

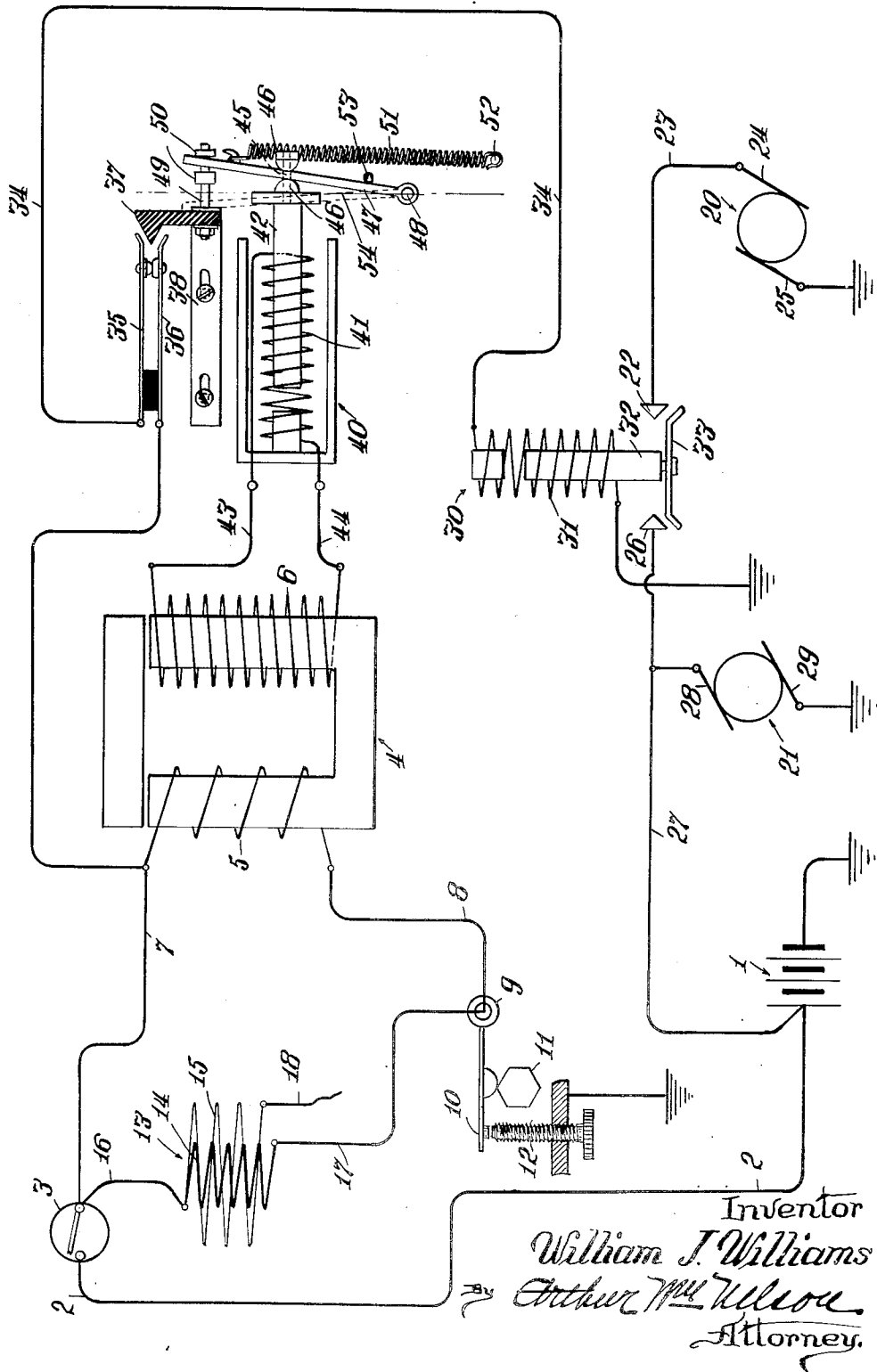
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MEANS FOR PRODUCING AN ELECTRIC CURRENT

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## UNITED STATES PATENT OFFICE

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## MEANS FOR PRODUCING AN ELECTRIC CURRENT

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This invention relates to improvements in methods of and means for producing an electric current and it consists of the matters hereinafter described and more particularly pointed out in the appended claims.

The primary object of the invention is to provide a novel method and means for producing electrical current of one form from that of another form by indeed simple and efficient means.

Another object of the invention is to provide an improved method of producing an alternating current from an available source of direct current by means of a transformer having a primary winding connected to said source of direct current which is interrupted in its passage to said winding to induce an alternating current in the associated secondary winding of the transformer, the output of which may be employed for any desired purpose.

The above mentioned objects of the invention as well as others, together with the many advantages thereof, will more fully appear as I proceed with my specification.

The drawing illustrates a diagrammatic view of a means whereby the improved method may be readily carried out.

The invention is herein illustrated and will be herein described as embodied in an automatic control for the starting systems of automobile and like engines, because in such systems many of the well-known elements are found by means of which the method may be advantageously carried out. Such elements include a source of direct current as for instance a storage battery, a relay actuated in one direction by alternating current and means such as the ignition breaker points driven by the engine for interrupting the flow of direct current to the primary winding of a transformer incorporated into the system to so effect the secondary winding of said transformer as to change its output to an alternating current which is fed to the relay for actuating it in one direction as before mentioned for controlling the circuit to the starting motor for the engine.

The value of the alternating current induced in the secondary winding of the transformer varies in direct ratio to the speed of said interruptions. In automobile engine starting systems, the number of interruptions at the lowest idling speed of the engine is about twice that of the fastest cranking speed of the starting system. Thus the setting of the relay switch is so gaged that it requires a current value equal to engine idling speed to cause it to operate for its intended purpose.

The invention is also of advantage in such systems because heretofore such systems operated either through the function of the generator, devices actuated by vacuum produced in the inlet manifold, mechanical governing devices and reverse current circuits and various combinations thereof, but such systems were unsatisfactory and unreliable because the elements upon which they relied for functioning were not in themselves constant.

Referring now in detail to that embodiment of the invention illustrated in the drawing, 1 indicates a source of direct current such as a storage battery found in the modern automobile. One side of this battery is grounded in the usual manner while the other side thereof is connected by a conductor 2 to one side of a switch 3 which in this instance is the ignition switch. 4 indicates as a whole a transformer that includes a primary winding 5 and a secondary winding 6. One end of said primary winding is connected by a conductor 7 with the other side of the ignition switch while the other end of said winding is connected by a conductor 8 with the axis 9 of a vibrating arm 10. Said arm in this instance forms a part of the ignition breaker and is vibrated in any suitable manner as by the cam 11 which of course, is rotatively driven in the operation of the associated engine (not shown). The vibrating arm is adapted to make and break contact with a fixed contact member 12 which is grounded as shown.

13 indicates as a whole the ignition coil including the primary and secondary windings 14 and 15 respectively. One end of both coils is connected to the switch 3 by a conductor

16 while the other end of the primary coil is connected by a conductor 17 to the axis 9 of the vibrating arm 10. The other end of the secondary winding of this coil is connected by a conductor 18 to the distributor (not shown).

20 indicates the starting motor for the engine and 21 indicates the generator driven by said engine. 22 indicates a fixed contact connected by a conductor 23 with one of the brushes 24 of the starting motor, the other brush 25 thereof, being grounded as shown. 26 indicates a second fixed contact associated with but spaced from the contact 22 and said contact is connected by a conductor 27 with the output side of the battery 1. One of the brushes 28 of the generator 21 is connected to said conductor 27 while the other brush 29 thereof, is grounded as shown.

30 indicates an electromagnetic switch for controlling the "on" and "off" periods of the starting motor and such a switch includes a winding or coil 31 and a movable armature 32 which carries a bridge bar 33 for connecting the contacts 22-26 when the coil 31 is energized. One end of said coil is grounded as shown while the other end is connected by a conductor 34 with one of a pair of normally engaged spring contact fingers 35-36, the latter in turn being connected to the conductor 7 before mentioned.

It is apparent from the foregoing that when the switch 3 is closed, current passes from the battery 1 through the conductor 2, switch 3, conductor 7, fingers 36-35, conductor 34 to the coil 31 of the switch 30 which coil being energized attracts the armature 32 and causes the bridge bar 33 to engage and connect the contacts 22-26. Current then flows from the battery 1, through the conductor 27, contact 26, bridge bar 33, contact 22, conductor 23 to the starting motor 20 which is energized and cranks the engine in the manner well-known.

It is apparent that when the engine turns over under its own power, the starting motor should be deenergized to stop the same and in this instance such deenergization is produced by breaking the current thereto by separating the normally engaged contact fingers 35-36. To so separate said fingers, I provide a wedge-like spreader member 37 which is mounted for a limited longitudinal movement toward and away from the associated end of said fingers. Said member is preferably mounted on a carrier plate 38 mounted on any suitable support by means of screw and slot connections 39 whereby said carrier is capable of a limited endwise movement in a guided path.

To impart such movement to said carrier in a direction to spread the contact fingers 35-36 apart, I provide a relay switch 40 operable in one direction by an alternating current. This switch includes a winding 41 and

an armature 42 and the ends of this winding are connected by conductors 43-44 to associated ends of the secondary winding of the transformer. This armature 42 carries at its outer end, a pin 45, carrying longitudinally spaced inner and outer shoulders 46. This pin also passes through the mid portion of a swingable arm or leaf 47 which is pivoted at its bottom end as at 48 to any suitable support. The top end of this arm has extending, there-through, one end of a stem 49 and mounted on said stem upon opposite sides of said arm 47 are inner and outer shoulders or stops 50. The other end of said stem has a limited lost motion connection with the spreader member 37; that is, in a movement of the top end of the arm 47 toward the spreader, the stem 49 slides therethrough, until the inner shoulder or stop engages the same after which further movement of said arm will impart a like movement to the spreader 37.

A spring 51 is anchored at one end as at 52 and has its other end operatively connected to the top end of the arm 47. When the parts are in their normal position wherein the wedge 37 is out of engagement with the fingers 35-36, the arm engages a stop 53 and stands in a position leaning toward the right of the perpendicular plane of the pivoted end of such arm and which plane is indicated by the dotted line 54.

After the engine has been started as before described, the ignition breaker of the engine will, of course, be engine driven and at an idling or driving speed, much higher than cranking speed. In the rotation of the cam 11 of the ignition breaker, it is apparent that the arm 10 is vibrated and rapidly moves into and out of engagement with the fixed contact 12. This, of course, interrupts or makes and breaks the flow of current through the primary winding 5 of the transformer and induces or forms an alternating current in the secondary winding 6. When the value thereof, has become great enough (in accordance with the speed of the engine running under its own power) to energize the winding 41 of the relay switch, then said winding attracts the armature 42 and tends to pull the same inwardly. As the armature moves inwardly, it will through the action of its stem 45 and stops 46, swing the arm 47 to the left as shown in the figure and through said perpendicular plane as shown by said dotted line 54. In this movement of the arm, the stem 49 slides through the wedge member with a lost motion action until the inner stop 50 engages the same, when the carrier 38 slides on its pin and slot connection and the wedge 37 will engage between the outer ends of the fingers 35 and 36 and spread them apart.

This lost motion arrangement is advantageous in that starting load on the relay switch is released so that it only has to overcome the resisting action of the spring 51, the real op-

eration of shifting the wedge being effected after this spring resistance has been overcome.

This breaks the connection between the conductors 7 and 34 so that the winding 31 of the switch 30 is deenergized and the bridge bar 33 then leaves the contacts 26-22 to break the connection the starting motor 20 has with the storage battery through the conductors 27-23. Thus the starting motor is cut out of the system automatically.

When the engine is running under its own power, at any speed above cranking speed (as when turned over by the starter) the direct current passing through the primary winding of the transformer is so effected by the vibration of the arm 10 of the ignition breaker as to induce an alternating current in the secondary winding 6 that will hold the relay switch in a position spacing the fingers 35-36 apart so that the starting motor is deenergized. It is pointed out at this time that due to positioning the spring, its greatest force is exerted when the arm 47 is to the right-hand side of the plane 54 and exerts its least force when in the left-hand side of said plane and such a force is amply resisted by the relay switch at any speed above cranking speed. Should the engine speed be such as to produce an alternating current of low value wherein the pull of the relay switch would substantially balance the pull of the spring, then the arm 47 will vacillate or waver in a balanced position without effecting movement of the wedge 37 because such movement will be accommodated by the lost motion sliding of the stem 49 through the wedge.

When the engine speed drops for any reason, to one below cranking speed as precedes a stopping of the engine, then it is apparent the arm 10 is not receiving those vibrations necessary to induce an alternating current in the winding 6 having a value that offsets the action of the spring 51 with the result that the winding 41 of the relay becomes deenergized. The spring 51 will then act on the arm 47 to swing it to the right and through said plane 54 back up against the stop 53. In this movement of the arm, the wedge member 37 is withdrawn from between the outer ends of the fingers 35-36 which will immediately electrically engage. This will automatically close the circuit from the battery, to the winding 31 of the starter switch and will cause the bar 33 to bridge and connect the contacts 26-22 so that the starting motor is connected to the battery. With the starting motor connected to the battery said motor is energized and will turn over and crank the engine. When the engine is running under its own power and above cranking speed, alternating current is again induced in the winding 6 which energizes the relay switch whereby the wedge 37

spreads the fingers 35-36 to break the circuit to the starter switch 30 which in turn will break connections between the battery and starting motor, which, of course, stops.

It is apparent that by the arrangement described, I am enabled by simple and efficient means to take a direct current and by interrupting it in its passage through the primary winding of a transformer to induce an alternating current in the secondary winding, the output thereof being led to a device to be operated thereby and which alternating current has a current value proportionate to the rapidity of such interruption.

By incorporating the invention in a control system for the starting motors of internal combustion engines as herein described many advantages are attained. Such a system is indeed simplified and made much more reliable and positive in operation.

While in describing the invention, I have referred to the same as embodied in a control system for starting motors for automobiles and the like, the same is to be considered merely as by way of illustration of one of the many practical uses therefor, so that I do not wish to be limited thereto except as may be specifically set forth in the appended claims.

I claim as my invention:—

1. An automotive current producing means comprising in combination, an ignition coil, an ignition circuit breaker, a starting motor and a magnetic circuit breaker therefor, a relay for controlling said magnetic circuit breaker, a transformer including a primary and a secondary winding, the primary winding being in parallel with the ignition coil and the secondary winding being operatively connected to the relay and a source of direct current operatively connected to the ignition coil and to said primary winding, said ignition circuit breaker being so connected in the circuit of said primary winding as to interrupt the feed of direct current thereto so as to produce an alternating current in the secondary winding for operating the relay.

2. An automotive current producing means comprising in combination with an ignition coil, a mechanically actuated vibrating arm for controlling the circuit through said coil, a starting motor, a magnetic circuit breaker therefor, a relay for controlling said magnetic circuit breaker, a transformer including a primary and a secondary winding, the primary winding being in parallel with the ignition coil and the secondary winding being operatively connected to the relay and a source of direct current operatively connected to the ignition coil and to said primary winding, said mechanically vibrating arm being so interposed in the circuit of said primary winding as to interrupt the feed of direct current thereto and thus produces an

alternating current in the secondary winding to actuate said relay.

3. In combination with a source of current supply having a predetermined value, an ignition circuit breaker, an engine starting motor, electromagnetic means for controlling the operative connection of said motor with said current supply, a switch for controlling the energizing of said ignition coil and said electromagnetic means, a transformer including primary and secondary windings and which primary winding is energized in the actuation of said switch and means operable by a current having a different current value for deenergizing said electromagnetic means and which last mentioned current is induced in the secondary winding by the action of said circuit breaker upon said primary winding.

4. In combination with a source of current supply having a predetermined value, an ignition circuit breaker, an engine starting motor, electromagnet means for controlling the operative connection of said motor with said current supply, a transformer including primary and secondary windings, a switch movable from an "off" to an "on" position and operating when moved to an "on" position to energize said ignition coil, electromagnetic means and said primary winding respectively, and means operable by a current having a different current value for deenergizing said electromagnet means and which last mentioned current is induced in the secondary winding by the action of said circuit breaker upon said primary winding.

5. In combination with a source of current supply having a predetermined value, an engine starting motor, electromagnetic means for controlling the operative connection of said motor with said current supply, a transformer including primary and secondary windings, a mechanically actuated circuit breaker and maker between said ignition coil and said primary winding, a switch movable from an "off" to an "on" position, and operating when moved to an "on" position to energize said ignition coil, said electromagnetic means and said primary winding respectively, and means operable by a current having a different current value for deenergizing said electromagnetic means and which last mentioned current is induced in the secondary winding by the action of said circuit breaker upon said primary winding.

6. In combination with a source of current supply having a predetermined value, an engine starting motor, electromagnetic means for controlling the operative connection of said motor with said current supply, a transformer including primary and secondary windings, normally closed, coacting contacts in circuit with said electromagnetic means, a mechanically actuated circuit maker and breaker between said ignition coil and said

primary winding, a switch movable from an "off" to an "on" position and operating when moved to an "on" position to energize said ignition coil, said primary winding and said electromagnetic means respectively, and the latter through said normally closed contacts, and means operable by a current having a different current value for separating said contacts to deenergize said electromagnetic means and which last mentioned current is induced in the secondary winding by the action of said circuit breaker upon said primary winding.

7. In combination with a source of current supply having a predetermined value, an engine starting motor, electromagnetic means for controlling the operative connection of said motor with said current supply, a transformer including primary and secondary windings, mechanically vibrated means including a part operatively connected to the primary winding, a switch member which when moved to "on" position, acts to energize said ignition coil, said electromagnetic means and primary winding respectively, normally closed contacts in circuit with said electromagnetic means and means including an electromagnetic device which is operatively connected to the secondary winding and operable by a current having a different current value for separating said contacts to deenergize said electromagnetic means and which current of different current value is produced by the secondary winding under the action of the vibrated means on the primary winding.

8. In combination with a source of current supply having a predetermined value, an engine starting motor, electromagnetic means for controlling the operative connection of said motor with said current supply, a transformer including primary and secondary windings, mechanically vibrated means between said source of supply and said primary winding for interrupting said current to said primary winding and creating a current in the secondary winding having a value in direct ratio with which said current to the primary winding is interrupted, a switch member which when moved to "on" position acts to energize said ignition coil, said electromagnetic means and said primary winding respectively and means actuated by current supply from the secondary winding to control the circuit to said electromagnetic means.

9. In combination with a source of current supply having a predetermined value, an engine starting motor, electromagnetic means for controlling the operative connection of said motor with said current supply, a transformer including primary and secondary windings, mechanically vibrated means between said source of power and said primary winding for interrupting said cur-

rent to the primary winding and creating a current in the secondary winding of a value in direct ratio with which the current is interrupted, a switch member which when moved to "on" position acts to energize said ignition coil, electromagnetic means and said primary winding respectively, means normally closing the circuit to said electromagnetic means and a second electromagnetic means operating on said last mentioned means to open said circuit and which second electromagnetic means is actuated by current supplied from the secondary winding. 70

In testimony whereof, I have hereunto set my hand, this 13th day of June, 1931.

WILLIAM J. WILLIAMS.

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