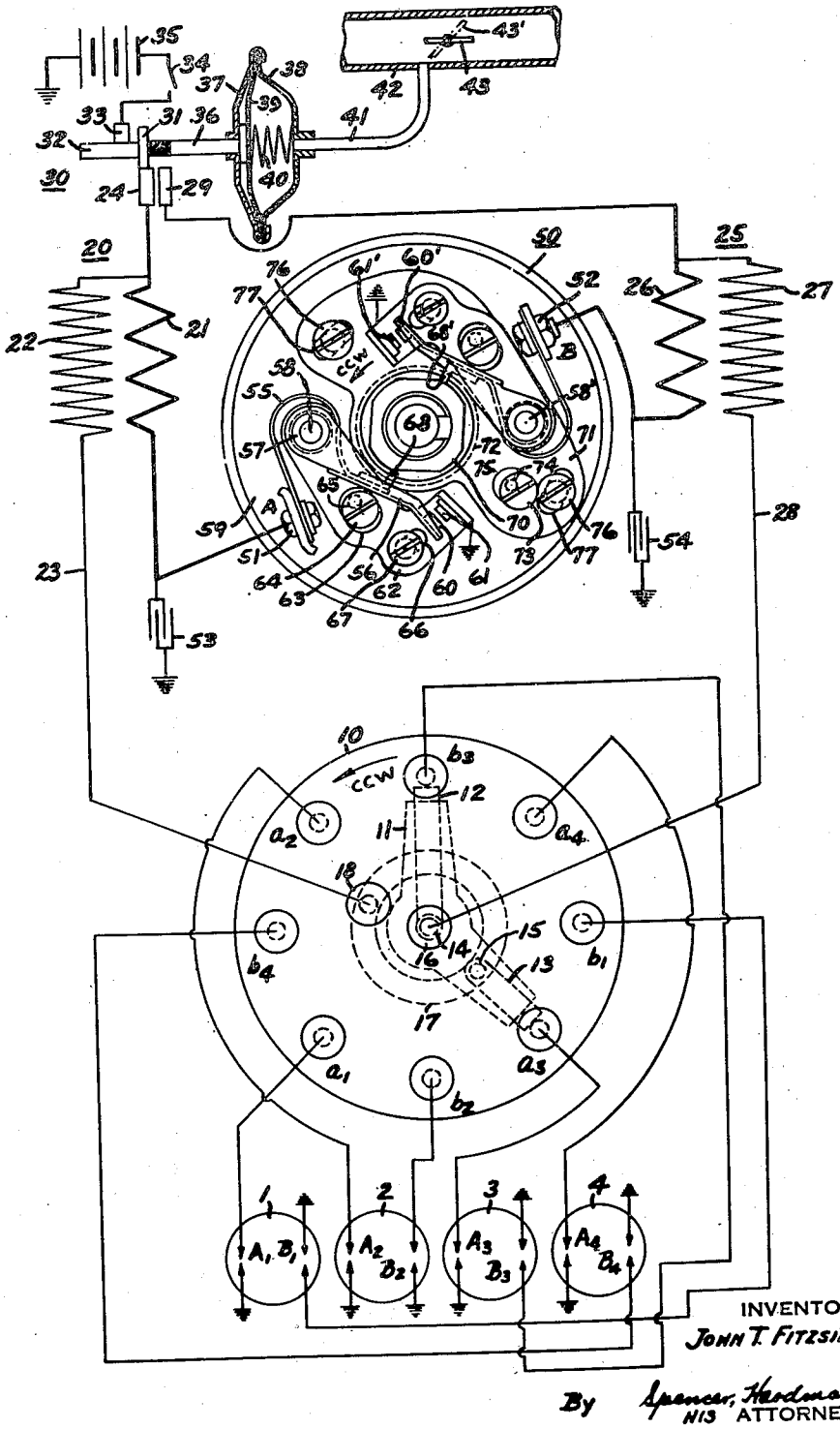
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IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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This invention relates to ignition systems for internal combustion engines and it aims to provide a dual ignition system, one system providing for part-load operation and the other for full-load operation, said dual system having means responsive to load conditions for selecting the system which is operative.

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

The drawing is a wiring diagram illustrating an embodiment of the invention.

In the drawing, the cylinders of the engine are represented by the circles 1, 2, 3 and 4 or a larger number of cylinders, if desired. Each cylinder has two spark plugs designated by A1, B1, etc. The A plugs are placed in the combustion chamber at a point most advantageous for combustion of the fuel for full-load operation and the B plugs are placed in the best position for part-load operation. It may be advantageous in some engines when operating at high speeds on wide open throttle to have the plugs set closer than for low speed operation. Hence the gaps of the A plugs are closer than the gaps of the B plugs as shown. The distributor 10 has distributor posts or terminals which are marked respectively *a1*, *b1*, etc., corresponding to the spark plugs with which they are respectively connected as shown. Distribution is effected by a rotor comprising a block 11 driven by the engine and carrying two distributor bars 12 and 13, having respectively contact buttons 14 and 15 which engage respectively terminal 16 and a metal ring 17 connected with a terminal 18.

The system provides two ignition coils 20 and 25 having respectively primary windings 21 and 26 and secondary windings 22 and 27. The secondary windings 22 and 27 are connected respectively by wires 23 and 28 with the terminals 18 and 16. The primary windings are connected respectively with contacts 24 and 29 forming a part of an automatic switch 30 having a movable contact 31 engageable with contacts 24 and 29 and a contact 32 connected with 31 and engageable with a brush 33. Brush 33 is connected by a hand control switch 34 with a battery 35. Contacts 31 and 32 are insulatingly supported by a rod 36 supported for a sliding movement by a diaphragm case member 37 having its edge formed around a case 38 and the edge of a diaphragm 39 which is urged toward the left by a spring 40. The space between the case 38 and the diaphragm 39 is connected by pipe 41 with the engine intake 42 on the engine side of the butterfly throttle valve 43.

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The ignition timer 50 provides terminals 51 and 52 connected respectively with ignition coil primaries 21 and 26 and with condensers 53 and 54. Terminal 51, which is insulatingly supported, is connected by a leaf spring 55 connected with a circuit breaker lever 56 having a non-conducting hub 57 pivotally supported by post 58 supported by the circuit breaker plate 59. Lever 56 carries a contact 60 for engaging a grounded contact 61 carried by contact bracket 62 pivoted upon the stud or post 58 and insulated from the lever 56. Bracket 62 provides a slot 63 receiving a disc 64 provided with a screw drive blade receiving slot and with an eccentric shank 65 pivoted in the plate 59. Bracket 62 is provided with an arcuate slot 66 whose center curvature is the axis of the post 58. Slots 66 receive the threaded shank of a screw 67. Circuit breaker lever 56 carries a non-conducting rubbing block or cam follower 68 engageable with a cam 70 connected with distributor rotor 11 and driven by the engine. When the screw 67 is loosened, the eccentrically supported disc 64 may be turned by a screw driver in order to change the distance between the rubbing block 68 and the axis of cam 70, while the relation of the contacts 60 and 61 remains unchanged. This adjustment is made to compensate for wear of the contacts and for wear of the rubbing block 68.

The other circuit breaker, which is connected with terminal 52, also insulated from the plate 59, is substantially the same as the circuit breaker connected with terminal 51. Its parts are designated with the same reference numerals but with a prime affixed. The breaker lever pivot stud 58' however is not supported directly by the plate 59 but is attached to an auxiliary circuit breaker plate 71 which is supported by plate 59 for adjustment about the axis of the cam 70. For this purpose plate 71 is provided with a flange 72 providing a journal which is received within a hole provided by plate 59 concentric with the axis of cam 70. The adjustment is made preferably by turning a slotted disc 73 having an eccentric shank 74 pivotally supported by plate 71, the disc 73 being received by slot 75 provided in plate 71 and located radially of the cam axis.

The plate 71 is secured in adjusted position by tightening screws 76, each of which passes through an arcuate slot 77 (through center of curvature being through axis of cam 70) and threadedly engaging the plate 59. The purpose of the adjustment is to vary the angular relation of the rubbing blocks 68 and 68' so that the timing effected by

the two circuit breakers may be the same or may be different to suit the requirements of the engine with which it is used; for example, it may be desirable that for part-load operation, the timing of the ignition be earlier than for full-load operation. The diagram shows the arrangement for counterclockwise rotation as indicated by the arrows *ccw*. The adjustment of breaker plate **71** is such that rubbing block **68'** would be engaged by cam **70** slightly in advance of its engagement with block **68**. Therefore, the timing for the B plugs would be earlier than the timing for the A plugs. This may be desirable in certain types of engine where for part-load operation the timing should be earlier than for full-load operation.

The drawing shows the switch **30** in condition for full-load operation with the throttle valve **43** wide open. Under full-load conditions, the suction in pipe **42** is low, hence, the spring **40** is able to maintain the diaphragm **39** in the position shown. For part-load operation with the throttle valve **43'**, the suction on the engine side of the throttle valve increases. Therefore the suction to the right of diaphragm **39** is sufficient to overcome the spring **40** and cause the diaphragm to move right and hence the contact **31** to move right into engagement with the contact **29**. The contact **31** is wide enough to bridge the gap between contacts **24** and **29** so that at no time will the engine be without ignition during the change from full-load status to part-load status.

From the aforegoing description, it is apparent that the present invention provides an ignition system for part-load operation and an ignition system for full-load operation and means responsive to load conditions for selecting that system which will give the best performance under the particular load conditions. One feature of the system is to avoid detonation with wide open throttle operation. It is believed that, by placing the A plugs near the exhaust valves, detonation can be prevented because combustion starts on the hotter side of the combustion chamber and progresses toward the cooler side where an intake valve is located. The fuel mixture, being cooler on the intake valve side of the combustion chamber, retards combustion so that it is less likely that such high temperatures of combustion will be reached that detonation will occur. For part-load operation, satisfactory ignition is obtained by placing the B plugs near the intake valves. Concerning the width of spark plug gaps, it is believed that wider gaps for part-throttle operation are satisfactory because the fuel mixture is thinner, and that narrower gaps for wide open throttle operation are satisfactory because the fuel mixture is denser.

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. The combination with an internal combustion engine provided with two spark plugs in each cylinder thereof; a current source; an ignition system including a set of spark plugs for full-load operation of the engine; an ignition system including a set of spark plugs for part-load operation of the engine; a switch interposed in the circuit of both systems and including a common movable contact connected with the source and a pair of stationary contacts, one for each system; and engine suction operated means including the movable contact and operable to change the position thereof for rendering one or both of the ignition systems operative in accordance with the load requirements of the engine.

2. The combination with an internal combustion engine provided with two spark plugs in each cylinder thereof; a current source; an ignition system including a set of spark plugs placed in the combustion chamber at a point most advantageous for combustion of fuel for full-load operation; an ignition system including a set of spark plugs placed in the best position in the combustion chamber for part-load operation; a switch interposed in the circuit of both systems and including a common movable contact connected with the source and a pair of stationary contacts, one for each system; and engine suction operated means including the movable contact and operable to change the position thereof for rendering one or both of the ignition systems operative in accordance with the load requirements of the engine.

3. The combination with an internal combustion engine provided with a plurality of spark plugs in each cylinder thereof; a current source; a plurality of ignition systems, one of said ignition systems including a set of spark plugs for full-load operation of the engine while another system includes a set of spark plugs for part-load operation of the engine; a switch interposed in the circuit of all systems and including a common movable contact and a plurality of spaced stationary contacts one for each system; and engine suction operated means including the movable contact for rendering one or both of the ignition systems operative in accordance with the load requirement of the engine, said movable contact capable of bridging all of the stationary contacts when same is moved from one position to another so that at no time will the engine be without ignition during the movements of the movable contact.

4. The combination with an internal combustion engine provided with two spark plugs in each cylinder thereof; a current source; an ignition system including a set of spark plugs for full-load operation of the engine; an ignition system including a set of spark plugs for part-load operation of the engine; a plurality of terminals, one for the current source and one for each ignition system; and a suction operated means including a common movable contact for all the terminals, said means normally arranging the movable contact to bridge the terminals to close a circuit through the first mentioned ignition system and operable for bridging all the terminals to connect both of the ignition systems at part-load operation of the engine.

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