

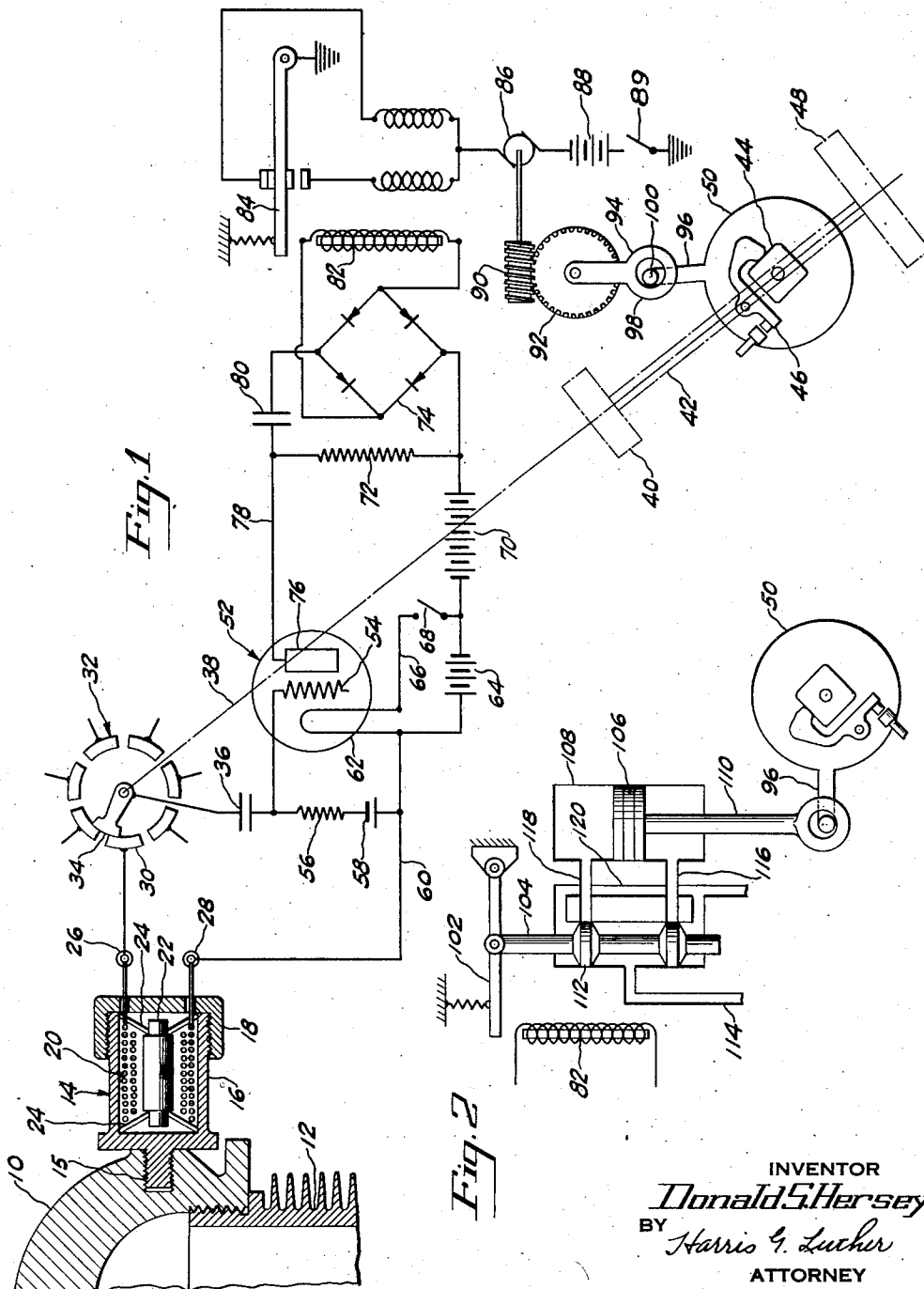
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ENGINE IGNITION CONTROL MEANS

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ENGINE IGNITION CONTROL MEANS

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This invention relates to improvements in engine ignition control means and has for an object the provision of improved spark timing control means for preventing detonation of the explosive charges in the engine cylinders.

A further object resides in the provision of an improved engine ignition control means which is sensitive directly to detonation of the engine fuel charges and is operative to maintain the engine spark timing just under the detonation point.

Other objects and advantages will be more particularly pointed out hereinafter or will become apparent as the description proceeds.

In the accompanying drawing, in which like reference numerals are used to designate similar parts throughout, there is diagrammatically illustrated in two slightly different forms a suitable arrangement constructed according to the invention. The drawing, however, is for the purpose of illustration only and is not to be taken as limiting or restricting the scope of the invention as set forth in the appended claims.

In the drawing, Fig. 1 is a diagrammatic view of an arrangement of elements constructed and arranged according to the invention for the purpose indicated, and

Fig. 2 is a diagrammatic view of a modified form of a portion of the arrangement shown in Fig. 1.

Referring to the drawing in detail, the numeral 10 indicates an engine cylinder head to which is secured a cylinder barrel 12. A piston, not illustrated, is reciprocable in the cylinder barrel for converting the expansive force of fuel charges burned in the cylinder into mechanical energy. The fuel charge is ignited in the combustion chamber by a timed electric spark when the piston is somewhere near its top dead center in a manner well known in the art of internal combustion engines. As is well known, when the degree of compression of the fuel charge at or immediately before ignition exceeds the ability of the fuel to burn without detonation the phenomenon of "knock" or detonation occurs. As the nature, occurrence and effect of detonation have been thoroughly investigated and completely described and are thought to be entirely familiar to those skilled in the art of internal combustion engines, it is believed that a further discussion of this condition is unnecessary except to state that the occurrence of detonation is highly undesirable in engine operation and should always be avoided.

It is a well known fact that a condition of detonation in engine operation can be usually rem-

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edied by delaying the ignition spark until the rate of pressure increase has been decreased to a value at which the fuel will burn without detonation. This action detracts somewhat from the power developed by the engine so that it is desirable to maintain the spark timing at the point of maximum advance consistent with non-detonating operation of the engine. As explained above it is among the purposes of this invention to provide a device which will maintain the spark advance just under the detonating point.

The numeral 14 generally indicates a detonation sensitive device rigidly secured to the cylinder head by suitable means such as the screw threaded stud 15. This device may conveniently comprise an outer casing 16 having an open end closed by a screw threaded cap 18 and containing an electric induction coil 20 surrounding a magnet 22 supported in space by springs 24 so that the magnet may move relative to the coil 20 when the casing 16 is suddenly moved. The springs 24 are so designed in consideration of the mass of the magnet 22 that the natural vibration frequency of the spring supported magnet will be in resonance with the frequency of vibration induced by detonation of the fuel in the combustion chamber of the engine. Thus, whenever the engine detonates the magnet 22 will oscillate on its spring support and generate a small current in the coil 20. This current is tapped at the terminals 26 and 28 and led to the remainder of the ignition controlling device. One terminal, for example the terminal 26, is connected with one segment 30 of a commutator generally indicated at 32 which has a separate segment for each or for selected cylinders of the engine. These segments are insulated from each other and are contacted by a rotor 34 which is electrically connected with a condenser 36. The segments of the commutator 30 are preferably of such a length that the rotor 34 is in contact with any particular segment substantially during the combustion period of the respective cylinder so that, if the magnet of the respective device is moved by vibration incident to valve action or other causes, the circuit will at that time be open and no current will flow. Thus, the device will be sensitive to detonation induced vibrations only and will not be influenced by vibration due to other causes. The rotor 34 is mounted upon one end of a shaft schematically indicated by the line 38 which may be connected through a reduction gear 40 with a shaft 42 which drives the cam element 44 of the interrupter 46 which induces the flow of spark producing current. The shaft 42 is driven from

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the engine through a suitable gear drive, as schematically indicated at 48, and the time relation of the spark to the position of the various engine parts is controlled by the operation of the interrupter 46 by the cam 44. The interrupter may be moved relative to the cam to advance or retard the spark by rotation of the support 50 upon which the interrupter is pivotally mounted.

As the current produced by the device 14 is very small it is necessary to increase its value by some suitable amplifying device such as the thermionic relay tube, generally indicated at 52. The arrangement for this purpose may be in accordance with general practice in the radio and electric industry, but as illustrated, the side of the condenser 36 opposite the side connected with the rotor 34, is connected with the grid 54 of the tube 52, and through a resistance or grid leak 56 and battery 58 with the line 60 leading from the terminal 28 opposite the terminal 26. The line 60 is connected with one side of the filament 62 which side of the filament is also connected with one terminal of a filament heating battery 64 the other terminal of which is connected with the other side of the filament through the line 66 and switch 68. The filament 62 is connected with one terminal of the high potential battery 70 the other end of which is connected in parallel to a resistance 72 and a rectifier 74. The plate 76 is connected to the side of the rectifier opposite the side to which the battery 70 is connected, by the line 78 which includes a condenser 80 located between the resistance 72 and the rectifier 74. The action of the tube 52 and rectifier 74 is to convert the relatively small alternating current produced by the magnet 22 into a relatively large uni-direction current which is applied to the coil of the electro-magnet 82. This electro-magnet controls a switch 84, in the arrangement shown in Fig. 1, connected into the field and rotor circuit of a small reversible direct current series motor 86 energized by a suitable source of electric current, such as the battery 88 one side of which may be grounded through a suitable switch 89. From the above description it is apparent that the motor 86 will be energized whenever a detonation induced current is produced by the device 14. The motor 86 is connected by suitable speed reducing means, such as the worm 90 and gear 92, with an arm 94 operatively connected with an arm 96 on the rotatable support 50 so that operation of the motor acts to rotate the support 50 to move the interrupter 46 relative to the cam 44 in a direction to retard the timing of the ignition spark. The arm 90 is connected with the arm 96 by means of a loose connection, such as the ring 98 and ring included pin 100, to allow play for the angular displacement of the arms 94 and 96 relative to each other and to avoid too sensitive an operation of the device, that is to render the device subject to response to a number of consecutive detonations rather than to a single isolated detonation which might happen without immediate recurrence in the operation of the engine.

In the slightly modified form of the invention shown in Fig. 2 the electro-magnet 82 acts on the armature 102 to which is connected to a valve 104 which controls the application of hydraulic fluid under pressure to the opposite sides of the piston 106 reciprocable in the cylinder 108 and having a rod 110 connected with the arm 96 of the rotatable support 50. Hydraulic fluid under pressure may be led to the valve casing 112 through the

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high pressure line 114 and may be conducted to or from the cylinder 108 through the spaced ports 116 and 118. The arrangement is such that when one of the ports 116 or 118 is connected by the valve 104 with the high pressure line 114 the other port is connected by the same valve with the drain line 120.

With this arrangement the hydraulic motor device shown in Fig. 2 serves the same purpose as the electric motor device shown in Fig. 1 to retard the timing of the ignition spark whenever a current is generated by the device 14 being subjected to detonation induced vibration.

While two operative arrangements of an ignition controlling device constructed according to the invention have been hereinabove described and diagrammatically illustrated in the accompanying drawing for the purpose of disclosing the invention, it is to be understood that the invention is not limited to the particular arrangements so illustrated and described, but that such changes in the form and arrangement of the various elements may be resorted to as come within the scope of the subjoined claims.

Having now described the invention so that others skilled in the art may clearly understand the same, what it is desired to secure by Letters Patent is as follows:

1. An ignition timing control for an internal combustion engine comprising, a detonation sensitive device operative to generate a small electric current when subjected to detonation induced vibration, a commutator for disconnecting said device during all of the engine cycle except the combustion period, and means actuated by said device for controlling the timing of the ignition spark comprising an amplifier, a solenoid, and a motor actuated by said solenoid and operatively connected with the ignition mechanism of said engine.

2. In combination with an engine having one or more cylinders each having a combustion chamber equipped with electric ignition means, and an engine driven current interrupter for timing the ignition spark, means for automatically controlling the timing of said spark to avoid detonation in said cylinders comprising, a device operative to generate electric energy when subjected to detonation induced vibration secured to each cylinder or to each of one or more selected cylinders, a hydraulic motor for changing the positions of said interrupter, a solenoid valve for controlling said motor, and an amplifying device between said generating device and said solenoid valve.

3. In combination with an engine having one or more cylinders each having a combustion chamber equipped with electric ignition means, and an engine driven current interrupter for timing the ignition spark, means for automatically controlling the timing of said spark to avoid detonation in said cylinders comprising, devices operative to generate electric energy when subjected to detonation induced vibration secured one to each of one or more of said cylinders, a commutator driven by said engine for rendering each generating device operative only during the combustion period of its respective cylinder, a motor for changing the position of said interrupter relative to said engine drive, a solenoid for controlling said motor, and an amplifying and rectifying electric circuit between said commutator and said motor.

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