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PATENTED JULY 2, 1907

R. VARLEY.
IGNITION SYSTEM FOR EXPLOSION ENGINES.

APPLICATION FILED APR. 6, 1907.

2 SHEETS—SHEET 1.

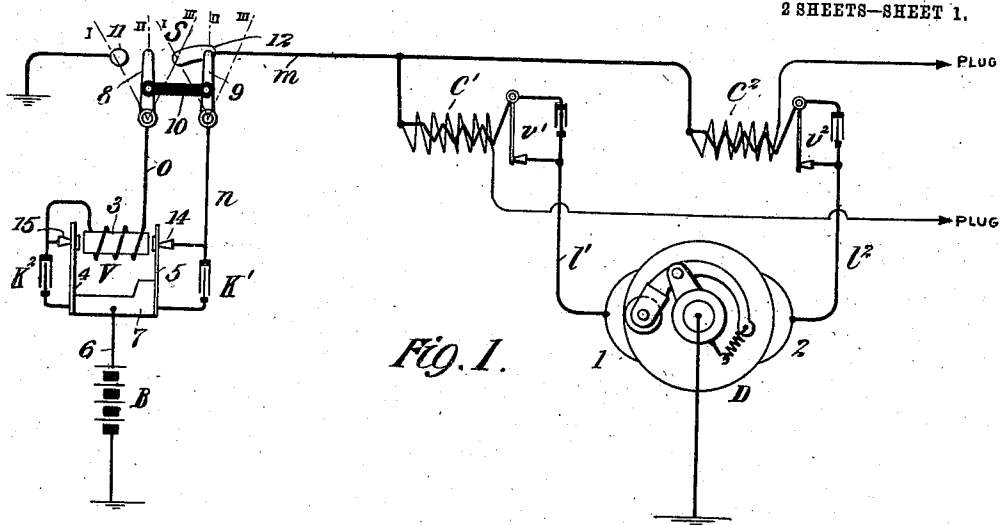
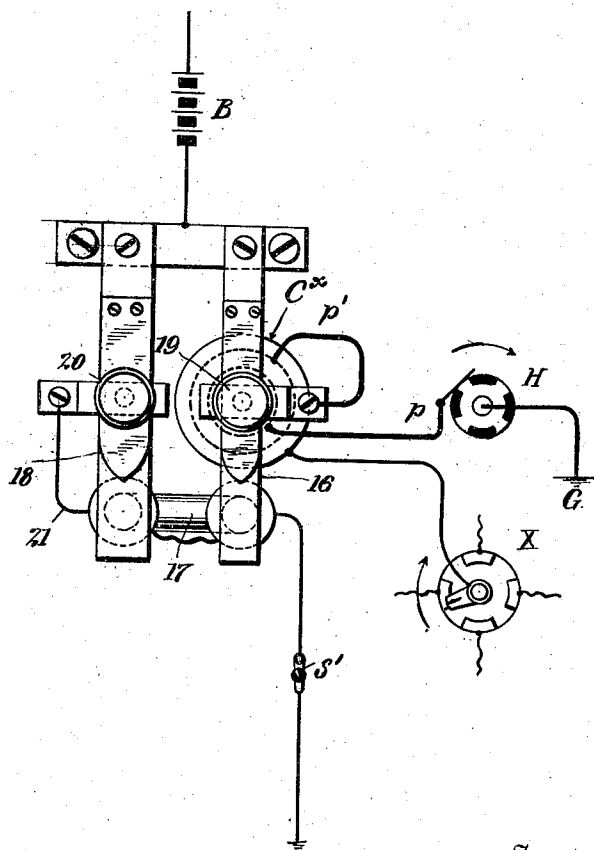


Fig. 2.



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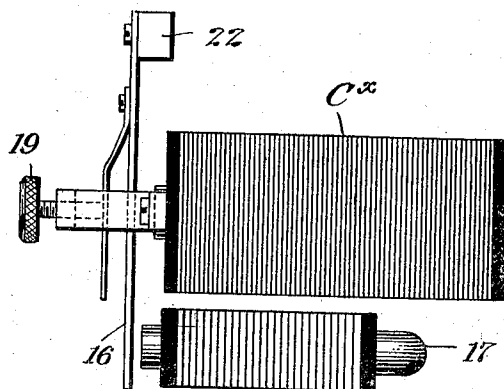
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2 SHEETS—SHEET 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

RICHARD VARLEY, OF ENGLEWOOD, NEW JERSEY, ASSIGNOR TO THE AUTOCOIL COMPANY,
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IGNITION SYSTEM FOR EXPLOSION-ENGINES.

No. 858,928.

Specification of Letters Patent.

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Application filed April 5, 1907. Serial No. 366,461.

To all whom it may concern:

Be it known that I, RICHARD VARLEY, a citizen of the United States, residing at Englewood, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Ignition Systems for Explosion-Engines, of which the following is a full, clear, and exact description.

My invention relates to ignition systems for explosion engines, particularly of that type having batteries as a source of the ignition current, and in which a cascade of sparks is desired at the plugs of the secondary circuit for the highest, as well as ordinary, engine speeds, and as long as the battery has strength to produce a spark at all.

The ordinary arrangement is to have a coil or series of coils with adjustable vibrators or tremblers so as to cause an intermittent rupture of the primary circuit and produce the torrent or cascade of sparks required. This works satisfactorily under ordinary conditions, but it is found that the vibrators "stick" or fail to act at the highest engine speeds. This is due to several causes, among them the fact that the duration of the circuit closure is insufficient to energize the coils to the point where they will attract the trembler armatures. Even the single circuit rupture of the usual circuit controller or timer does not produce a spark because the usual condenser across the vibrator contacts is short circuited and ineffective when the vibrator or trembler fails to act. This latter difficulty has been partly overcome by the use of a second condenser, but it is evident that in the latter case only a single spark, and not a torrent of sparks, is obtained at the high speeds.

In carrying out my invention I provide means to secure the intermittent primary circuit rupture across a condenser at the highest engine speeds so as to get the torrent or cascade of sparks required, but in carrying out my invention I do not disturb the usual arrangement and normal operation of the vibrator coils which is found to be the most satisfactory under ordinary conditions in normal running. In addition to providing for a torrent or cascade of sparks at the high speeds, the present invention secures a still further and very important function in getting some additional work out of a battery after it has been used to the point where it is too weak to operate with a normal apparatus. This not only is a gain in economy by reason of the greater mileage obtainable, but is even more important, since it furnishes a way of getting to at station or destination should the batteries become exhausted unexpectedly during a trip. As the exhaustion of the batteries is nearly always unexpected in both the matter of time and place, it becomes extremely convenient to have a means of rendering them

effective to furnish the ignition after they have ceased to operate in the normal working of the apparatus. This feature, like the first mentioned one, is accomplished without disturbing the ordinary and normal action of the ignition system in ordinary running. Inasmuch as the greater part of ordinary running is done with undischarged batteries and moderate speeds, I regard the last named feature as a very important one in the invention.

So far as I am aware, all devices hitherto used for insuring a cascade or torrent discharge, notwithstanding high speeds and weak battery, have interfered with, or dispensed entirely with, the usual functions and features of trembler coils in which the intermittent primary current is obtained by the necessarily pulsating magnetization of the usual cores. By reason of its greater economy, this standard operation is the best where it is operative. By my present invention I make use of it as long as it is operative, and only employ the apparatus which causes the system to work in a different and special way when the usual or standard arrangement for any reason fails to work properly.

In the drawings: Figure 1 is a diagrammatic view showing the circuits and arrangements of parts of an ignition system embodying the principles of my invention; and Fig. 2 is an end view of the coil of a slightly modified arrangement where only a single coil is used. Fig. 3 is a side view of the same.

Referring to the drawings in which like parts are designated by the same reference sign, C' and C² denote ordinary trembler or vibrator coils, of which the usual vibrators with their condensers are shown at v' and v². For reasons which will later appear these vibrators may be made without any adjusting screws.

D is a circuit controller or timer which closes the primary circuits of the coils C' and C² at the proper intervals to secure the desired ignition. For this purpose the circuit controller has segments 1 and 2, which connect with the primaries of coils C' and C², through wires L' and L². The other sides of the primaries of the coils C' and C² are joined to a common wire m, which under certain circumstances is put in permanent connection with a battery B. Under these circumstances the trembler coils C' and C² act in the usual and standard way, producing a cascade discharge in their secondary circuits at the intervals when their circuits are closed by the circuit controller D.

These features up to this point constitute the ordinary and well known arrangement of a trembler coil ignition system, and in themselves do not constitute a part of my invention.

The means by which the system is caused to act in a special way, under special or abnormal conditions, is

as follows: I provide a supplemental or auxiliary vibrator V, having a magnet 3, with its two poles acting on a pair of spring blade armatures 4 and 5. These armatures have a common connection with a battery B, through the wire 6, and the metallic yoke 7, which also serves as the frame or support therefor. The armature 4 together with the magnet 3 constitutes the vibrator proper since this armature is the one which governs the pulsations. In practice the armature 4 should be made heavier or longer or both than the armature 5 so as to have a less rapid period of vibration. If made in this way the armature 4 will vibrate at its natural period and control the magnet 3 to have corresponding magnetic pulsations and these will be effective to give the armature 5 exactly the same vibrations or movements. If made otherwise the armatures are liable to get out of step or synchronism with one another and give trouble.

8 and 9 are blades of a switch S and movable in unison by connecting link 10. These blades are adapted to move together into any one of three positions denominated I, II and III respectively. There are two contacts 11, and 12, of which 11 is engaged only by the blade 8 at position I and blade 9 at positions I and II. Contact point 11 is grounded and contact point 12 is joined to the wire *m*. The spring blade 9 has a wire connection *n*, with a vibrator contact 14, of the armature 5. Spring blade 8 is connected by a wire *o*, through the magnet 3, to a vibrator contact 15, of the armature 4. It is obvious that these specific details of the switch and its connections with the vibrator armatures are merely a practical plan for carrying out the invention, and may be modified in many respects without departing from the principles thereof.

The operation is as follows: Under normal running conditions such as ordinarily occur, the switch blades 8, 9, are at the position II. In this position the circuit of the magnet 3 is not completed since the switch blade 8 does not rest on any contact. The armature 5 is therefore not attracted and current is free to flow uninterruptedly from the battery B, through armature 5, contact 14, wire *n*, spring blade 9, and wire *m*, to the coils, and circuit controller in the normal and standard way, as has already been described. The cascade or torrent of sparks is secured by the usual tremblers *v'* and *v''* of the coils, which are the most economical means of obtaining this result. Under these circumstances the auxiliary vibrator V does not come into action at all. The auxiliary vibrator V is not intended to come into action until the usual tremblers *v'* and *v''* fail to act. The usual tremblers will sometimes fail to act at excessively high speeds and sometimes by reason of weakness of the battery. In either case the trouble is at once remedied by manipulating the switch S to one or another of the positions I and III. For example, supposing the tremblers *v'*, *v''*, of the usual coils fail to act by reason of insufficient charging period due to high engine speed. This is a common occurrence and causes failure of the igniting spark, since the primary circuit is not broken across condensers. Under these circumstances the switch S is moved into position I. This closes an entirely separate circuit from the battery B, through the vibrator armature 4, contact 15, magnet 3, wire *o*, blade 8, contact point 11, to ground. The energiza-

tion of the magnet 3 causes the armature 4 to vibrate or tremble in the usual way, and the pulsating magnetization communicates a corresponding motion to the other armature 5. But the primary ignition circuit is interrupted by movement of the armature 5 at the point 14. Accordingly the primary ignition circuit is intermittently broken across a special condenser K', notwithstanding the fact that the usual vibrators *v'* and *v''* fail to be attracted, or "stick" against their contacts. As the auxiliary vibrator operates constantly under the above conditions, it is evident that the intermittent rupture of the primary circuit is secured, no matter how high the speed of the engine, or how brief the primary current dwell under the influence of the circuit controller D. Of course it is true that there is a somewhat higher current consumption under these circumstances, but this special operation is in the nature of an emergency remedy for a condition which otherwise disables the system. As soon as the car slows down to normal speed, the switch S is thrown back to position II.

At any time it is liable to happen that the batteries become so much worn down or exhausted that the usual vibrators *v'* and *v''* fail to act. This disables the ignition system, notwithstanding the fact that the batteries have strength enough to secure the ignition, if the primary circuit closure could be intermittently broken across condensers in any way whatever. Under these circumstances the switch S may be thrown to position III. A new circuit is thereby formed from the battery B, through wire 6, armature 4, contact 15, magnet 3, wire *o*, blade 8, contact 12 and wire *m* through the usual primary circuit already described. As the vibrators *v'* and *v''* are assumed not to act at this time by reason of the weak current, the only place where the primary circuit is intermittently broken, is at the contact 15, under the influence of the magnet 3. The magnet 3 is, however, made to act under very much weaker current conditions than the usual vibrators *v'* and *v''*. The intermittent primary break across condenser K' is accordingly obtained as long as the battery has strength enough to be of any service at all. Position III of the switch S is therefore a special or emergency condition only used when the batteries are so much exhausted as to be otherwise ineffective. This last feature of the invention I consider an important one in practice, because it enables a car to get to any destination within reasonable distance, notwithstanding the unexpected exhaustion of the batteries during the trip. It also is economical because it gets a certain additional mileage out of the battery after the time when it would be thrown away by ordinary usage.

A further feature of the invention lies in the characteristic by which the coils C', C'' may be originally adjusted to vibrate properly and thereafter permanently fixed in such adjustment for all time. The initial adjustment is made so that the coils receive a definite current, less than that liable to fuse the trembler contacts under any circumstances. Under these conditions, and with the tremblers or vibrators sealed up to exclude dust and moisture, there is no reason why the coils should ever need attention and they may be packed away in any convenient place in a motor vehicle without the usual necessity of having it accessible.

This is impractical with an ordinary system because under special conditions, which have been above referred to, it is necessary to do something to get ignition when the coils cease to operate in the regular and normal use. In an ordinary system there is nothing to do but increase the current by screwing down the usual coil vibrators a little harder or some similar manipulation thereof which must be provided for in the construction of the mechanism. But by the present invention all of the special conditions are taken care of by the auxiliary vibrator and this may be made with an adjustment if desired. When conditions arise that cause the temporary failure of the ignition system the trouble is taken care of by the use of the switch S and the auxiliary vibrator and there is no need of changing the usual coil vibrator adjustments under any circumstances. They may accordingly be sealed up if desired.

In Fig. 2 I have shown a form of the invention where only a single coil is employed with a distributor for a multiple cylinder engine. In this case it is not necessary to have an entirely separate and auxiliary vibrator of the form shown in Fig. 1. CX indicates the coil, and in place of the usual vibrator armature there is provided a rather long vibrator 16, which is not only acted on by the core of the usual coil CX, but is adapted to be attracted by one pole of a U-shaped electromagnet 17. The other pole of the electro-magnet 17 attracts a separate vibrator armature 18. 19 and 20 are the respective contacts of the two vibrator armatures 16, and 18. H is an ordinary form of circuit controller or timer adapted to intermittently ground a primary circuit wire p of the coils CX. The secondary of the coil CX runs to a spark plug or a secondary distributor X. S' is a switch in a ground connection from the electromagnet 17. The other terminal of the electromagnet is connected to the vibrator contact 20, through wire 21. The other primary terminal p' of the coil CX is connected to the vibrator contact 19. Battery B is joined to a single metallic yoke connection 22 of the armatures 16 and 18. The operation of this form of the invention is as follows: Under normal conditions, the switch S' is open and current flows from battery B, through yoke 22, armature 16, vibrator 19, wire p', primary of coil CX, wire p, where the circuit is intermittently grounded and completed by the circuit controller H. The coil therefore acts in the normal manner of a trembler coil and produces a cascade discharge in the secondary. The armature 18 is not attracted under these circumstances. If it now becomes necessary to attain a high speed, so high that the primary circuit closure is not sufficient to permit the attraction of the armature 16, the switch S' is closed, so that a divided circuit is produced from the battery B, through the armature 18, vibrator contact 20, wire 21, magnet 17, to ground. As this circuit is continuously closed, the magnet 17 will also insure the continuous vibration of the armature 16 so that there will be a cascade discharge at the periods of primary circuit closure under the influence of the usual circuit controller H. The armature 16 vibrates continuously whenever the switch S' is closed so as to put magnet 17 in the circuit. This is because the circuit through magnet 17 thus closed is entirely separate and independent of the circuit controller H. The magnet 17 is energized in a pulsating manner on account of the vibrator contact 20 and the pulsating mag-

netization produces a continuous vibratory movement of the armature 16. The spark cascade is therefore secured immediately after the primary circuit of the various coils is closed by means of the circuit controller H, without waiting for the armature H to take up a movement of vibration. This secures accurate firing at the highest engine speeds.

What I claim is:

1. In an ignition system for explosion engines, a coil having a trembler or vibrator, an additional or auxiliary vibrator coil, and means for connecting and disconnecting said auxiliary vibrator coil to operate in said primary circuit.
2. In an ignition system for explosion engines, a coil having a trembler or vibrator in its primary circuit, an additional or auxiliary vibrator coil, means for connecting and disconnecting said auxiliary vibrator coil to operate continuously, and means operated by said auxiliary vibrator coil for interrupting said primary circuit in unison therewith.
3. In an ignition system for explosion engines, a coil having a trembler or vibrator in its primary circuit, an additional or auxiliary vibrator coil, means operated by said auxiliary vibrator coil for intermittently interrupting said primary circuit, and means for discontinuing the operation of the auxiliary vibrator coil when desired.
4. In an ignition system for explosion engines, a plurality of coils having tremblers or vibrators in their primary circuits, an auxiliary vibrator coil, and means for connecting said auxiliary vibrator coil in series or multiple with said primary circuits, and means actuated by said auxiliary vibrator coil for interrupting said primary circuits when said vibrator coil is in series therewith.
5. In an ignition system for explosion engines, coils having vibrators or tremblers in their primary circuits, an additional or auxiliary vibrator coil in a multiple circuit with said coils and means operated by said auxiliary vibrator coil for interrupting said primary circuits independently of the usual vibrators or tremblers.
6. In an ignition system for explosion engines, coils having vibrators or tremblers in their primary circuits, an additional or auxiliary vibrator coil in a series circuit with said coils and means operated by said auxiliary vibrator coil for interrupting said primary circuits independently of the usual vibrators or tremblers.
7. In an ignition system for explosive engines, coils having vibrators or tremblers in their primary circuits, an additional or auxiliary vibrator coil in a multiple circuit with said coils, means operated by said auxiliary vibrator coil for interrupting said primary circuits independently of the usual vibrators or tremblers, and means for discontinuing said auxiliary vibrator coil.
8. In an ignition system for explosion engines, coils having vibrators or tremblers in their primary circuits, an auxiliary vibrator coil adapted to be placed in series or parallel therewith, and means operated by said auxiliary vibrator coil for interrupting the primary circuits.
9. In an ignition system for explosion engines, coils having tremblers or vibrators in their primary circuits, an additional or auxiliary vibrator coil having two armatures, one of said armatures controlling the said auxiliary vibrator coil and the other operating to interrupt said primary circuits.
10. In an ignition system for explosion engines, coils having tremblers or vibrators in their primary circuits, an additional or auxiliary vibrator coil having two armatures, one of said armatures controlling the said auxiliary vibrator coil and the other operating to interrupt said primary circuits, and means for discontinuing said auxiliary vibrator coil when desired.
11. In an ignition system for explosion engines, a coil having a vibrator or trembler in its primary circuit, an additional or auxiliary vibrator coil having two armatures, one of which is adapted to operate the vibrator coil, and means for including either of said armatures in the primary circuit of said coil.
12. In an ignition system for explosion engines, a coil having a vibrator or trembler in its primary circuit, an ad-

ditional or auxiliary vibrator coil, and means operated by said auxiliary vibrator coil for acting in lieu of the usual pulsating magnetization of the coil, for causing an intermittent primary circuit rupture thereof.

- 5 13. In an ignition system for explosion engines, a coil having a trembler or vibrator in its primary circuit, an additional or auxiliary vibrator armature, a magnet acting on said armature, means for including said magnet in shunt or series with said primary circuit, an additional
10 means operated by said magnet for interrupting the primary circuit when said magnet is in multiple therewith.

14. In an ignition system for explosion engines, coils having vibrators or tremblers in their primary circuits, an additional or auxiliary vibrator coil having two armatures,
15 one having a slower period of vibration than the other and controlling the auxiliary vibrator coil and the other operating to interrupt said primary circuits.

15. In an ignition system for explosion engines, coils

having tremblers or vibrators in their primary circuits, an additional or auxiliary vibrator coil having two armatures 20 one of which is longer and heavier than the other so as to have a slower period of vibration said armature controlling the auxiliary vibrator coil, the other armature operating to interrupt said primary circuits.

16. In an ignition system for explosion engines, coils 25 having non-adjustable tremblers or vibrators in their primary circuits, an additional or auxiliary vibrator coil, and means for putting such auxiliary vibrator coil in the primary circuits of said first mentioned coils when it is desired to obtain a hotter ignition spark.

In witness whereof, I subscribe my signature, in the presence of two witnesses. 30

RICHARD VARLEY.

Witnesses:

WALDO M. CHAPIN,
MAY BIRD.