2, the operation of the automatically controlled governor or weight 37 will tend to move the pin 32 upwardly as the speed of the engine increases.

During the initial range of speed, the pin will pass through the portion 49 of the slot which is of slight angularity, and therefore will effect a consequently small relative movement of the timer cam 24, relative to the contacts 44 and 45, thereby effecting a small degree of advance of the sparking impulse.

However, during what may be termed the

second range of advancement or movement of the pin 32, in accordance with a still further increase of the engine speed, the pin will tend to move through the central portion 50 of the slot, which is of a much more decided angularity than the first portion just described. This movement of the pin will tend to effect a much greater relative movement of the timer cam 24, relative to the contacts 44 and 45, and thereby effect a much greater degree of advance of the sparking impulse.

Now, if extreme speeds of the engine are secured, the pin will continue to move upwardly, and will pass through the upper portion 51 of the slot which is of different angularity from either of the two portions heretofore described. That is, the angularity of the upper portion 51 of said slot is less than the angularity of the central portion 50, but is greater than the angularity of the lower portion 49.

In this connection it may be stated that the angularity of the slot shown in connection with Figs. 1 and 3, is computed in accordance with a given power curve of an engine to which the ignition system is to be applied, and it is obvious that practically any condition of power curve may be duplicated by varying the angularity of the slot.

In Figs. 3 and 4, the sleeve 22 is shown with slots of different angularity from that just described in connection with Figs. 1 and 3, it being understood that the angularity of these slots is in accordance with power curves of different types of engines.

The sleeve which is shown in Fig. 4 is provided with a slot, wherein the angularity of the lower portion 52 is abrupt, therefore tending to give a decided advance and retard of the spark while the pin 32 works through this portion of the slot, while the central portion 53 of the slot is of lower angularity, and therefore for intermediate speeds of the engine, the pin 32, which tends to automatically move through this slot, will only slightly advance or actuate the timer cam, to effect a further advance of the sparking impulse.

The extreme upper portion 54 of the slot is of greater angularity than the portion 53, but is of less angularity than the portion 52. Therefore, during extremely high speeds of an engine which has a power curve substantially of the same contour as the slot shown in Fig. 4, the advance at extremely high speeds will be greater than the advance for intermediate speeds, but will be less than the advance for low speeds.

The slot shown in Fig. 5 again shows the variation, wherein the lower portion 55 and the intermediate portion 56 are substantially the same as those shown in Fig. 4, while the extreme upper portion 57 is of abrupt angularity, and tends to effect a decided increase in the advance and retard of the spark, when the engine is operating at extremely high speeds.

While the form of mechanism herein shown and described constitutes a preferred form of embodiment of the invention, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In ignition systems for combustion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit; means for opening and closing said circuit; and means automatically controlled by the operation of the engine for advancing or retarding the closing and opening of said circuit in accordance with the predetermined power curve of the engine, whereby, for a given engine speed, the degree of advance or retard will be correct for maximum power performance.

2. In an ignition system for combustion or explosion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit having a timing device; means controlled by the operation of the engine for automatically adjusting said timing device to advance and retard the spark in the ignition circuit in accordance with the predetermined power curve of the engine for effecting the adjustment of the timing device by varying increments for equal increments of change of engine speed.

3. In an ignition system for combustion and explosion engines, the combination with an engine, of an ignition system therefor, including a sparking device having a timer capable of adjustment throughout a given range of advance and retard; and means controlled by the operation of the engine for adjusting said timing device, and comprising an element responsive to the operation of the engine, a timer adjusting element and provisions for transmitting motion from the said responsive element to the timer adjusting element is accordance with the predetermined power curve of the engine whereby equal increments of movement of said responsive element will effect varying increments of adjustment of the timer.

4. In an ignition system for combustion or explosion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit having a timing device and a distributing device associated therewith; said timing and distributing device being capable of adjustment throughout a given range of advance and retard; and speed controlled means having provisions acting in accordance with the predetermined power curve of the engine for adjusting said timing and distributing device by varying increments throughout a

given range, upon equal increments of change of speed.

5. In an ignition system for combustion or explosion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit; means for opening and closing said circuit, including a movable element provided with a slot of varying angularity; and means operable in accordance with the speed of the engine associated with said slot for automatically advancing the closing and opening of said circuit different degrees throughout a given range, upon equal increments of movement of the means operable in accordance with the speed of the engine.

6. In an ignition system, for combustion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit; engine actuated means for intermittently opening and closing said circuit, including a rotatable sleeve provided with a slot therein of varying angularity; and means operable in accordance with the speed of the engine, associated with said slot and automatically adjustable to advance said sleeve variable degrees for equal increments of movement of the means operable in accordance with the speed of the engine.

7. In an ignition system for combustion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit; means for opening and closing said circuit to effect sparking impulses; and means controlled by the speed of the engine, having provisions acting in accordance with the predetermined power curve of the engine for advancing and retarding the closing and opening of said circuit varying increments throughout a given range, upon equal increments of change of speed.

8. In an ignition system for combustion or explosion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit; means for creating sparking impulses in said circuit; and means controlled automatically by speed of the engine for advancing and retarding the creation of the sparking impulses in the sparking circuit, in accordance with the predetermined power curve of the engine, whereby for a given engine speed, the timing of said impulses will be correct for maximum power performance.

9. In an ignition system for combustion engines, the combination with an engine, of an ignition system therefor, including a sparking circuit; means for opening and closing said circuit, including an adjustable element provided with a slot of varying angularity, the variation in the angularity of said slot being in accordance with the power curve of the engine; and means associated with said slot and adapted to operate in accordance with the speed of the engine, for advancing the closing and opening of said circuit different degrees throughout a given range upon equal increments of movement of the means actuated in accordance with the speed of the engine.

10. In an ignition system for internal combustion engines, the combination with an engine, of an ignition system therefor, including a sparking device having a timer capable of adjustment throughout a given range of advance and retard; and means controlled by the speed of the engine for automatically adjusting the timer, said means comprising a speed responsive element, a timer adjusting element and provisions for transmitting motion between said elements including a member having a camming surface formed in accordance with the predetermined power curve of the engine, whereby, for a given speed, the adjustment of the timer will be correct for maximum power performance.

In testimony whereof I affix my signature in the presence of two subscribing witnesses.

CHARLES F. KETTERING.

Witnesses:
J. W. McDONALD,
O. D. MOWRY.