

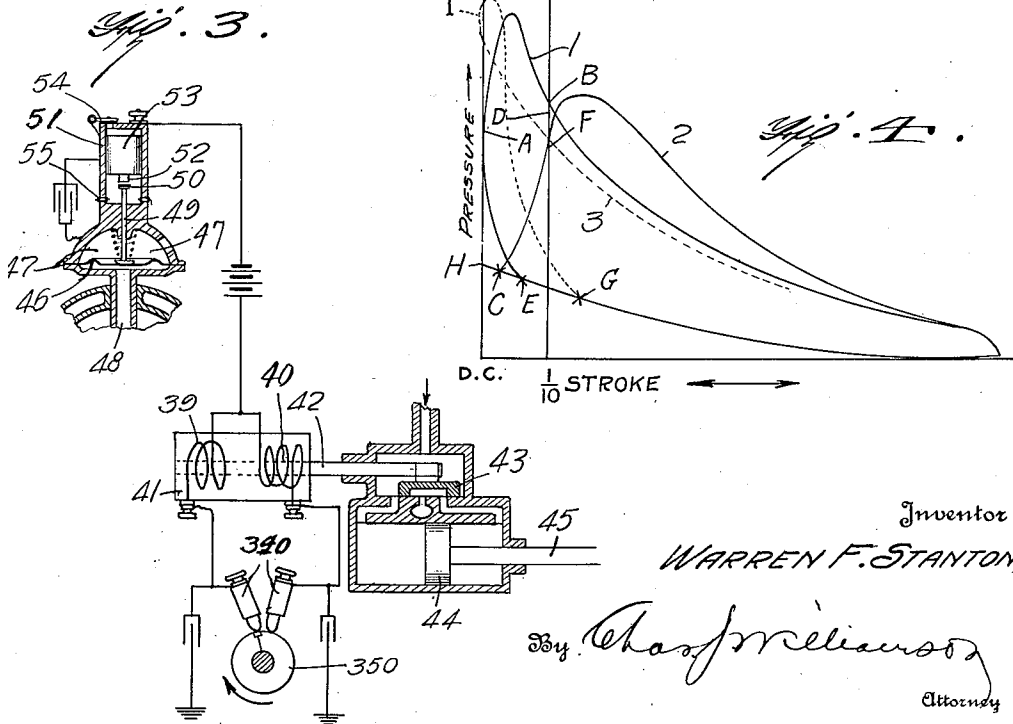
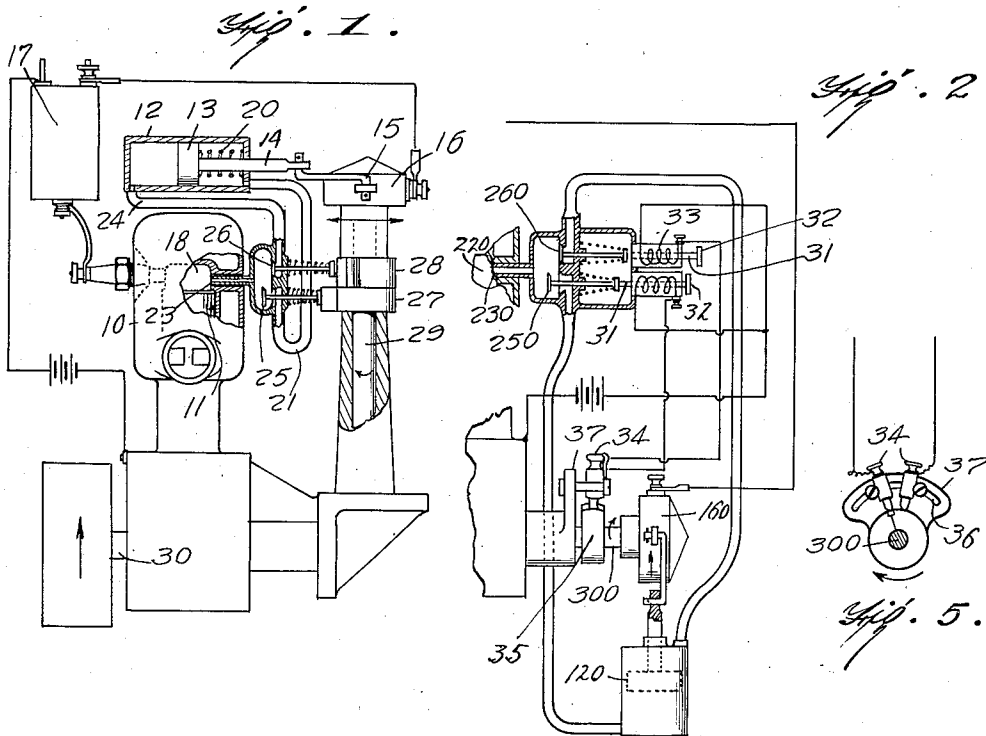
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INTERNAL COMBUSTION AND OTHER ENGINE

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INTERNAL COMBUSTION AND OTHER ENGINE

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Broadly stated the object of my invention is to utilize the conditions existing in an engine cylinder at different points of the piston stroke to control automatically factors which enter into the operation of the engine to the end that the highest efficiency thereof may be promoted and the necessity of hand adjustment by the engine operator may be eliminated. It will be enough to illustrate my object to consider as one embodiment of my invention the case of an internal combustion engine and the utilization of the pressures within the cylinder at different points of the stroke of the piston to control or adjust automatically the ignition, and I illustrate such an application of my invention in the drawings and will describe the same hereinafter in detail, thus complying with the requirement of the statute that there be at least one exemplification of the invention which forms the subject of Letters Patent. My invention consists in whatever is described by or is included within the terms or scope of the appended claims, for what is shown in the drawings and will be described is merely an illustration or exemplification thereof and not a restriction beyond the legal requirements of such claims.

In the accompanying drawings:

Fig. 1 is a view partly in side elevation and partly in section of a two-cycle internal combustion engine embodying my invention;

Figs. 2 and 3 are respectively similar views of other embodiments of my invention;

Fig. 4 is a card or graph that illustrates the operation and effect of my invention in the case of an internal combustion engine;

Fig. 5 is a detail view of a brush adjustment for the commutator of Figs. 2 and 3.

Referring first to what is shown in Fig. 1, the internal combustion engine shown is a two-cycle engine having a cylinder, 10, and piston, 11, means being provided as hereinafter explained in detail to establish pressure communication between the combustion chamber of the engine and a piston in a cylinder so that the piston will be moved in one direction or the other according to the pressures in the combustion chamber and its movement utilized to operate the timer of the igni-

tion system so as to shift the time of ignition of the explosive charge, advancing or retarding the ignition as it may become necessary to bring about or approximate ideal conditions of ignition.

Outside the power cylinder, 10, is mounted a cylinder, 12, within which is a piston, 13, the rod, 14, of which is connected by a link, 15, with the timer, 16, of usual construction which by the movement of the piston, 13, is shifted to advance or retard the ignition by changing the time of closing the circuit through the primary circuit of the spark coil, 17, of the ignition system. Each end of the cylinder, 12, of the control device thus constituted is adapted to be placed in communication with the combustion chamber, 18, of the engine so that there will be an interchange or equalization of gas pressure upon one side of the piston, 13, or the other (according to which end of the cylinder, 12, is placed in communication with the combustion chamber) with the pressure within the combustion chamber, and if the pressure upon opposite sides of the piston, 13, is unbalanced, the piston, 13, will move in the direction of the side where the pressure is lower. A coil spring, 20, within the cylinder, 12, bearing at one end upon the piston, 13, and at the other end upon the adjacent cylinder end acts to move the piston, 13, in the direction to rotate the timer, 16, in the direction to retard the ignition so that when the engine is stopped the timer will be adjusted to retard. From the end of the cylinder, 12, at that side of the piston, 13, on which the spring, 20, is located a pipe, 21, extends to a chamber, 22, which by a passage, 23, is in communication with the combustion chamber, 18, and from the opposite end of the cylinder, 12, a pipe, 24, leads to said chamber, 22. A poppet valve, 25, in the chamber, 22, controls communication between the chamber and the pipe, 21, and a poppet valve, 26, likewise controls communication between the chamber, 22, and the pipe, 24, and these valves are alternately opened and closed by means of cams, 27, and 28, respectively keyed to the timer shaft, 29, which is driven by suitable gearing from the engine crank shaft, 30, so

that the shaft, 29, rotates at the same speed as the crank shaft. The cam, 27, is timed to lift the valve, 25, from its seat by the time the piston, 11, is in the dead center position on the compression stroke so that there occurs an interchange of pressure between the combustion chamber and the cylinder, 12, at the side of the piston, 13, into which the pipe, 21, opens, and at the time the engine piston, 11, has moved from such dead center position through a portion of its power stroke, say one tenth thereof the cam, 28, is timed to lift the valve, 26, from its seat (the valve, 25, having already closed communication between the chamber, 22, and the pipe, 21), and thus interchange of pressure takes place between the combustion chamber and the cylinder, 12, on the opposite side of its piston, 13. It will be seen that the control mechanism valve, 13, will move in one direction or the other according as the pressure within the cylinder, 12, is greater or less on one side of the piston, 13, and the other side thereof. If the ignition is delayed or occurs late after the power stroke movement of the engine piston, 11, begins (during which time communication exists between the combustion chamber and the side of the piston, 13, to which the pipe, 24, leads), the rapid increase in explosion pressure which takes place will result in a superior pressure upon that side of the piston, 13, to the pressure upon the opposite side which resulted from and exists in consequence of the pressure taken at the time the engine piston was in its dead center position and the result will be that the piston, 13, will be moved in the direction to adjust the timer to advance the spark. This is graphically illustrated in Fig. 4 by the graph designated, 2, on which the point designated, C, indicates the belated spark from which point the rapidly ascending curve indicates the explosion pressure. The pressure existing at the dead center position of the engine piston is indicated on the graph at, H, from which point the pressure curve starts and, of course, the pressure drops from that point to the point of ignition at C. The dash or broken lines on Fig. 4 show the pressure curve when the spark is too early, as when it occurs at the point designated, G, which results in the greatest pressure when the engine piston reaches the dead center position and which is designated, I, in Fig. 4, (at which time the valve, 25, is opened and the control mechanism piston, 13, is subjected to pressure through the pipe, 21) the pressure diminishing from the dead center position of the piston so that when one tenth of the power stroke of the piston is completed the pressure is that designated at the point, F, the result being that the valve, 26, being opened at that time there will be less pressure in the cylinder, 12, on the side of the piston, 13, into which the pipe, 24, opens than on the op-

posite side of the piston, 13, and in consequence the timer will be adjusted by the movement of the piston, 13, to retard the spark.

By the automatic change of the point of ignition according to the pressure conditions in the engine cylinder a state of equilibrium is reached when the pressures at the dead center position of the engine piston on its compression stroke and when it traverses one tenth of its power stroke are substantially equal these pressures being designated respectively A and B on the graph or curve designated 1 in Fig. 4, and the time of ignition is at the point designated, E, between the lines on the chart or diaphragm which respectively are designated "pressure" and "1/10th stroke". Maximum pressure thus occurs between the dead center and one tenth stroke positions of the engine piston which assures maximum efficiency. Of course, the portion of the power stroke may be more or less than one tenth for measuring or working the pressures against one another, a shorter distance giving a sharper card and a greater distance giving a flatter card.

It is to be understood that instead of using poppet valves as shown in Fig. 1 alternately to place opposite ends of the control cylinder, 12, in communication with the combustion chamber other types of valves or control devices may be used and instead of being operated by cams such valves may be operated by other devices or mechanisms.

Referring to what is shown in Fig. 2 the control of the valves which provide for the interchange of pressures between the combustion chamber and the cylinder of the control mechanism is accomplished by electrical means, this arrangement having certain advantages, such as a remote location of the control mechanism. In Fig. 2 there is a chamber, 220, connected by a passage, 230, with the combustion chamber of the engine and there are two poppet valves, 250, and, 260, which respectively control pressure communication with opposite ends of the control mechanism cylinder, 120, each of the poppet valves being movable from its seat by the movement of a push rod, 31, attached to an armature, 32, of an electromagnet, 33, in a circuit that includes a brush, 34, for each magnet and a commutator 35, mounted on the crank shaft, 300, of the engine which successively closes the circuit through the brushes. The timer, 160, is mounted on the engine crank shaft and is operated to advance or retard the spark by a connection with the piston, 120, corresponding to what is shown in Fig. 1. To assure the prompt demagnetizing of each magnet upon the breaking of its circuit and thus prevent retardation of seating of the poppet valves, each magnet may have a fine wire reverse winding. Fig. 5 is a detail view in end elevation of the commuta-

tor and brush form of current interrupter of Fig. 2.

Referring to Fig. 5 it will be seen that the brushes, 34, are mounted for adjustment in a slot, 36, in a supporting plate, 37, attached to the engine frame.

It will be seen that the control mechanism of Fig. 2 is so compactly arranged and assembled that the essential parts thereof may well constitute a unit construction.

Referring to what is shown in Fig. 3 the control mechanism is electrically operated by a pair of brushes, 340, and a commutator, 350, similar to that employed in Fig. 2, the brushes, 340, being respectively in circuit with the reversed coils, 39, and, 40, of a solenoid, 41, so that the core, 42, thereof is alternately moved in opposite directions and is connected with the slide valve, 43, of a servomotor, the piston, 44, of which is reciprocated by oil, air or other fluid under pressure controlled by the slide valve, the piston rod, 45, operating the timer or the desired device or mechanism, whatever it may be whose movements are to be automatically controlled or effected. The solenoid, 41, in Fig. 3 performs a function corresponding to that of the cylinder, 12, of Fig. 1.

The reverse coils, 39, and 40, of the solenoid are branches of a circuit that includes a switch mechanism which closes the circuit according to the point of maximum pressure in the engine cylinder and is so related to the closing of the circuit through the brushes, 340, as to determine the direction of movement of the solenoid core, 42, to suit the necessity of advancing or retarding the spark. Thus if the time of maximum pressure in the engine cylinder is at the dead center of the piston on the compression stroke or near it, the current will flow through the coil, 39, only and cause the shifting of the slide valve, 43, to effect the retarding of the spark. When the point of maximum pressure occurs at the completion or near the completion of say one tenth of the power stroke the circuit will be closed through the coil, 40, only and result in the movement of the piston, 44, in the direction to advance the spark. Said switch mechanism comprises a diaphragm, 46, in a chamber, 47, which on one side of the diaphragm through a passage, 48, is in communication with the combustion chamber of the engine and a rod, 49, on the outer side of the diaphragm which terminates in a contact, 50, within a cylinder, 51. The contact, 50, by the upward or outward movement of the diaphragm is moved into contact with a contact or terminal, 52, on a piston, 53, in the cylinder, 51, and the piston, 53, thereby moved upward in the cylinder. The cylinder, 51, has an air vent closed by an outwardly moving valve, 54, that allows the piston to move upward readily under the thrust from the diaphragm but

downward movement of the piston (which may be by gravity or spring pressure) is retarded so that when the diaphragm moves downward the contact, 50, will be withdrawn from the terminal, 52, and thus the circuit between them broken and will continue unbroken during the one tenth power stroke of the engine piston which takes place faster than it is possible for the switch mechanism piston, 53, to descend and place its terminal, 52, in contact with the contact, 50, and thus the circuit being broken to both solenoid coils no movement of the core, 42, will take place but it will remain in the position to which it was shifted by the energizing of the coil, 39. As the condition which results in this action is brought about by the existence of the maximum pressure at or near the dead center position of the power piston and the pressure thereafter diminishes during the power stroke of such piston the lowering of the diaphragm, 46, will ensue as a result of such reduction of pressure during the one tenth of the power stroke. The solenoid circuit from one pole of the battery includes the switch mechanism cylinder, 51, and a ground connection to the engine cylinder and this necessitates the insulation of the cylinder, 51, by an insulating ring, 55, between the cylinder, 51 and the diaphragm chamber.

The arrangement shown in Fig. 3 avoids the necessity of the use of valves in the combustion space or in the presence of the burning gases in the engine cylinder and being electrical has the further advantage of a remote location of the control mechanism.

The electrical controls of Figs. 2 and 3 are provided with a switch so that the current need not flow when the engine is stopped and preferably such switch as actuated by or is a part of the switch mechanism of the ignition system.

It will be seen that when the ideal card or graph designated 1 in Fig. 4 is produced the ignition point remains fixed until the cylinder pressures require a change in the spark and until such time the solenoid circuit remains broken with no current flowing through either coil.

The solenoid core, 42, of course, could be connected with the timer directly as is the piston rod, 14, of the control mechanism shown in Fig. 1.

By taking the cylinder pressures at different positions of the power piston and employing a member which is capable of movement or control as to its position by the differential of such cylinder pressures I am able automatically to change or adjust or modify the engine working conditions in a variety of ways. The ignition may be timed whether the ignition is by spark or otherwise; the timing of valves may be changed, the mixture of the combustible may be changed; anti-

knocking fluids may be supplied, etc. The pressures, however, need not all be taken from the cylinder, but pressure at one point within the cylinder may be taken and the
 5 pressure at the exhaust or inlet manifold may be taken or it may be the atmospheric pressure, or some constant pressure outside the engine cylinder.

The principle of my invention extends to
 10 utilizing differences in temperature by using as a basis of comparison a temperature selected at some desired point in the piston stroke and utilizing the differential of temperature to operate or control means for varying the
 15 cylinder temperature or maintaining it at some desired degree. As is known the temperatures and pressures within an engine cylinder bear a definite relationship to one another.

20 What I claim is:

1. The combination of a power producing engine having a power cylinder and a piston, pressure operated means, means to cause the
 25 operation of said pressure operated means by the differential of two pressures within the cylinder one of which pressures is obtained from the engine cylinder at a predetermined point in the travel of the engine piston, and means to utilize movement of said pressure
 30 operated means for some purpose in the operation of the engine.

2. The combination of an engine having a cylinder and a piston, pressure operated means, means to subject the latter to oppositely acting pressures existing in the cylinder
 35 at different points in the travel of the piston, and means to utilize the action of said pressure operated means for some purpose useful in the operation of the engine.

3. The combination of an internal combustion engine having a cylinder and a piston and igniting means, a pressure operated means connected with the ignition means to regulate the same and means for the transfer
 45 of pressure between said pressure operated means and the engine cylinder at different points in the travel of the engine piston.

4. The combination of a power producing engine having a power cylinder and a piston, a pressure-operated means subjected to pressure within the cylinder at different
 50 points in the travel of the piston and means for utilizing the action of said pressure operated means for a purpose useful in the running of said engine.

5. The combination of a power producing engine having a power cylinder and a piston, pressure-operated means, means to cause the
 60 operation of said pressure operated means by the differential of two pressures within the cylinder one of which pressures is obtained from the engine cylinder at a predetermined point in the travel of the engine piston, and
 65 means to utilize movement of said pressure

operated means for some purpose useful in the operation of the engine.

6. The combination of a power producing engine having a power cylinder and a piston, pressure-operated means, means to subject the
 70 latter to oppositely acting pressures existing in the cylinder at different points in the travel of the piston, and means to utilize the action of said pressure operated means for some purpose useful in the operation of the engine.

7. Means for regulating ignition of the charge of an internal combustion engine comprising pressure-operated means having a to and fro moving member, means to place the
 80 opposite sides of such member in communication with the engine cylinder comprising successively acting control devices, and means to actuate the latter at different points in the travel of the engine piston in its cylinder.

8. Means for regulating ignition of the
 85 charge of an internal combustion engine comprising pressure-operated means having a to and fro moving member, passages leading from the engine cylinder to opposite sides of said member, valve means to open and close
 90 such passages in succession, and means to actuate said valve means at different points in the travel of the engine piston in its cylinder.

9. The combination of a power producing engine having a power cylinder and a piston, and a member having an action essential to the engine operation and whose appointed
 95 action should be varied according to the engine requirements, and means for causing such variation in action, acted upon by the differential of two similar conditions, at least one of which is a condition in said power cylinder at a predetermined point in the travel
 100 of the piston.

10. The combination of a power producing engine having a power cylinder and a piston, pressure-operated means and means to subject the latter to the differential of two pressures
 105 within the cylinder, one such pressures being obtained from the engine cylinder at a predetermined point in the travel of the engine piston, and means to utilize movement of said pressure-operated means.

In testimony whereof I hereunto affix my
 115 signature.

WARREN F. STANTON.

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