R. VARLEY.

ELECTRICAL SYSTEM.

APPLICATION FILED OCT. 16, 1914.

1,198,794.

Patented Sept. 19, 1916.

5 SHEETS—SHEET 1.

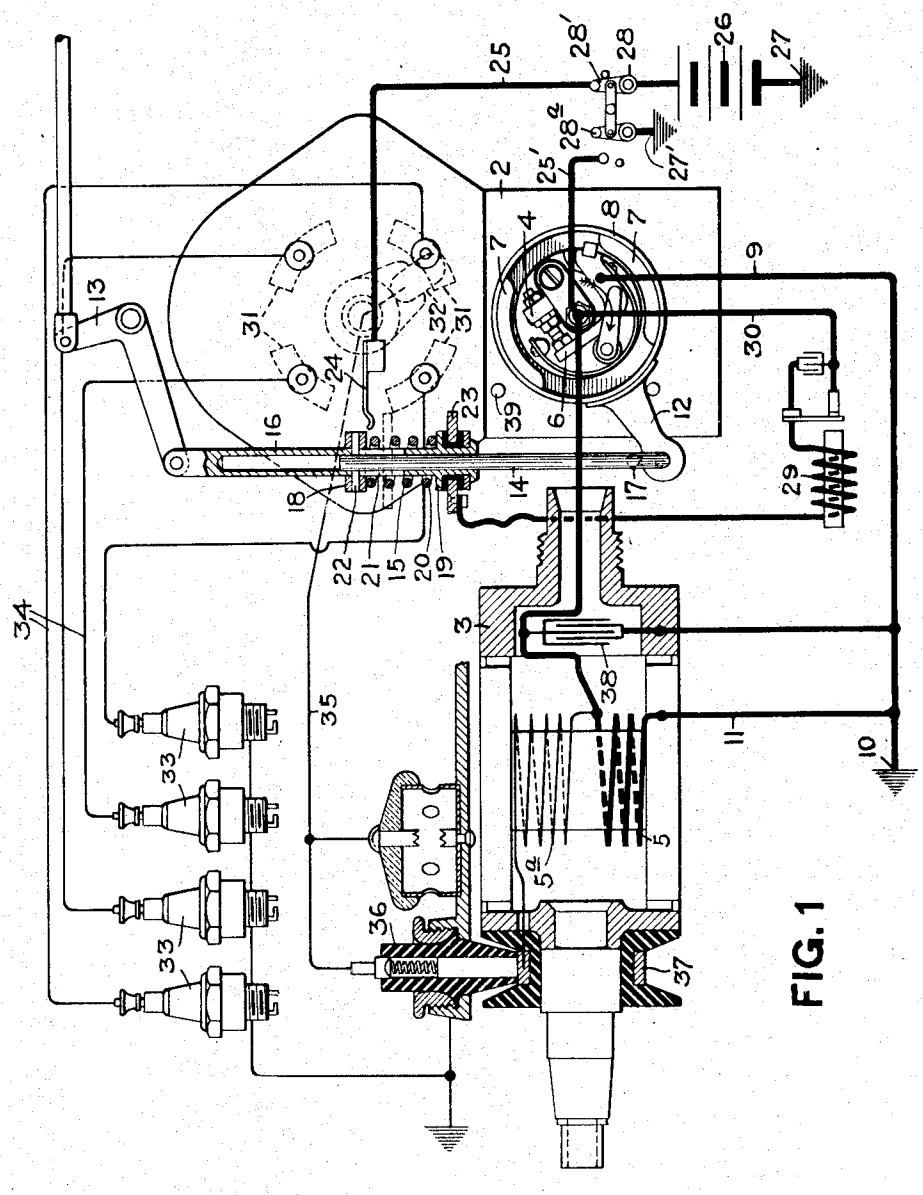

FIG. 1

WITNESSES

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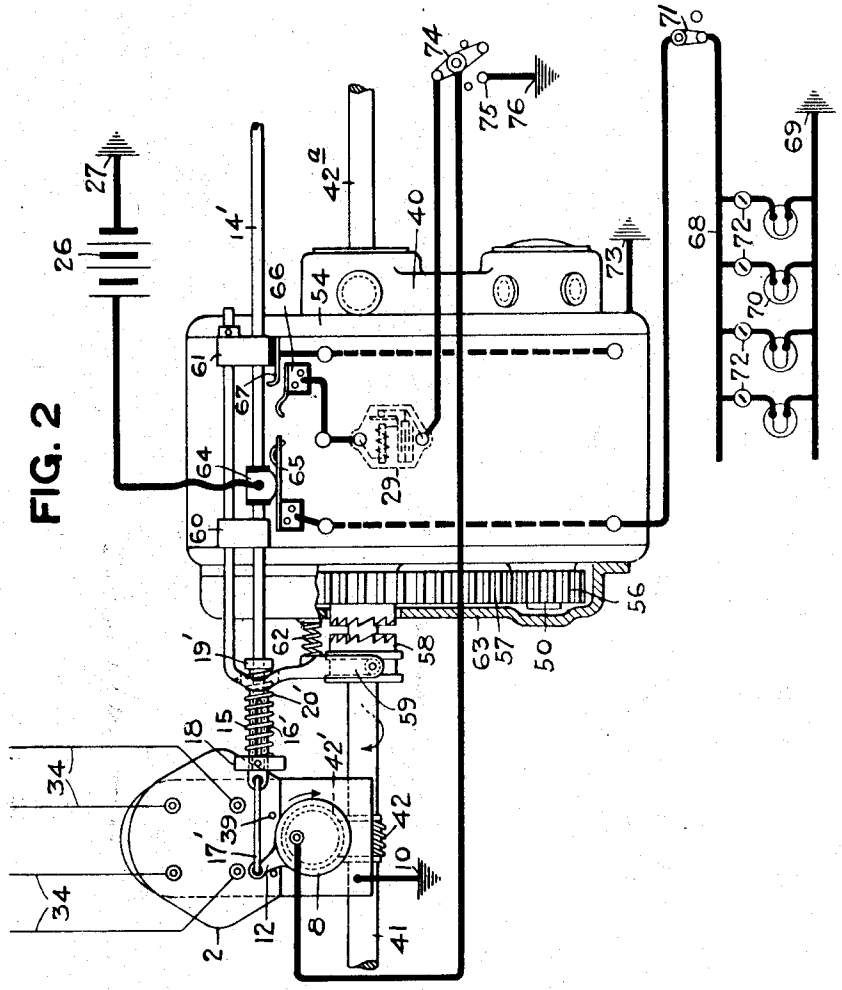
5 SHEETS—SHEET 2.

FIG. 2



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5 SHEETS—SHEET 3.

FIG. 4

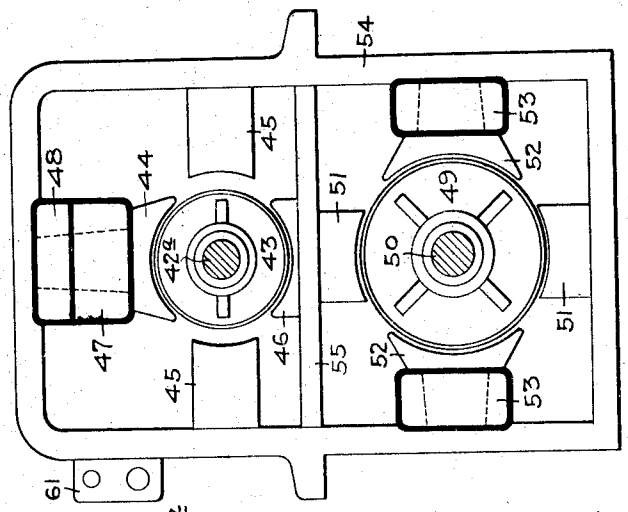

FIG. 3

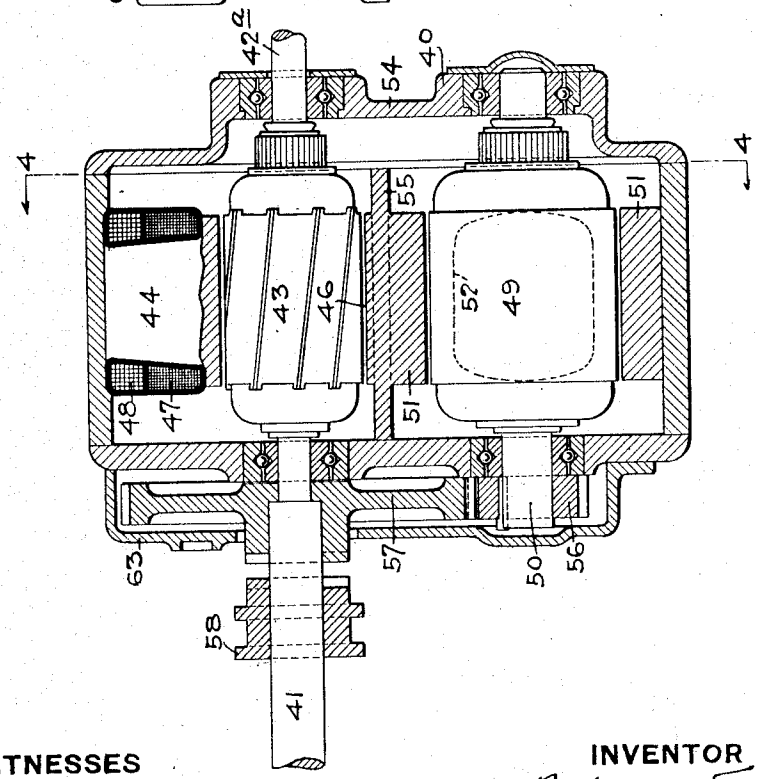

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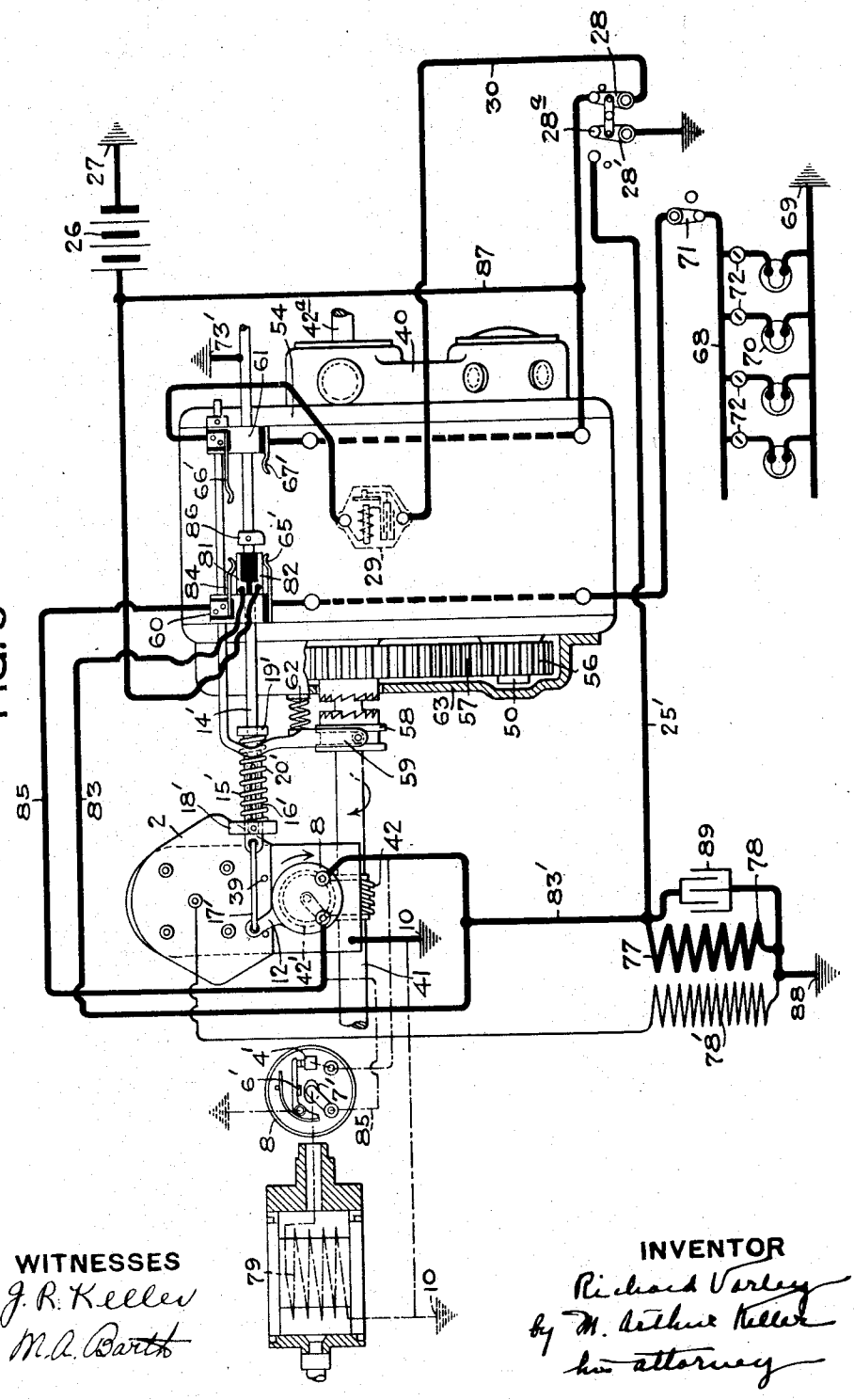
FIG. 5



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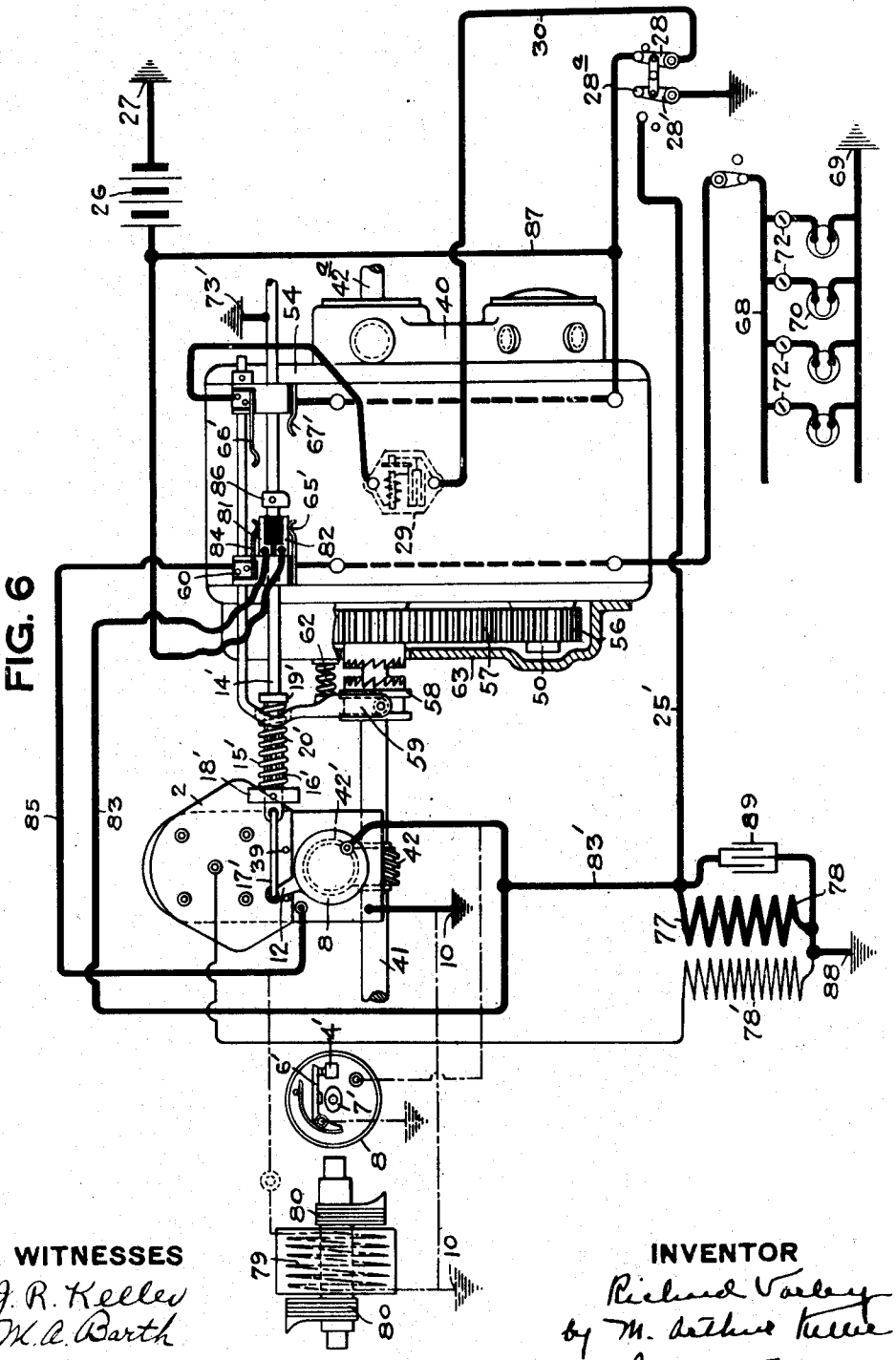
5 SHEETS—SHEET 5.

FIG. 6



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UNITED STATES PATENT OFFICE.

RICHARD VARLEY, OF ENGLEWOOD, NEW JERSEY, ASSIGNOR TO VARLEY DUPLEX MAGNET COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTRICAL SYSTEM.

1,198,794. Specification of Letters Patent. Patented Sept. 19, 1916.

Original application filed March 12, 1913, Serial No. 753,703. Divided and this application filed October 16, 1914. Serial No. 866,922.

To all whom it may concern:

Be it known that I, RICHARD VARLEY, a citizen of the United States of America, residing at Englewood, in the county of Bergen and State of New Jersey, have invented new and useful Improvements in Electrical Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form part of this specification.

This invention is a new and improved system and apparatus whereby the propelling combustion engine of an autovehicle, such as an automobile, etc., may be started and driven. It relates particularly to the production of sparks for exploding the combustible mixture in the cylinders of the engine, and also has relation to a system wherein the particular spark producing means hereinafter disclosed is advantageously associated with engine starting mechanism. As such a device, I provide, generally stated, a system wherein a magneto generator is employed in association with a current source, preferably a battery, in such manner that I may obtain, without the use of the usual heavy vibrator coil or other complicated apparatus, efficacious sparks for initial driving or starting of the engine and at other times. This system may, as hereinafter described, find embodiment in apparatus wherein the current source may be brought into and out of association with the magneto generator, upon adjustment of the ignition contact mechanism or upon engagement and disengagement of starting means with the engine.

The present application is a division of my application Serial No. 753,703, filed March 12th, 1913.

While I have shown my invention as embodied in preferable apparatus and circuit arrangements, it will be premised that changes may be made therein without departing from my invention.

Figure 1 is a diagrammatic view showing a system including magneto generator apparatus, involving my invention; Fig. 2 is a side elevational view of an engine starter and generator unit and a magneto generator, embodying my invention; Fig. 3 is an enlarged longitudinal vertical sectional view of the starting motor and generator; Fig. 4 is an elevational view taken on the line 4—4 of Fig. 3, but showing the commutators of the motor and generator in elevation; Fig. 5 is an elevational view, partly diagrammatic, corresponding with Fig. 2, but showing my invention as employing a magneto generator having a separate high tension transformer associated with a primary winding on the magneto armature; and Fig. 6 is a similar view, but showing the magneto as having its primary winding stationary, or separate from the movable armature.

Referring to Fig. 1, I show, largely in diagram, a magneto generator, preferably of the "high tension" self-contained type, or that form in which the magneto armature is provided with a primary winding and an inductively associated secondary winding in the circuit of which is included the usual high tension distributer of the magneto and the spark plugs of the engine cylinders, as is well understood in the art. In this view the mageto is indicated by the numeral 2, and the armature 3 thereof is shown as diagrammatically transposed and partly in section for the purpose of clarity in illustrating the winding thereon and the circuit connections to be hereinafter more fully described.

The magneto interrupter or timer mechanism may be of the usual construction, comprising a fixed contact 4 which connects with the live end of the primary winding 5 of the armature, and a movable contact or interrupter lever 6 pivotally carried by the armature or otherwise associated therewith as to be commensurately rocked on its pivot by the symmetrical projections or cams 7 carried by the casing 8 which is concentrically mounted and rotatively shiftable with respect to the armature to obtain spark advance and retard, as is well understood. The contact lever 6 is grounded, as by lead 9, and ground 10, in common with the opposite end of the primary winding 5, as through lead

11; said grounding leads being merely symbolical of the usual ground circuit connections preferably established through the frame of the magneto generator or associated equipment.

To obtain spark advance and retard the magneto timer or interrupter casing 8 usually has a shift lever or rock arm 12, and in the present invention I show this arm as being operatively connected to a bell crank arrangement 13 through the intermediary of a connecting link 14 intercalated in which is a yieldable coupling or tension member 15 which permits of further movement of the bell crank after the casing 8 (and cams 7) has been shifted to spark delay or retard position, for the purpose to be hereinafter described. This yieldable coupling 15 comprises a sleeve member 16 which receives a rod 17 of the link 14, and a collar 18 fixedly carried by the rod 17, between which collar and a flange or shoulder 19 on the sleeve 16 is interposed a coil spring 20; the sleeve 16 having an elongated slot 21 to permit of travel of the pin 22 by means of which the collar is fastened to the rod 17. Positively associated with the shifting member or crank 13, as being carried by the sleeve 16, is a contact plate 23, and mounted above the said contact plate 23 so as to be engaged by the plate is a contact finger 24 which connects, as by lead 25, with a battery 26 which is grounded as at 27. A switch arm 28 of a double arm switch 28′ is shown as controlling the connection of finger 24 with the battery. The plate 23 connects with vibrator coil mechanism or a trembler coil 29, the other terminal of which connects with the live end of the primary winding of the magneto armature, as by lead 30, and contact 4. The usual distributer segments of the magneto distributer are indicated at 31 and the distributer arm 32; said segments connecting with spark plugs 33 of the engine cylinder as by leads 34, and the distributer arm 32 with the secondary winding 5^a of the magneto armature through lead 35, brush 36 and collector ring 37, in the usual manner, while connected across the primary winding of the armature is the regular condenser 38, and connecting with the fixed contact 4 or the live end of the primary winding is a lead 25′ through which and the other arm 28^a of the double arm switch the magneto may be short circuited or grounded, as through ground 27′ and thereby rendered inoperative in the usual manner.

In starting the engine of an autovehicle it is desirable that the ignition controller or magneto contacts be adjusted, as by rotative shifting of the casing 8, to spark delay position so as to overcome advanced or previous energizing of the ignition circuit and tendency to premature explosion of the combustible charge in the cylinders of the engine and resultant back firing. By shifting the rod or connecting link 14 upwardly through the action of the bell crank 13 the magneto casing 8 will be shifted so as to bring the cams 7 to spark delay position; such movement preferably being limited by a suitable finger or upper stop 39 against which the arm 12 may abut when said casing occupies full retard position. Shifting of the casing 8 to spark delay position, as above described, brings the contact plate 23 to a position beneath the finger 24, as indicated in dotted lines, and upon further upward shifting of the sleeve 16, through compression of the spring 20 of the yieldable coupling 15, the plate 23 may be brought into contact with the finger 24. As a result, upon separation of the magneto timer or interrupter contacts 4 and 6 through rotation of the magneto armature and action of the cam 7 on said contact lever 6, a primary battery circuit will be established from battery 26, lead 25, contact finger 24 and plate 23, vibrator coil or trembler 29 through lead 30 to the primary winding 5 of the armature and usual ground (ground 10) back to battery. Pulsative flow of the current, set up by the activity of the vibrator coil or trembler 29 causes a disturbance of the induced flux of the magneto armature so that a high potential current is produced in the secondary winding 5^a of the armature as the distributer closes a circuit through a spark plug 33, in a well known manner.

By providing a positive station or fixed stop to limit the spark retarding movement, as stop 39, it will be apparent that the casing 8 at any time may be brought to full retard position without connecting the battery with the winding of the armature, for in order to complete such circuit through contacts 24 and 23, a further movement of the sleeve 16, through compression of the spring 15, is necessary to bring the plate 23 into engagement with contact finger 24. Therefore, when the magneto is being driven at a speed productive of efficient ignition sparks and it is desired to retard the time of ignition in the usual manner, such shifting of the cams 7 to spark delay position may obtain without liability of bringing the battery into circuit with the magneto winding with resultant bucking or counter-action of the battery current on the magneto generated current.

In Fig. 2 I show a starting and lighting system involving my above described principle of establishing a battery ignition circuit through the magneto. In this view the numeral 40 indicates a generator and motor unit operatively associated with a shaft 41 which may be geared to the engine in any suitable manner, and by which the magneto may be driven, as through spiral or worm gear 42 carried by the shaft 41 and gear 42′

mounted on the magneto armature. The generator and motor may be of any suitable design but, preferably, as indicated in Figs. 3 and 4, the generator is a shunt wound machine such as described in my Patent No. 1,081,413, dated December 16th, 1913, while the starting motor is preferably of the series wound type.

In Figs. 3 and 4 the armature 43 of the generator element is shown as being carried by the shaft 41, around which armature are disposed pole pieces 44, 45 and 46 forming between them the magnetic field chamber for said armature. To obtain compactness of space the upper pole 44 is elongated and carries a shunt winding 47 and a series winding 48, while the lower pole 46 is of a shallow nature, which permits close spacing of the armature 43 and a motor armature 49 carried by a shaft 50; the field poles of the motor being indicated by the numerals 51 and 52 which latter poles are the longer ones of the set, carrying the field winding 53, and are disposed laterally so as to operate toward vertical compactness of the general framework 54 which is preferably common to both the generator and motor elements, although, if desired, the generator and motor may each have their own separate frame instead of the single frame shown and in which the pole pieces 46 and upper pole 51 are commonly carried by a cross-piece or member 55 thereof.

The shaft 50 of the motor element fixedly carries a pinion 56 meshing with which is a gear 57 normally loosely carried by the shaft 41. As shown in Fig. 3, the gear 57 is preferably provided with a stepped bore so as to fit the shaft 41 and a reduced portion 42^a of the shaft which directly carries the armature 43, to prevent longitudinal shifting of the gear. Keyed to the shaft 41 is a clutch collar 58 longitudinally shiftable into and out of clutch engagement with the gear 57 by means of a shifting yoke 59 slidably mounted, as shown in Figs. 2, 5 and 6, in suitable bearings 60 and 61 at the side of the frame 54. A coil spring 62 (see Fig. 2) interposed between the yoke 59 and a casing 63 inclosing the gears 56 and 57, normally holds the collar 58 in non-operative position or non-clutch engaging position.

As shown in the more diagrammatic view, Fig. 2, a shiftable rod 14′ also preferably mounted in the bearing pieces 60 and 61, passes through a bore in the shifting yoke 59 and connects by means of a yieldable coupling 15′ and link 17′ with the shifting arm 12 of the timer casing 8. The yieldable coupling 15′ may correspond in construction with the coupling 15 above described, comprising a tubular member or sleeve 16′ slotted to slidably receive the fastening pin or cotter which secures a collar piece 18′ to the operating rod 14′. This collar, as in the case of collar 18 described in connection with Fig. 1, loosely surrounds the sleeve 16′ and between said collar and a shoulder 19′ on the sleeve is interposed a spring 20′.

The shifting rod or member 14′ carries a switch plate or button 64 arranged to be shifted into and out of engagement with switch contact blades 65, 66 and 67, as hereinafter described. The contact switch member 64 connects with the battery 26, and the contact 65 leads to one terminal of the generator series field winding which in turn connects as described in my application Serial No. ——— with a light or work circuit 68 grounded at 69, and in which are shown lamps 70 which may be controlled either collectively by a suitable switch 71 or individually by switches 72. The contact blade 67 connects with one terminal of the exciting winding of the motor element while the opposite end of the said motor winding is grounded, as at 73. The live end of the primary winding of the magneto connects through lead 30 and switch 74 with vibrator or trembler coil mechanism 29 and contact 66. In this view the small vibrator coil or trembler apparatus is shown as being disposed or housed within the frame of the generator or motor elements. The switch mechanism 74 may be shifted so as to short circuit the magneto, as through contact button 75 and ground 76, in a well known manner.

It will be apparent, by referring to Fig. 2, that the magneto casing 8 may be shiftably adjusted to obtain spark advance or retard in the usual manner, during driving of the engine. If it is desired to start the engine after it has become idle, the operating rod 14′ is shifted so as to bring the shifting arm 12 of the magneto casing 8 to position of full spark retard against the stop 39, and upon continued movement of the rod, under compression of the coupling 15′, the switch member or contact 64 may be brought into engagement with contact piece 66. As the magneto is necessarily geared in synchronism with the engine, should the engine be under a compressible charge susceptible of explosion, upon energizing of the ignition circuit, and without initial cranking, the contacts 4 and 6, (see Fig. 1) would be separated, so that engagement of switch member 64 with contact piece 66 will establish a circuit from battery 26 through vibrator 29, lead 30, magneto winding 5, and ground 10 of the magneto, back to the battery in the manner already described in connection with Fig. 1, for explosion of the combustible charge in the cylinders of the engine. If the condition of the engine is such that it must be turned over or initially driven for intake of live gas charges, the rod 14′ may be advanced still farther so as to bring the con-

tact 64 into engagement with contact 67, upon doing which current will flow from the battery 26 through the motor winding to ground 73 and ground 27 back to battery thereby energizing the motor. Such movement of the rod 14′ will also bring the collar 18′ carried by the rod into shiftable engagement with the yoke 59, bringing the clutch member 58 into clutch engagement with the gear 57 as the motor circuit is completed. Energizing of the motor sets up driving of the shaft 41 through the gearing connection above described and driving of the shaft also operates the magneto generator through the gears 42 and 42′ so that closing of a circuit through the spark plug or spark plugs, of the engine by the distributer occurs concomitantly with opening or separation of the magneto contacts and resultant completion of a circuit through primary winding thereof and vibrator mechanism 29, as already described; the switch contact member 64 remaining in contactual engagement with the contact piece 66 during the motor circuit engagement, above described, with contact member 67. The generator contact member 65 is preferably so disposed that the switch contact 64 passes therefrom as it moves into engagement with either one or both contact members 66 and 67, so that full battery current is available for starting service.

The yieldable coupling 15′, or more particularly, the collar 18′ and the switch member 64 are so positioned on the operating rod 14′ with respect to the shifting yoke and length of travel of the magneto spark adjusting arm 12 that ordinary spark advance or retard adjustability of the magneto casing 8 may obtain as already described, without necessarily bringing the battery into circuit with the magneto winding, and the battery ignition circuit through the vibrator mechanism may be completed without bringing the battery into motor starting connection so that where the engine is under a charge capable of being exploded without cranking or turning over of the engine and upon energizing of the ignition circuit, the ignition circuit may be completed without the necessity of operating the motor.

In Figs. 5 and 6 I show my system as involving a magneto having a separate high tension transformer or "step up" coil 77 the primary 78 of which is periodically brought into circuit with the energizing winding 79 of the magneto, upon opening and closing of the magneto contacts 4′ and 6′, as is well understood in the art. In these two views 5 and 6 I show the magneto winding, armature and contact connections transposed in skeleton diagram for the purpose of clarity in illustrating the circuits, and the generator and engine starting unit shown corresponds with Fig. 2 above described with the exception of certain changes in switch connections to be hereinafter described. In Fig. 5 the energizing winding 79 is shown as being carried by the magneto armature, while in Fig. 6 the construction indicated is of the type having a fixed or stationary winding which is impressionistically energized by the rotating or oscillating armature 80. In each of these views the shifting rod 14′ carries a plurality of contact members 81 and 82 the former of which connects, as by lead 83, with the contact 4′ of the magneto while contact 82 connects with the battery 26. Normally lying in contactual engagement with the switch contact members 81 and 82 are contact fingers 84 and 65′ respectively. Contact 84 connects with the live end of the magneto winding, as by means of lead 85, and contact 65′ connects with the generator winding as in the case of contact 65 above described.

The numeral 66′ indicates a contact connecting with the vibrator 29, while the numeral 67′ indicates a contact finger connecting with the exciting winding of the motor and adapted to be engaged by the contact pieces 86, grounded as at 73′, as will be hereinafter described. The opposite terminal of the motor windings connects with the battery as by lead 87 and the vibrator mechanism also has connection with the battery through lead 30, above described, switch arm 28 of the double armed switch 28′, and the lead 87. The secondary coil or winding 78′ of the transformer is grounded in common with the primary coil 78, as at 88, and leads to the high tension distributer of the magneto in the usual manner. At 89 is indicated the regular condenser connected across the contacts 4′ and 6′, which condenser is charged and discharged through the primary coil upon opening and closing of the primary magneto circuit, as is well understood. As described in connection with Fig. 1, the magneto may be rendered inoperative when desired in the usual way by grounding as through the switch arm 28^a and lead 25′.

It will be seen that under normal operation of the magneto, with the contacts 4′ and 6′ closed the winding of the magneto remains short circuited and upon separation of the contacts through driving of the magneto, and rotation of the interrupter cam 7′, as is well understood, current will flow from the winding of the magneto through lead 85, contacts 84 and 81, lead 83 and lead 83′ to the primary coil 78 of the transformer back to the magneto winding through grounds 88 and 10, thereby inducing an ignition current in the secondary coil or winding 78′. Where the engine is idle but is capable of starting, without cranking, upon energizing of the ignition circuit, it may be started by so shifting the operating

rod 14′ as to bring the switch contact 81 into engagement with the contact finger 66′ upon doing which current will flow from the battery through lead 87, switch arm 28, vibrator mechanism 29, contacts 66′ and 81, lead 83 and, the contacts 4′ and 6′ being open or separated, to lead 83′ through the primary coil of the transformer and grounds 88 and 27 back to battery. Where the engine is capable of starting, as just described, without cranking, the contacts 4′ and 6′ would be separated so that the current from the battery would not be short circuited through the magneto. Upon starting of the engine and rotation of the magneto armature and resultant periodical opening and closing of the contacts the battery is alternately connected in circuit with the primary coil of the transformer and short circuited through the magneto contact or breaker arm 6′. Where it is necessary to crank or turn over the engine by the starting motor, as above described, the rod 14′ may be shifted so as to bring the contact member 86 into engagement with the contact finger 67′ for energizing of the motor winding; the circuit from the battery through the motor winding being completed through lead 87, contacts 67′ and 86 and ground 73′ back to battery through ground 27. After the engine has become self-propulsive and drives the magneto at a speed productive of effective ignition sparks, the switch member 81 may be shifted from engagement with the battery connecting contact 66′ into engagement with the magneto winding contact 84, thus breaking the battery ignition circuit through the vibrator mechanism and restoring to normal the magneto circuit conditions through lead 85 and lead 83.

It will be apparent that changes may be made in the construction and the circuit arrangements shown, without departing from my invention. For instance, any suitable switch mechanism may be provided for establishing an ignition circuit through the magneto winding, and the arrangements of the electrical circuits in association with the starting apparatus and generator unit may be varied and controlled by any suitable switch mechanism.

It will be seen that I provide a system wherein the magneto generator delivers a hot effective spark upon slow driving of that element. As a result, it is not necessary to employ starter apparatus designed to drive the engine at high speeds in order to bring about effective driving of the magneto. The starting apparatus may be of such character as to slowly drive or turn over the engine, or the system will be found to be of great value where the engine is manually started.

In the particular construction and arrangement shown and described it will be seen that the control of the system is largely automatic by reason of the fact that spark adjustment of the contact mechanism is necessary to bring the magneto winding into and out of energizing relationship with the source of current. Furthermore, this requirement insures the adjustment of the contact mechanism to spark retard position before the magneto can be connected with the source of current.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In electrical systems, a magneto generator, a primary winding associated therewith, a source of electrical energy, an ignition circuit, circuit controlling mechanism for the primary winding and capable of spark adjustment, and means for connecting the primary winding into circuit with the source of electrical energy, for energizing the ignition circuit; said means including current vibrator mechanism, dependent for operation upon adjustment of the controller.

2. In electrical systems, a magneto generator, spark producing winding associated therewith, controller mechanism, means for adjustably shifting the controller mechanism for obtaining spark advance and retard, a source of electrical energy, and means whereby the winding may be energized from the source of energy only after the controller mechanism has been adjusted to spark retard position.

3. In electrical systems, a magneto generator, spark producing winding, an ignition circuit associated therewith, controller mechanism capable of spark adjustment, means for adjustably shifting the controller mechanism for spark advance and retard, a battery, and means whereby said winding may be energized by the battery only after the contact mechanism has been adjusted to spark retard position.

4. In electrical systems, a magneto generator having winding, an ignition circuit associated therewith, an ignition controller, a source of electrical energy, means for shifting the controller to spark retarding position, and means associated with the shifting means, whereby the winding may be brought into energizing relationship with the source of energy after said controller mechanism has been shifted to spark retarding position.

5. In electrical systems, a magneto generator, spark producing winding, associated therewith, an ignition circuit, contact mechanism capable of spark adjustment, a source of electrical energy, means for shifting the contact mechanism to spark retarding position, and means associated with the shifting means, whereby the winding may be brought into energizing relationship with the source

of energy after said contact mechanism has been shifted to spark retarding position; said shifting mechanism being capable of adjusting the contact mechanism to full retard position without establishing said energizing relationship of the winding and source of energy aforesaid.

6. In electrical systems, engine starting apparatus, a source of electrical energy, spark producing means including a magneto generator having primary winding associated therewith, means for bringing the primary winding into circuit with the source of energy, and means for connecting the starting apparatus with the source of energy and so associated with the last named means that said energizing of the starting apparatus occurs subsequent to energizing of the primary winding from the source of energy.

7. In electrical systems, engine starting apparatus, a generator, a battery, a work circuit, switch means for bringing the work circuit into association with the generator and battery, spark producing means including a magneto generator having winding, and an ignition controller capable of spark adjustment, means for bringing the magneto winding into circuit with the battery, and means including the switch means aforesaid, for disconnecting the generator and work circuit from the battery and for connecting the starting apparatus with the battery and dependent for operation upon spark adjustment of the controller.

8. In electrical systems, engine starting apparatus, a generator, a battery, a work circuit associated with the generator and battery, switch apparatus for bringing the generator, motor and work circuit into and out of circuit with the battery, a magneto generator, a primary winding associated therewith, an ignition circuit associated with the winding, contact interrupter mechanism actuated by the magneto, means for adjusting the contact mechanism to spark retard position, and means including the switch apparatus, associated with the adjusting means, whereby the magneto may be brought into circuit connection with the battery to cause the primary winding to be periodically energized from the battery upon operation of the contact mechanism; said last named means being dependent for operation upon shifting of the contact mechanism in spark retarding position.

9. In electrical systems, engine starting apparatus, a generator, a battery, mechanism for connecting the starting apparatus with the engine, a work circuit associated with the generator, switch apparatus associated with the connecting mechanism, for bringing the work circuit and generator into circuit with the battery, spark producing means including a magneto generator having a primary winding associated therewith, means for connecting the starting apparatus with the battery and including the switch apparatus, and means associated with said connecting means, for bringing the winding of the magneto into circuit with the battery.

10. In electrical systems, engine starting apparatus, a generator, a battery, mechanism for connecting the starting apparatus with the engine, a work circuit associated with the generator, switch apparatus for bringing the work circuit into circuit with the battery and also the generator into circuit with the battery, spark producing means including a magneto generator and a primary winding associated therewith, means for connecting the starting apparatus with the battery, and including the switch apparatus aforesaid, and means operated by said connecting means, for bringing the magneto winding into circuit with the battery; said switch apparatus being adapted to disconnect the generator and work circuit from the battery during energizing connection of the battery with the primary winding.

11. In electrical systems, engine starting apparatus, a generator, a battery, mechanism for connecting the starting apparatus with the engine, a work circuit associated with the generator, switch mechanism associated with the connecting apparatus, for bringing the work circuit and generator into circuit with the battery, spark producing means including a magneto generator and a primary winding associated therewith, means including said switch mechanism for making a circuit connection between the battery and starting apparatus, means for bringing the primary winding into circuit with the battery before completion of the starting circuit, for establishing an ignition circuit, and switch mechanism for controlling said ignition circuit.

12. In electrical systems, engine starting apparatus, a generator, a battery, mechanism for connecting the starting apparatus with the engine, a work circuit associated with the generator, switch apparatus for bringing the work circuit and generator into circuit with the battery, spark producing means including a magneto generator having a primary winding associated therewith and contact mechanism capable of spark adjustment, means for adjusting the contact mechanism, means including the switch apparatus, for making a circuit connection between the battery and starting apparatus, and dependent for operation upon shifting of the contact mechanism to spark delay position, and means for bringing the primary winding into circuit with the battery; said switch apparatus being adapted to disconnect the generator and work circuit from the battery during energzing connection of the battery and starting apparatus, said connection of

the primary winding with the battery being dependent upon occupation of the contact mechanism of spark delay position and subsequent to completion of the circuit connection between the starting apparatus and battery.

In testimony whereof I have hereunto set my hand.

RICHARD VARLEY.

Witnesses:
N. P. HAMILTON,
E. I. CROSWELL.