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IGNITION SYSTEM

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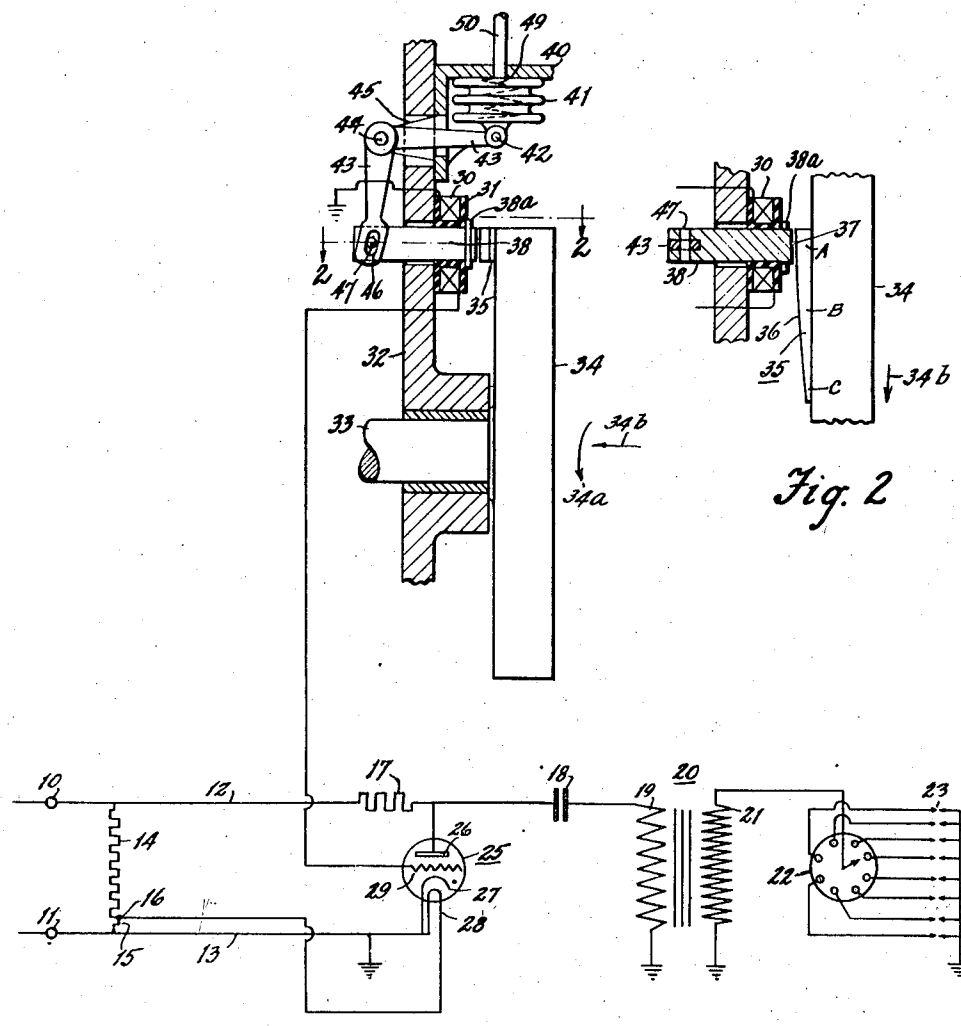


Fig. 2

Fig. 1

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IGNITION SYSTEM

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1 Claim. (Cl. 123—148)

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This invention relates to ignition apparatus for internal combustion engines and particularly to apparatus such as disclosed in the copending application of Short and Tynan, Serial No. 611,402, filed August 18, 1945. That application discloses the supplying of energy for ignition purposes by the discharge of a condenser which is charged by a power source, the discharge being withheld until the required instant of ignition by a thyratron under control by an ignition timer or periodic circuit make and break device driven by the engine. In such cases, the variations in the timing of the ignition in response to variations in engine speed and engine load would be effected by the use of a timer having speed responsive means for varying angular relation between the ignition timer cam and the engine driven shaft which drives the cam and means responsive to engine intake suction for varying the angular relation between the circuit breaker lever and the cam.

An object of the present invention is to control the thyratron by means other than that which requires the use of a circuit breaker. This object is accomplished in the disclosed embodiment of the invention by the use of a pick-up coil connected with a grid of the thyratron and threaded by magnetic flux produced by a permanent magnet attached to the engine flywheel or other rotating part driven by the engine. Since the voltage generated in the pick-up coil is a function of speed and flux, the surface of the permanent magnet which is presented as a pole piece surrounded by the pick-up coil is so shaped that the timing of the ignition can be varied according to engine speed. The pole piece is moved toward or away from the permanent magnet in response to variations in engine load as indicated by variations in engine intake suction.

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.

In the drawing:

Fig. 1 is a diagram of a form of the invention.

Fig. 2 is a fragmentary view, partly in section, on the line 2—2 of Fig. 1.

Referring to Fig. 1, numerals 10 and 11 are terminals connected with a current source and with wires 12 and 13 between which there is located a potentiometer or voltage divider comprising resistances 14 and 15 connected by tap 16. Wire 12 is connected through a resistance 17 with a condenser 18 connected with the primary

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winding 19 of an ignition coil 20 having a secondary winding 21 connected with a distributor 22 connected with the various spark plugs 23 of the engine. The discharging of the condenser 18 for the purpose of supplying energy to the coil 20 for ignition purposes is under control by a thyratron 25 (preferably filled with hydrogen) whose plate 26 is connected with wire 12 whose cathode 27 is connected with wire 13. Cathode heater 28 is connected between wire 13 and tap 16.

Tube 25 is tripped by the action of a magneto generator driven by the engine. For this purpose the magneto includes a pick-up coil 30 connected with the grid 29 of tube 25. Coil 30 is wound upon a spool 31 attached to the frame 32 of an engine having a shaft 33 which drives a flywheel 34 in the direction of arrow 34a when viewed in the direction of arrow 34b. Flywheel 34 carries a permanent magnet 35 having a surface 36 of suitable contour for a purpose to be explained. In case of an 8-cylinder 4-cycle engine there would be four magnets 35 spaced around the flywheel. These magnets 35 move successively past the pole face 37 of a magnetizable core 38 forming a part of the magnetic path which includes the magnetizable frame 32 and flywheel 34. Each time a magnet 35 moves past the pole face 37 a voltage is generated in the coil 30 sufficient to render the thyratron 25 conducting when the voltage of the pick-up coil has increased to the required value.

The voltage generated in the pick-up coil is a function of speed and flux. Therefore, in order to generate in the pick-up coil a voltage sufficient to trip the thyratron at lowest speed, the flux density at the gap between the magnet 35 and the pole face 37 must be the greatest. As speed increases the flux density may diminish. The surface 36 of the magnet is shaped to provide air gap varying with speed. At low speed, the required air gap is obtained when portion A of the magnet 35 is adjacent pole face 37. At medium speed sufficient voltage to trip the thyratron would be generated when portion B of the magnet 35 is adjacent the pole face 37. At high speed, the air gap which occurs when portion C is adjacent the pole face 37. Since C is ahead of B and B is ahead of A in the direction of rotation as indicated by arrow 34b, it is apparent that ignition timing will be advanced at high speed and retarded at low speed.

In order to provide for control of ignition timing in response to variations in load, the core 38 is caused to move axially by means responsive to engine intake suction. For this purpose there is

provided a bracket 40 supporting a flexible metal bellows 41, the lower end of which is connected by pin 42 with a bell crank lever 43 pivoted at 44 upon a bracket 45 integral with the bracket 40. Lever 43 has a slot 46 receiving a pin 47 carried by the pole piece 38. Within the bellows 41 there is located a spring 49 tending to expand the bellows and cause the core 38 to move toward the left until a stop 38a thereof engages spool 31. This establishes a maximum distance between the pole face 37 and the face 36 of magnet 35. The interior of bellows 41 is connected by pipe 50 with the engine intake manifold.

When engine suction is relatively low, due to wide opening of the throttle for full load operation, the spring 49 will be permitted to locate the core 38 as shown. When the engine operates at partial load as when driving on a level road, the bellows 41 would be somewhat collapsed and the pole face 37 would be moved toward the right from the position shown. Consequently ignition would occur earlier than when the engine operates at full load, the speed remaining the same. At high speed and part load the timing of ignition would occur earlier than at high speed, full load. At low speed the timing of the ignition would be earlier at part load than at full load. At low speed and full load a greater amount of retard would be provided since the thyratron would not be tripped until part A of the magnet is adjacent the pole face 37 of core 38.

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 claim which follows.

What is claimed is as follows:

Ignition apparatus comprising an ignition coil having a secondary winding for connection with a spark gap and having a primary winding, a condenser connected with the primary winding and charged by a current source, means responsive to a certain voltage to provide for the discharge of the condenser at the required instant of ignition and a magneto generator having a pick-up coil providing a voltage for said means, a core surrounded by the coil and having a pole face and a permanent magnet moved by the engine past the pole face and presenting to the pole face a surface of such contour as to provide an air gap of varying width, a portion of the magnet which provides a wider air gap being ahead, in direction of movement of the magnet, of a portion of the magnet which provides a narrow air gap whereby the timing of ignition is advanced or retarded as engine speed increases or decreases and means for moving the core toward the magnet as engine intake suction increases.

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