June 14, 1932. H. L. HARTZELL 1,863,306

IGNITION APPARATUS

Filed Jan. 5, 1931 2 Sheets-Sheet 1

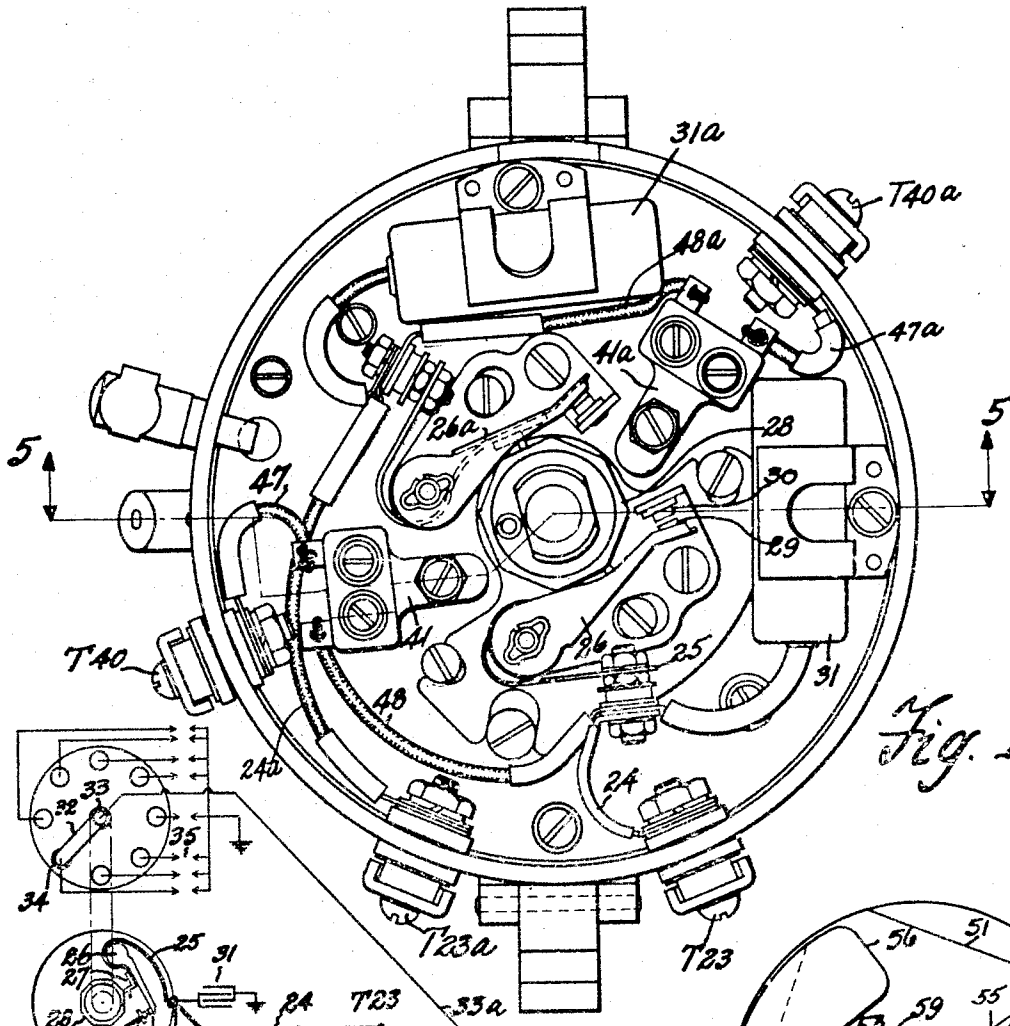


Fig. 1

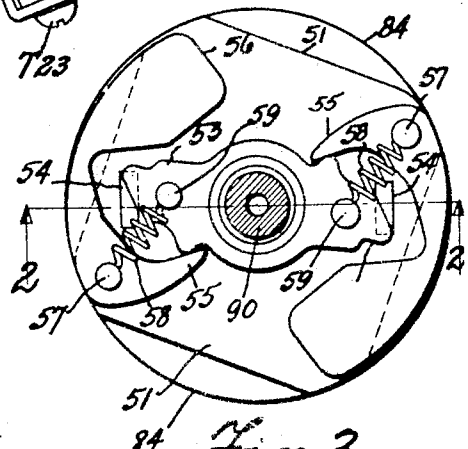


Fig. 3

Fig. 2

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IGNITION APPARATUS

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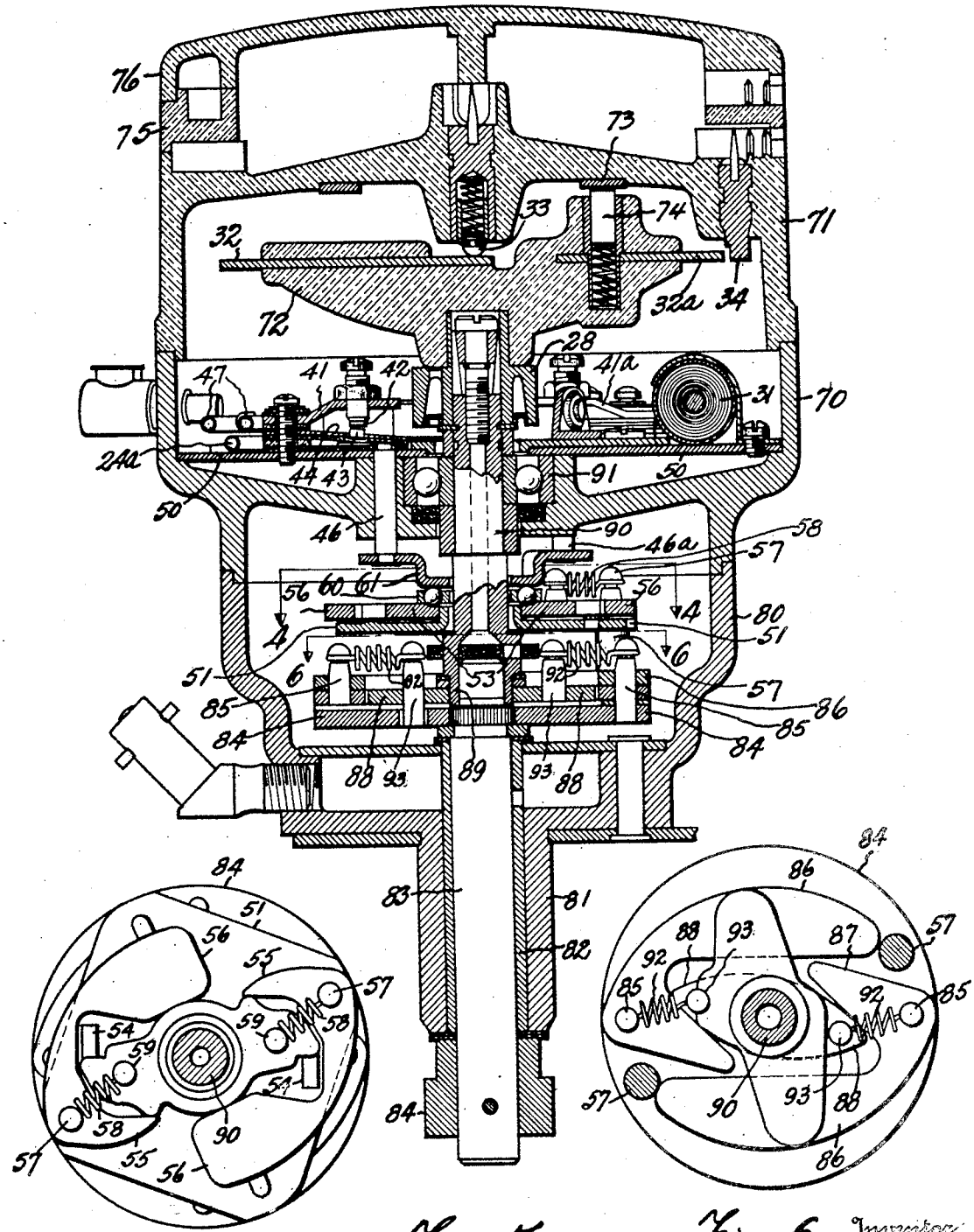


Fig. 5

Fig. 4

Fig. 6

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UNITED STATES PATENT OFFICE

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IGNITION APPARATUS

Application filed January 5, 1931. Serial No. 506,693.

This invention relates to ignition apparatus for internal combustion engines and one of the objects of the invention is to provide means for obtaining satisfactory ignition through the speed range of the engine and particularly at high speed. This aim of the invention is accomplished by means of a booster induction coil located in parallel to the primary winding of the regular ignition coil. Normally the circuit to the booster induction coil is interrupted but is connected above a predetermined high speed. The circuit is closed by a speed responsive switch so that at the higher speed the booster ignition coil will operate to boost the voltage in the primary winding of the regular ignition coil, thereby increasing its energy.

A further object of the invention is to provide an ignition timer and distributor unit embodying the speed responsive switch for controlling the booster coil.

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 one form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a plan view of an ignition timer embodying the present invention, the distributor head being removed for the sake of clearness.

Fig. 2 is a part of a wiring diagram illustrating the invention and is in part a fragmentary, vertical, longitudinal, sectional view of a portion of the speed responsive switch and is taken substantially on the line 2—2 of Fig. 3.

Figs. 3 and 4 are plan views of the speed responsive switch operating mechanism showing the weights in outer and inner positions respectively. These figures are partly in section, the section being taken on the line 4—4 of Fig. 5.

Fig. 5 is a vertical, longitudinal, sectional view of the ignition apparatus and is taken on the line 5—5 of Fig. 1.

Fig. 6 is a plan view of the speed responsive ignition controller and is partly in section, the section being taken on the line 6—6 of Fig. 5.

Referring to Fig. 2 the ignition circuit embodying the present invention will first be described. A storage battery 20 is connected by a switch 21 with a wire 22 connected with a primary winding 23 of an ignition coil connected with terminal T23 in turn connected by a wire 24 with an ignition circuit breaker which comprises a leaf spring member 25 attached to a circuit breaker lever 26 and urging a rubbing block 27 toward an ignition timer cam 28. The lever 26 carries a contact 29 engageable with a stationary contact 30 which is grounded. The contacts 29 and 30 are shunted by a condenser 31 one terminal of which is grounded. The shaft which drives the timer cam 28 also drives a distributor rotor having a conducting segment 32 adapted to connect a center contact 33 with certain stationary contacts or distributor posts 34 arranged in a circular row and each connected with a spark plug 35 of the engine. The center contact 33 is connected by a wire 33*a* with an ignition coil secondary winding 36 which is grounded through connections with a battery as shown. An auxiliary or booster induction coil 40 is connected at one end with wire 22 and at the other with a terminal T40 connected by a wire 47 with a metallic contact bracket 41 carrying one contact 42 of a speed responsive switch, the other contact 43 being mounted on a leaf spring conductor 44 which is normally biased so as to separate the contact 43 from the contact 42. The spring 44 is connected by a wire 48 with wire 24. A non-conducting strip 45 is located against the bottom of the leaf spring conductor 44 to receive a plunger 46 to transmit motion from the plunger 46 to the leaf spring 44 while maintaining these parts insulated from each other. The contact bracket 41 and the leaf spring 44 are mounted upon a plate 50 and insulated therefrom and from each other. The plate 50 is supported within a housing 70 to be described later which provides a guide for the rod 46.

The speed responsive mechanism for operating the rod 46 and hence for controlling the switch in circuit with the coil 40, comprises a

rotatable weight supporting plate 51 which is driven in a manner to be described. The plate 51 provides an annular flange 52 which provides a bearing for a plate having two lever arms 53, the ends of which rest upon ridges or projections provided by inclined planes 54 which are inclined in opposite directions with respect to a horizontal line as viewed in Fig. 3. Each lever arm 53 cooperates with an arm 55 of a weight 56 pivoted upon a pin 57 which also serves to connect one end of the spring 58 with the plate 51 the other end of spring 58 being connected by a pin 59 with the lever arm 53. Normally the weights are maintained in inner position due to the action of the spring 58 as shown in Fig. 4. As the speed of the plate 51 increases above a predetermined speed, the weights 56 move outwardly into the position shown in Fig. 3, thereby causing each lever arm 53 to move from a lower position upon the inclined planes 54 as shown in Fig. 4 to a higher position upon the inclined planes as shown in Fig. 3. These movements of the lever arm members 53 cause the plate of which they are a part to be separated from the plate 51, that is, to move upwardly as viewed in Fig. 2 thereby causing upward motion to be transmitted through a thrust bearing 60 to a collar 61 having an arm 62 attached to the rod 46. The inclination of the inclined planes 54 is such that when the weights 56 move from the innermost position shown in Fig. 4 to an outermost position shown in Fig. 3, the motion transmitted to the rod 46 will be sufficient to move the movable contact 43 from a disengaged position into a position of engagement with the stationary contact 42. Consequently at a certain predetermined speed and above that speed the circuit to the booster coil 40 will be complete, thus placing it in parallel with the primary 23 of the regular ignition coil. Consequently, when the contacts 29 and 30 of the circuit breaker are separated at high speeds, the sparking impulses generated are of greater magnitude than would be the case if the booster coil 40 were not in circuit. The present invention therefore provides in combination with an ignition apparatus, which will produce satisfactory ignition at ordinary engine speed, an auxiliary device which will operate at higher speeds in order to enable the production of satisfactory ignition at a time when the closing period of the ignition primary circuit would be too short for adequate energization of the regular ignition coil. Since the booster coil is energized in addition to the regular ignition coil, at these high speeds, the cumulative effect of the energy of both coils is sufficient to produce satisfactory ignition.

I will now proceed to show how the centrifugal switch for controlling the booster coil is particularly adapted for mounting in the housing of an ignition timer and is structurally combined with other elements found in the usual ignition timer using speed responsive means for controlling the timing of the ignition. Referring to Figs. 2 and 5, the plate 50 which was mentioned when describing Fig. 2 serves as a plate for supporting two circuit breakers, one of which has been shown diagrammatically in Fig. 2 and is designated by reference characters corresponding to those in Fig. 1. The ignition timer chosen to illustrate the use of the present invention is one which provides ignition for a sixteen cylinder engine. Hence the eight lobe cam 28 operates upon two circuit breaker levers alternately in order to control alternately the generation of sparking impulses in two separate ignition coils. The second circuit breaker is designated by similar reference characters accompanied by the affix "a".

The housing 70 which supports the plate 50 supports a distributor head 71 carrying a center contact 33 and the stationary contacts or distributor posts 34 which are arranged in a circular row there being sixteen in number for a sixteen cylinder engine. Since each circuit breaker controls the operation of a separate ignition coil to furnish spark plugs for eight of the sixteen engine cylinders, the rotor 32 which is carried by a non-conducting rotor block 72 mounted upon and driven by the cam 28 operates to distribute sparking impulses to eight alternate distributor posts 34. Hence only eight of the distributor posts 34 are represented in the diagram shown in Fig. 2. It will be understood that the other ignition coil which is not shown diagrammatically has its secondary winding connected by suitable means with a ring contact 73 engageable by a brush 74 which is movable with the rotor block 72 and is connected electrically with a second conducting segment 32*a* which serves to distribute sparking impulses generated in the second ignition coil to eight alternate distributor posts 34. The head 71 receives cap or cover members 75 and 76 which enclose the ends of insulated braided wire cables by which the spark plugs are connected to the distributor posts 34 and the ignition coil secondary windings are connected respectively to the center contact 33 and the ring contact 73.

The housing 70 rests upon and is attached to a second housing 80 having a shank 81 provided with a bearing 82 for receiving a drive shaft 83, the lower end of which carries a gear 84 by which the timer is connected with a gear driven by the engine. The upper end of the shaft carries a weight supporting plate 84 supporting pivot studs 85 each pivotally supporting a weight plate 86 having an arm 87 engageable with a lever arm 88 fixed to the tubular lower end portion 89 of a cam shaft 90 journalled in a bearing 91

provided by the housing 70. The shaft 90 is detachably connected with the cam 28 for driving the latter. Movement of each weight 86 outwardly from the position shown in Fig. 6 is resisted by spring 92 each having one end connected with a pivot post 85 and the other end with a stud 93 attached to an arm 88. It is apparent that when the weights 86 move outwardly from the shaft 90 due to increase in speed, there will be a change in angular relation between plate 84 and arms 88 hence between the drive shaft 83 and the cam shaft 90. This change in angular relation in response to speed changes is used to control the timing of the ignition impulses with respect to the cycle of engine operation. The weight plate 84 also supports the weight pivot studs 57 which pivotally support the weights 56 of the speed responsive switch operating mechanism shown in Figs. 3 and 4. These posts or studs 57 also support the weight plate 51 in the desired position above the weight plate 84 and maintain said plate 51 with its flange 52 coaxial with the shaft 90. The housing members 70 and 80 cooperate to provide a chamber for enclosing both the speed responsive devices of the ignition apparatus.

As explained, the ignition timer and distributor unit provide means for controlling alternately the generation of sparking impulses in two separate ignition coils. Since there are two regular ignition coils in the complete system for the sixteen cylinder engine there will of course be two booster coils 40 one for each ignition coil. Hence there will be two booster coil switches. The first of these switches has been described with reference to Fig. 2 and the second switch is also shown in Fig. 1 and has similar reference characters applied thereto with the affix "a". Since there are two booster coil switches to be controlled the switch operating collar 61 carries two switch operating rods or plungers 46 and 46*a*. It is apparent therefore that the ignition timer has a single booster coil switch operating mechanism which controls the operation of both of the booster coil switches.

While the form of 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 comprising, in combination, an ignition coil having a primary winding, an interrupter in series with the primary winding and including a movable contact and a rotary cam for operating it, a booster inductive winding, a shaft for driving the cam, speed responsive means for connecting the shaft and cam and for varying the angular relation betwen them, and a second speed responsive means driven by the first speed responsive means for rendering the inductive winding effective to assist the primary winding.

2. Ignition apparatus comprising in combination, an ignition coil having a primary winding, an interrupter in series with the primary winding, and including a movable contact and a rotary cam for operating it, a booster inductive winding, a shaft for driving the cam, speed responsive means for connecting the shaft and the cam and for varying the angular relation between them, said speed responsive means including a plate for carrying centrifugally operated weights and driven by the shaft, and a second weight plate supported by the first weight plate, centrifugally operated weights supported by the second weight plate, and a switch operated by movement of the weights carried by the second weight plate for rendering the inductive winding effective to assist the primary winding.

3. Ignition apparatus comprising, in combination, an ignition coil having a primary winding, an interrupter in series with the primary winding and including a circuit breaker lever and a cam for operating the same, a housing for the interrupter and carrying a breaker lever supporting plate, a shaft coaxial with the cam, a weight plate driven by the shaft, a plurality of weights eccentrically pivotally mounted thereon and each having an arm, arms attached to the cam each cooperating with a weight arm, springs maintaining said arms in cooperative relation and resisting movement of the weights away from the shaft, a second weight plate attached to the first weight plate, weights eccentrically pivotally supported thereby and each having an arm, a lever plate supported by the second weight plate coaxially of the shaft and having arms each cooperating with a weight arm, inclined plane members provided by the second weight plate and engaged by the arms of the lever plate, a booster induction coil, and a switch operated by axial movement of the lever plate for rendering the booster coil operative to assist the ignition coil.

4. Ignition apparatus comprising, in combination, an ignition coil having a primary winding, an interrupter in series with the primary winding and including a circuit breaker lever and a cam for operating the same, a housing for the interrupter and carrying a breaker lever supporting plate, a shaft extending through said supporting plate for operating the interrupter, a booster induction coil, a switch located upon the supporting plate on the same side with the interrupter and operative to render the induction coil operative to assist the ignition coil, and speed responsive means actuated by the shaft on the opposite side of the supporting plate for controlling the switch.

5. Ignition apparatus comprising, in combination, an ignition coil having a primary winding, an interrupter in series with the primary winding and including a circuit breaker lever and a cam for operating the same, a housing for the interrupter and carrying a breaker lever supporting plate, a shaft extending through said supporting plate for operating the interrupter, a booster induction coil, a switch located upon the supporting plate on the same side with the interrupter and operative to render the induction coil operative to assist the ignition coil, a weight plate carried by the shaft on the opposite side of the supporting plate, weights eccentrically pivotally supported by the weight plate, a lever plate supported by the weight plate coaxially of the shaft and having arms each cooperating with a weight arm, inclined plane members provided by the weight plate and engaged by the arms of the lever plate, and a rod operated by axial movement of the lever plate and extending through the supporting plate for operating the switch.

In testimony whereof I hereto affix my signature.

HERMAN L. HARTZELL.