

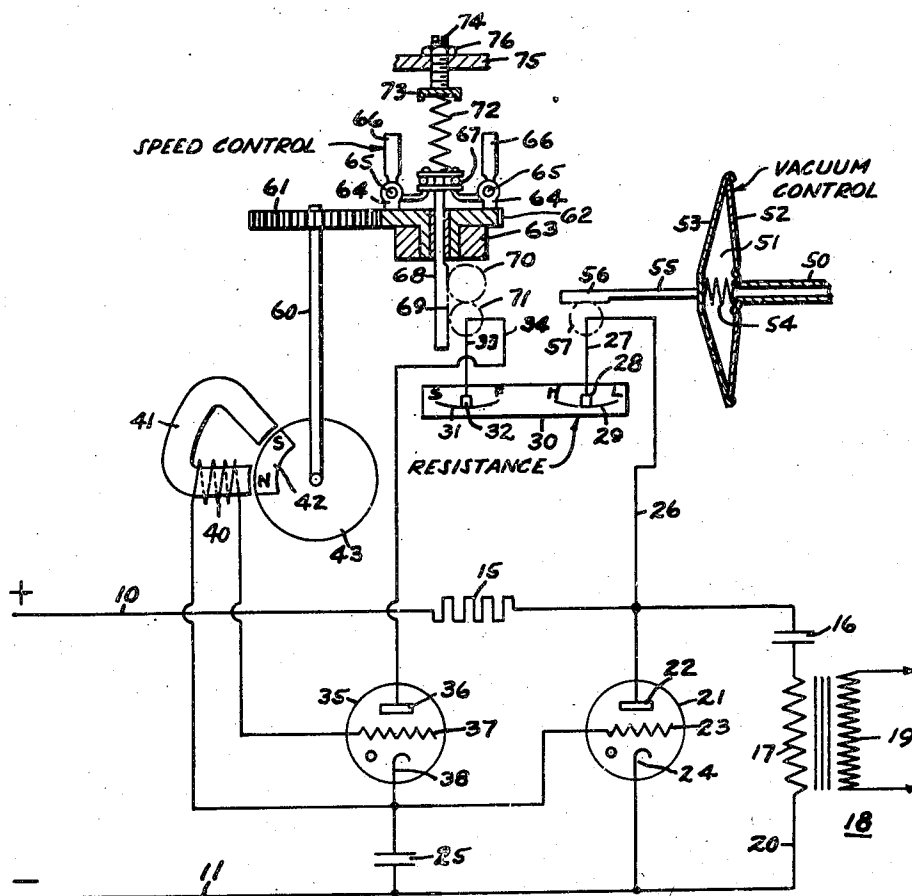
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IGNITION SYSTEM

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IGNITION SYSTEM

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This invention relates to ignition systems for internal combustion engines, particularly the type of system in which ignition energy is provided by the discharging of a condenser which is charged by a suitable current source. The discharge of the condenser is under control by thyatron which is normally nonconducting but which becomes conducting when an auxiliary condenser discharges through the grid of the thyatron. In the copending application of Short and Tynan, Serial No. 611,402, filed August 18, 1945, now Patent No. 2,463,123, issued March 1, 1949, there is disclosed an engine driven ignition timer for controlling the discharge of the auxiliary condenser to the grid of the thyatron. The variations in ignition timing in response to engine operating conditions, such as speed and load, would be effected by the use of a conventional timer having speed responsive means for varying angular relation of the timer cam and the engine driven shaft which drives it and having means responsive to manifold vacuum for varying the position of the circuit breaker lever relative to the timer cam.

An object of the present invention is to provide means under the control of the engine and effected by variations in speed and engine load for varying the timing of the ignition in a system of the type referred to but without resorting to the use of a timer having make and break contacts. In the disclosed embodiment of the invention, this object is accomplished by the use of a pick-up coil in which a voltage is induced by a permanent magnet driven by the engine. The pick-up coil is located far enough in advance of top dead center to take care of all possible advance requirements. The energization of the pick-up coil determines the beginning of the charging of the auxiliary condenser. The variations in the ignition timing are effected by varying the extent of the time required to bring the auxiliary condenser up to such state of charge that it has sufficient potential to render the thyatron conducting. The variation of the extent of time for charging the auxiliary condenser up to the required potential is effected by variable resistance under joint control by speed responsive means and by engine load responsive means, such as engine intake vacuum.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred embodiment of the present invention is clearly shown.

The figure of the drawing is a diagram of an embodiment of the invention.

In the drawing, power supplying wires are designated by numerals 10 and 11. Wire 10 is connected through resistance 15 with a main condenser or capacitor 16 and the primary 17 of an ignition coil 18 having a secondary 19 which is connected with an ignition distributor, not shown. Wire 20 connects primary 17 with wire 11. Thus, the main condenser 16 is charged. The discharge of the main condenser 16 is withheld by thyatron 21, filled preferably with hydrogen and having a plate 22, a grid 23 and a cathode 24 having a heater, not shown. Grid 23 is connected with an auxiliary condenser or capacitor 25 connected with wire 11. Wire 26 is connected with wire 10 and with an arm 27 carrying a contact or wiper 28 moving as indicated by arc 29 upon the face of a resistance bar 30. Bar 30 is contacted by another wiper 32 moving in the path of arc 31 and carried by an arm 33 connected with a wire 34 which is connected to the plate 36 of a thyatron 35 also filled with hydrogen. Thyatron 35 has a grid 37 and a cathode 38 having a heater, not shown. Grid 37 and cathode 38 are connected with a pick-up coil 40 surrounding one leg of a U-shaped core 41, the poles of which face toward a permanent magnet bar 42 carried by a disc such as the flywheel 43 driven by the engine. The parts 40, 41 and 42 constitute an engine operated magneto generator. The number of magnets 42 depends on the number of cylinders of the engine. For example, in a four-cycle engine having eight cylinders, the flywheel would carry four magnets 42. The location of the core 41, and hence the pick-up coil 40, is located far enough in advance of top dead center to take care of all possible advance requirements of the timing ignition.

The operation of the system is as follows: During the rotation of the disc 43 the capacitor 16 is charged through the resistor 15 to full voltage and the capacitor 25 is uncharged before the magnet segment is in alignment with pick-up coil core 41. When the magnet segment 42 is in alignment with the pick-up core 41, a voltage is generated in winding 40 that is applied to the grid 37 of the thyatron tube 35 and causes the tube to be conducting. At this instant the condenser or capacitor 25 is then charged through the resistance of bar element 30 and through the plate 36 and cathode 38 of thyatron tube 35, at a rate determined by the resistance of the element 30. When the voltage across the con-

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condenser reaches a critical value for firing the grid 23 of the thyatron tube 21, the tube becomes ionized and the condenser or capacitor 16 discharges through the plate 22 to cathode 24 of tube 21 and then through primary 17 of ignition coil 18. This discharge is stepped up in the secondary 19 to ignition magnitude. The capacitor continues to discharge until its voltage drops to a very low value, thus allowing both thyatron tubes 35, 21 to delonize as the capacitor 25 was discharged by the grid 23 at the time of its ionization. Following this series of conditions the capacitor 16 is again charged through the resistance 15 and the entire circuit is again conditioned for the next impulse. Since the pick-up coil 40 causes the thyatron 35 to be conducting at the same instant or instants during each revolution, it is apparent that the beginning of the charging of the condenser 25 will not vary with respect to the angular position of the flywheel 43. The variation in the ignition timing is dependent upon the time required to so charge the condenser 25 that the potential as applied to the grid 23 is sufficient to cause the thyatron 35 to become conducting. The time of the conducting of condenser 25 depends on the relative position of the wipers 28 and 32. When these wipers are close together the time for charging the condenser 25 with the required potential will be less than when the wipers are further apart.

Wiper 28 is under control by engine intake vacuum which is communicated through pipe 50 to a chamber 51 closed by a fixed wall 52 and a diaphragm 53 urged away from the fixed wall by a spring 54. Diaphragm 53 is connected with a rod 55 having a rack 56 meshing with a gear 57 which carries the wiper arm 27. When intake vacuum is high, wiper will move toward position H and when intake vacuum is low, wiper will move toward position L.

Wiper 32 is under control by engine speed. For this purpose an engine driven shaft 60 is connected by a gear 61 with a gear 62 journaled in a bearing 63 and carrying lugs 64 carrying pins 65 pivotally supporting weighted bell crank levers 66. Levers 66 engage the under race of a thrust bearing 67, the upper race of which is connected with a rod 68 having a rack 69 meshing with a gear 70 meshing with a gear 71 which carries the arm 33. Centrifugal force affecting levers 66 is opposed by spring 72 confined between the upper end of rod 68 and a retainer cup 73 which can be adjusted vertically by screw 74 threaded through a stationary part 75 and retained in desired position by lock nut 76. As engine speed increases the weighted levers 66 move out and upwardly to cause rack 69 to move upwardly, thereby effecting clockwise rotation of the gear 70 and counterclockwise rotation of gear 71. Therefore, as engine speed increases, wiper 32 moves toward position F; and, when engine speed decreases, it moves toward position S. When engine speed is high, engine load is relatively low, the wipers 32 and 28 will be located, respectively, near the F and H marks. Since the amount of resistance included between the wiper is relatively low, the time required for rise in potential of the condenser 25 to that required for rendering the thyatron conducting will be relatively short, and the timing of the ignition will be advanced. When the speed is low and the engine load is high, the wipers will be nearer to S and L, respectively. Hence the effective value of the resistance 30 will be higher, and the time required for raising the potential of

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the condenser 25 to the critical value will be longer. Therefore, the timing of the ignition will be retarded. The apparatus responds to various combinations of speed and load to vary the time of increase of voltage of condenser 25 to the value required to render the thyatron conducting. Hence the timing of ignition is advanced or retarded to suit engine operating conditions.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, 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. Ignition apparatus for internal combustion engines comprising an ignition coil, a current source, a main condenser charged thereby, a thyatron for withholding discharge of the main condenser to the coil until the desired instant of ignition, an auxiliary condenser connected with the grid of the thyatron to cause the thyatron to become conducting when the auxiliary condenser attains a potential sufficient for discharge to said grid, means controlled by the engine for effecting a connection between the current source and the auxiliary condenser, a variable resistance in the charging circuit of the auxiliary condenser, and means responsive to engine operating conditions for controlling the variable resistance.

2. Ignition apparatus for internal combustion engines comprising an ignition coil, a current source, a main condenser charged thereby, a thyatron for withholding discharge of the main condenser to the coil until the desired instant of ignition, an auxiliary condenser connected with the grid of the thyatron to cause the thyatron to become conducting when the auxiliary condenser attains a potential sufficient for discharge to said grid, means controlled by the engine for effecting a connection between the current source and the auxiliary condenser, a variable resistance in the charging circuit of the auxiliary condenser, and means responsive to engine speed for controlling the variable resistance to lower the resistance in the charging circuit of the auxiliary condenser as speed increases.

3. Ignition apparatus for internal combustion engines comprising an ignition coil, a current source, a main condenser charged thereby, a thyatron for withholding discharge of the main condenser to the coil until the desired instant of ignition, an auxiliary condenser connected with the grid of the thyatron to cause the thyatron to become conducting when the auxiliary condenser attains a potential sufficient for discharge to said grid, means controlled by the engine for effecting a connection between the current source and the auxiliary condenser, a variable resistance in the charging circuit of the auxiliary condenser, and means responsive to engine intake suction for controlling the variable resistance to lower the resistance in the charging circuit of the auxiliary condenser as intake suction increases.

4. Ignition apparatus for internal combustion engines comprising an ignition coil, a current source, a main condenser charged thereby, a thyatron for withholding discharge of the main condenser to the coil until the desired instant of ignition, an auxiliary condenser connected with the grid of the thyatron to cause the thyatron to become conducting when the auxiliary condenser attains a potential sufficient for discharge to said grid, means controlled by the engine for

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effecting a connection between the current source and the auxiliary condenser, a resistance element in the charging circuit of the auxiliary condenser, two wipers for traversing the element, means for controlling the position of one of the wipers in accordance with engine speed, and means for controlling the position of the other wiper in accordance with engine intake suction.

5. Ignition apparatus for internal combustion engines comprising an ignition coil, a current source, a main condenser charged thereby, a thyatron for withholding discharge of the main condenser to the coil until the desired instant of ignition, an auxiliary condenser connected with the grid of the thyatron to cause the thyatron to become conducting when the auxiliary condenser attains a potential sufficient for discharge to said grid, a circuit for connecting the auxiliary condenser with the current source and including a second thyatron and a variable resistance, a magneto generator operated by the engine and having a coil connected with the grid of the second thyatron to render said thyatron conducting whereby the charging of the auxiliary condenser begins at a certain instant in the operation of the engine, and means responsive to engine operating conditions for controlling the variable resistance in order to vary the duration of potential increase at the auxiliary condenser to a value sufficient to cause the first thyatron to become conducting.

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6. Ignition apparatus for internal combustion engines comprising an ignition coil, a current source, a main condenser charged thereby, an auxiliary condenser, means rendered effective to connect the main condenser with the ignition coil for discharge of said condenser when the potential at the auxiliary condenser attains a certain value, a circuit for connecting the auxiliary condenser with the current source and including a thyatron and a variable resistance, a magneto generator operated by the engine and having a coil connected with the grid of the thyatron to cause it to become conducting at a certain instant in the operation of the engine, and means responsive to engine operating conditions for controlling the variable resistance in order to vary the duration of potential increase at the auxiliary condenser to a value sufficient to cause said means to establish a discharge circuit for the main condenser through the ignition coil.

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