Dec. 29, 1953 W. P. NEWSOME 2,664,012

IGNITION TIMING DEVICE

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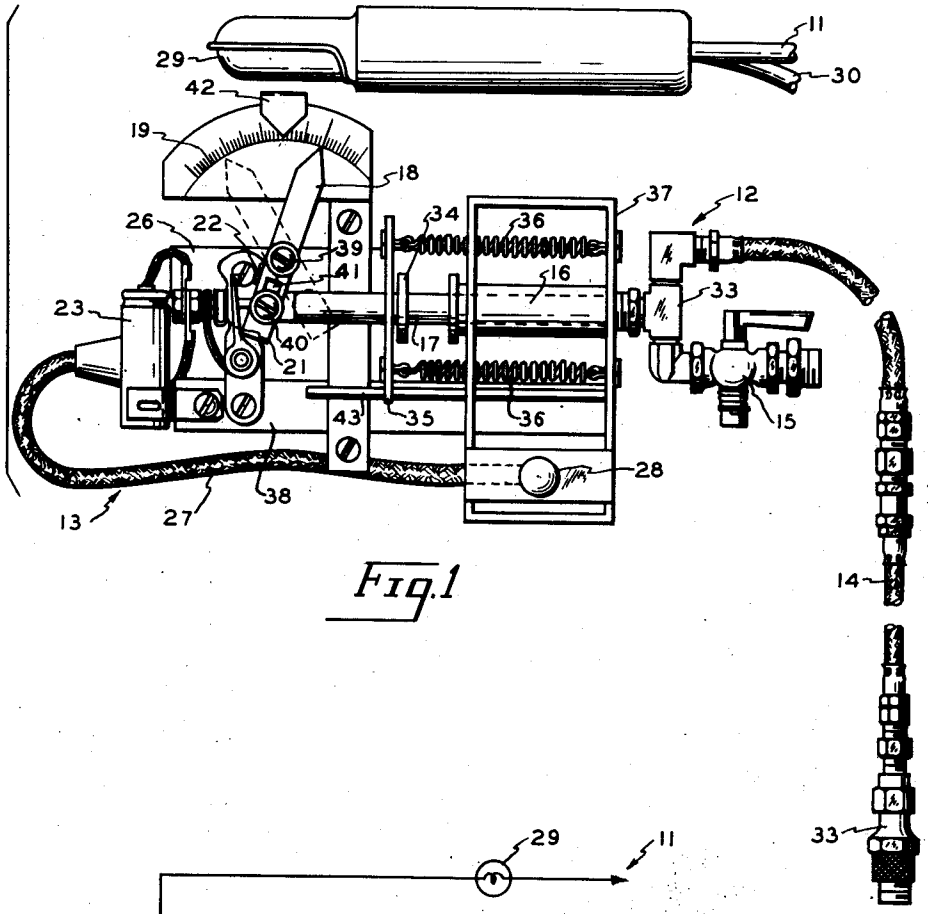

Fig. 1

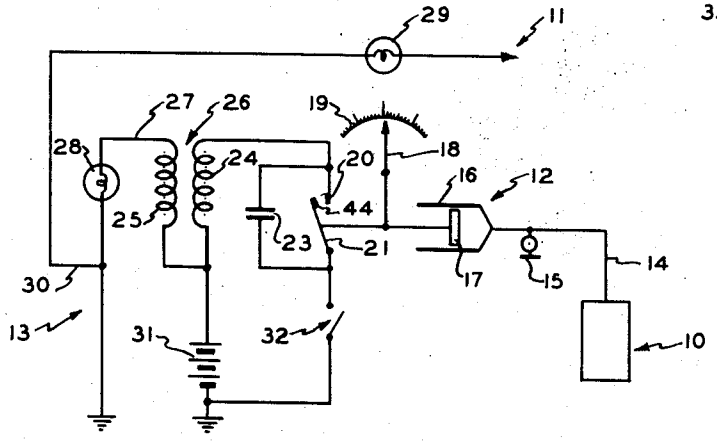

Fig. 2

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IGNITION TIMING DEVICE

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2 Claims. (Cl. 73—116)

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The invention relates to ignition timing devices and more particularly to apparatus for correlating the point of ignition in a cylinder of an internal combustion engine to the top-dead-center position of the piston.

The device of the instant invention provides a means of observing together the motion of the piston in a given cylinder and the ignition of the cylinder.

The applicant has further provided such an apparatus that is compact, efficient, simple in operation, and can be easily and reasonably constructed of standard parts and materials, and enables more accurate setting of the timing than can be obtained by previously-known methods and devices.

The instant invention further provides a device of the type described which can be housed in a small, portable case, or can be incorporated into the well-known types of engine-testing machines.

Furthermore, the applicant has provided an ignition timing device that is particularly useful in the timing of automobile engines and which may be used in comfort without the user being required to get under the car or in any awkward position as is the case with previously-known methods and devices in this field.

With the above objects in view, as well as others which will appear as the specification proceeds, the invention comprises the construction, arrangement, and combination of parts as now to be fully described and as hereinafter to be specifically claimed, it being understood that the disclosure herein is merely illustrative and intended in no way in a limiting sense, changes in details of construction and arrangement of parts being permissible so long as made within the scope of the invention and the scope of the claims which follow.

The character of the invention, however, may be best understood by reference to certain of its structural forms, as illustrated by the accompanying drawings in which:

Figure 1 is a plan view of the entire apparatus with sections broken away for clarity of presentation.

Figure 2 is a schematic view of the apparatus showing, principally, the electrical circuits and their relationship to the various mechanisms.

In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar devices as is possible. Furthermore, like references denote like parts in the several figures of the drawings.

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In the operation of internal combustion engines, it is quite important that the time of ignition of a particular cylinder have a definite relationship to the time when the piston in that cylinder reaches its uppermost point in the cylinder, generally known as "top dead center." In the past, this timing has been done by making use of a stroboscopic light and a mark on the flywheel of the engine. The mark is so placed as to be at the uppermost position when the first cylinder is in top dead center position. On some engines this mark is stamped on the flywheel, but such a mark can be made by the mechanic by "feeling out" top dead center while rotating the crankshaft by hand or by use of some sort of indicator resting on top of the piston and protruding from the spark-plug aperture. In any case, once this mark has been obtained, a neon light is attached from the free spark-plug wire of the first cylinder to ground and, of course, it flashes every time a sparking current is induced in the secondary of the ignition coil. The mechanic then flashes the lamp on the turning flywheel while the engine is idling and the flashing of the lamp shows how far before or after dead center the ignition is set. Then, the housing, bearing the breaker points of the distributor, is rotated about the shaft of the distributor until the flashing of the lamp shows that the ignition is set a the proper point with relation to top dead center. The difficulties and inaccuracies of this method are apparent. The inaccuracy of the marking is always present, as well as the difficulty of knowing when it is in the highest median position in its rotation. Perhaps the greatest difficulty lies in the fact that the distributor in most automobiles is on top of the engine, while the flywheel is in the front bottom portion. This means either that two men are required to adjust the timing, that is, one to adjust the distributor while the other holds the lamp and watches the flywheel, or that one man has to do it by the trial-and-error method of first setting the distributor by guessing and then observing the flywheel to see if he has guessed correctly. Needless to say, the fact that the number of degrees that the flywheel mark is before or after dead center is a matter of estimation makes for inaccuracy, to say the least.

Referring now to the drawings, the applicant's device consists generally of a mechanical arrangement 12 for duplicating or indicating the position of the piston in the cylinder under consideration, and an electrical circuit 13 for indicating the exact point of top dead center of the piston and the exact time of ignition of the spark

plug of the cylinder under consideration. Considering first the mechanical arrangement 12, a pressure hose 14 is connected to any cylinder by means of an adapter 33. The commercial adaptation of the applicant's device would be furnished with a series of adapters to fit any spark plug socket encountered. The hose 14 is connected through a T-fitting 33 to a cylinder 16 on one hand and a relief valve 15 on the other hand. Sliding in the cylinder 16 is a piston 17 which is of generally elongated cylindrical shape. The cylinder 16 is fixed to a frame 37 which, in turn, is fixed to a base member 38 which supports all of the parts of the device. Welded to the generally central portion of the piston 17 is a cross-piece 35 which may be slidable along guide member 43, the ends of said cross-piece being attached to the frame 37 by means of light coil springs 36, so that the piston, when not under compulsion, is drawn into the cylinder. In practice, a snubber 34 of resilient material will be positioned between the cross-piece 35 and the mouth of the cylinder to prevent noisy operation. The end of the piston 17 away from the cylinder is formed with a flat surface to which is attached a pointer 18. The pointer is pivotally attached to the base 38 by means of a bolt 39, and slidably attached to the piston 17 by means of a bolt 40 on the piston and an elongated slot 41 on the pointer. Also fixed to the base 38 is a scale 19 whose markings are arranged to lie under the arc traversed by the free end of the pointer 18. An auxiliary indicator 42 may be pivotally attached to the scale 19 for a purpose to be explained later.

Considering next the electrical circuit 13, a breaker switch 44 is fixed to the base 38 adjacent the end of the piston 17 which is away from the cylinder 16, said switch 44 consisting of a fixed contact 20 and a movable contact arm 21 which is spring-biased to closed position. The movable contact arm 21 is positioned perpendicular to the path of motion of the piston 17 and arranged so that the piston in its extreme position out of the cylinder 16 will contact the intermediate portion of said arm, thus breaking switch 44. A condenser 23 is connected across said switch and the movable contact arm 21 is connected to ground through a circuit switch 32. The fixed contact 20 is connected to one side of the primary 24 of a transformer or coil 26, the other side of which is connected to the "hot" or non-grounded side of the battery 31 of the automobile. The secondary 25 of the coil 26 is connected on one side to the battery through the same lead used in connecting the primary 24 thereto and on the other side to one filament lead a neon lamp 28 which is mounted on the frame 37 or in some other convenient place. The other filament lead of the lamp 28 is attached to ground. Another neon lamp is provided, preferably mounted above the scale 19, as shown, said lamp having filament leads 11 and 30 for attachment, one to ground and the other to the wire leading from the distributor for attachment during the operation of the engine to the spark plug of the cylinder being used. The whole apparatus can be mounted as a convenient, compact unit in a case or in the ordinary console-type engine analyzer, whichever is preferable.

In operation, the engine is started and the idler adjustment is moved until the engine is idling at about 500 R. P. M. Then, the ignition wire is removed from the spark plug of the cylinder to be used, which may be any cylinder, and the spark plug is also removed. The valve 15 is opened and the adapter 33 is screwed into the spark plug aperture. If the hose 14 is not already joined to the adapter 33, then this is done. The common lead of the coil 26 is connected to the "hot" side of the battery, and the base 38, to which all ground leads are preferably attached, is grounded to the automobile frame or any convenient place. The free lead 11 of the lamp 29 is connected to the ignition wire of the cylinder being used. While this is being done, the switch 32 is kept in open position, and, after all electrical connections have been made, that switch may be closed. Of course, it may be found preferable to make all the preceding connections before the engine is started.

Next the valve 15 is slowly closed until the pressure building up in the cylinder 16 will move the piston 17 outwardly against the biasing of the springs 36. Since the pressure in the engine cylinder is greatest when the engine piston is at top dead center, and since the displacement of the piston 17 outwardly of the cylinder 16 is directly proportional to the pressure in said cylinder, it is evident that the time of greatest displacement of the piston 17 is the time when the engine piston is in top dead center position. Now, the actual amount of displacement of the piston 17 is dependent on the amount of the pressure from the engine cylinder 16. The next step, then, is to continue to close the valve until the piston contacts the movable arm 21 of the breaker switch, at which time the lamp 28 will light momentarily in a manner to be described later. It is important to close the valve only to the point where the piston 17 begins to break the switch; in other words, for an accurate determination of top dead center the switch must be opened by a very small increment of movement of the piston 17 at its position of greatest displacement from the cylinder 16. Also, it can be seen that the reciprocating motion of the piston 17 will result in the pivoting of the pointer 18 about its pivot point 39, the difference in the distance from the pivot 39 to the bolt 40 during a cycle being compensated for in the elongated slot 41. The scale 19 will be calibrated to show the degrees of rotation of the engine crankshaft. For most purposes, a linear scale will be sufficient, but for extreme accuracy, the scale may be non-linear to compensate for the fact that the relationship between engine piston displacement and engine cylinder pressure may not be a linear relationship in a given application.

Going back to the electrical circuit 13, it can be seen that, while the contacts 20 and 21 are closed, direct current from the battery will flow through the circuits including the primary 24 and the secondary 25 of the coil 26, but the voltage will be too low to light the lamp 28, which is selected with that quality. However, when the arm 21 is moved away from the contact 20, there is no current flow through that circuit; as a result, a charge builds up in the condenser 23 until the voltage reaches the breaking point. When the breaking point is reached, the condenser 23 discharges into the primary circuit; this induces a momentary high voltage flow of current in the secondary 25 of the coil and this is sufficient to make the lamp 28 glow for a short time. It will be appreciated that the electrical lag is very small compared with the speed of the mechanical movements involved and that the error introduced thereby will be negligible. In addition, it will be noted that the lamp 29 is selected to respond to the ignition charge released by the distributor, and, thus, will flash momentarily at the same time that the plug would spark in the ordinary operation of the engine cylinder being used.

Now, having adjusted the pressure admitted to the cylinder 16 so that the piston 17 just barely breaks the connection between arm 21 and contact 20, the lamp 28 is then flashing when the engine piston is at top dead center. Of course, it would be possible to observe the point on the scale at which the pointer 18 stops moving in one direction and starts moving in the other direction and note that point as indicating top dead center were it not for the fact that the engine piston, and thus, indirectly, the pointer, moves very little and very slowly for, say, fifteen degrees before and after top dead center. This makes a visual selection of top dead center by observing the extreme movement of the pointer very inaccurate; therefore, a more sensitive electrical method is provided by the applicant, as has been described. Top dead center can be determined, then, by observing where the pointer is when the lamp 28 flashes and by setting the auxiliary indicator 42 at that point. Then the flashing of the lamp 29 will show where the indicator, and, thus, where the piston is with relation to top dead center in terms of degrees of rotation of the crankshaft. The indicator moves slowly enough so that one can always tell whether the lamp 29 is flashing before or after top dead center.

Then, of course, the distributor housing and breaker points are adjusted around the rotor until the flashing of lamp 29 on the pointer 18 and the scale 19 shows that the ignition is timed to fire at the desired number of degrees of rotation of the crankshaft before or after top dead center, which setting is the purpose of this apparatus.

Among the evident modifications to the device is the provision of a movable scale which eliminates the need for an auxiliary indicator such as 42. In the case of a movable scale, the scale can be moved until the zero marking is under the position of the pointer 18 at top dead center; then the timing can be read and adjusted as before.

It is evident that other indicating devices can be used in place of the lamp 28. An ordinary spark plug will flash sufficiently to give a good indication. A pair of ear-phones will respond to the "breaking" of the condenser 23 also.

Another change that may be made within the scope of this invention is to place the lamp 28 beside the lamp 29 so that both may flash directly on the pointer 18 and the scale 19, thus "stopping" the motion because of the stroboscopic effect of the lamps.

Having thus described my invention, what I

claim as new and desire to secure by Letters Patent is:

1. An ignition timing device for internal combustion engines, comprising: a conduit connected to the spark plug aperture in a cylinder of an engine, a fitting including a relief valve connected to the other end of said conduit, a cylinder connected to said conduit through said fitting, a piston sliding in said cylinder, spring means biasing said piston into said cylinder, a pivotally-mounted pointer attached to said piston and actuated thereby, a scale over which said pointer passes, a normally-closed switch positioned so as to be opened by said piston in its extreme position out of said cylinder, a condenser attached across said switch, a transformer whose primary is connected in series with said switch, a battery connected in series with said switch and with the primary and secondary of said transformer, a first lamp connected in series with said secondary and said battery, and a second lamp connected in series with said battery and with such part of the ignition system of the engine as relates to said cylinder.

2. An ignition timing device for internal combustion engines comprising a mechanical means responsive to the pressure in an engine cylinder generally to duplicate the movement of the piston in said cylinder, electrical means connected to and actuated by the movement of said mechanical means to indicate the position of top dead center of said engine piston, a pointer connected to said mechanical means, a scale over which said pointer passes, and a first lamp connected in the ignition circuit for said cylinder which flashes on said pointer at the time of ignition of said cylinder, the indication of the electrical means and the flashing of the lamp serving to show the point relative to top dead center at which ignition takes place, said electrical means comprising a switch in series with a battery and the primary coil of a transformer, the secondary coil of said transformer being in series with said battery and with a second lamp, a capacitor across said switch, said switch being normally biased closed, but being opened upon contact by said mechanical means.

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