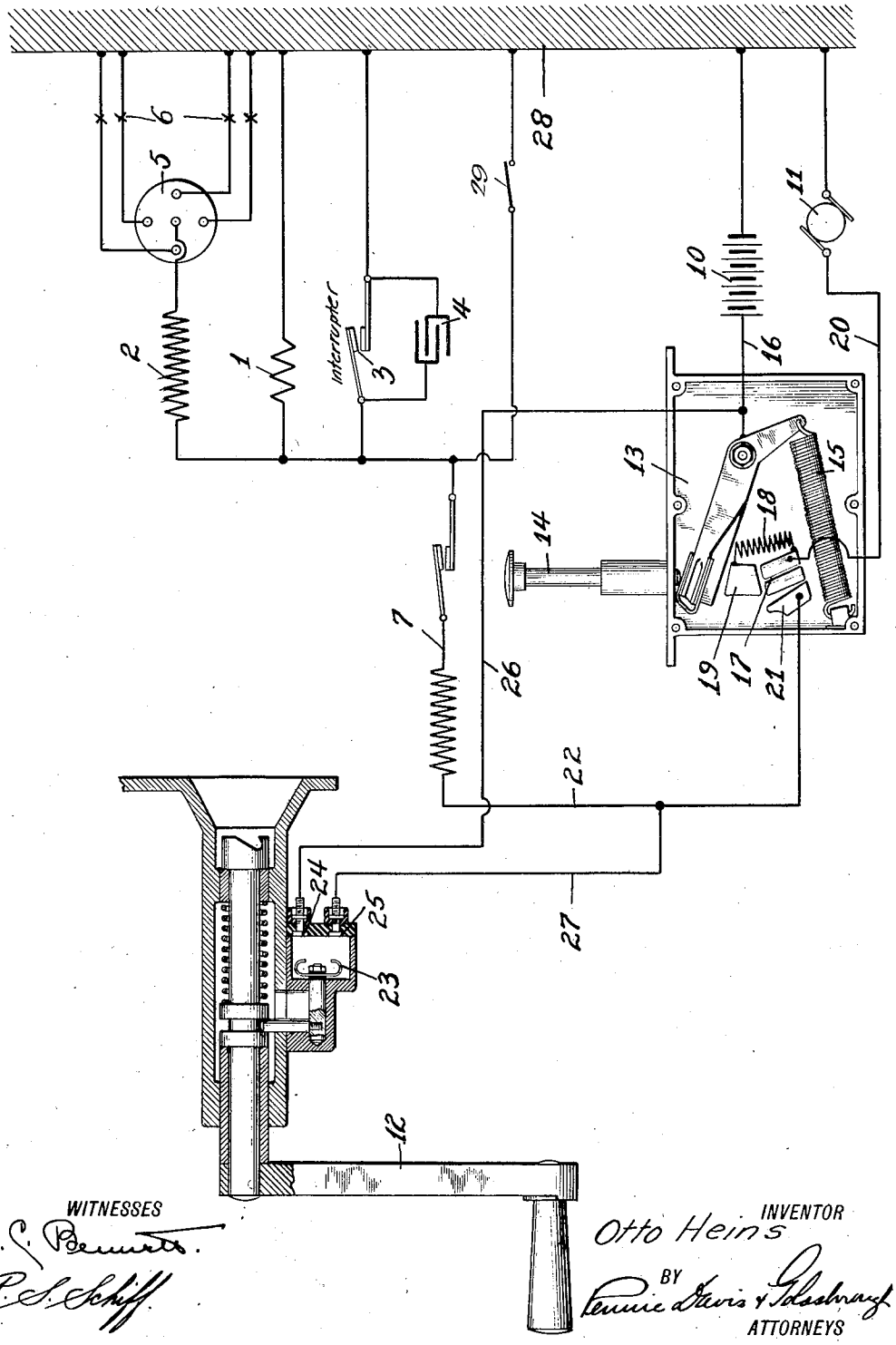
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STARTING IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES.

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WITNESSES

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STARTING IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES.

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To all whom it may concern:

Be it known that I, OTTO HEINS, a subject of the Emperor of Germany, residing in the city, county, and State of New York, whose post-office address is 336 West Eighty-eighth street, New York city, have invented certain new and useful Improvements in Starting Ignition Systems for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Inasmuch as internal combustion engines are not self-starting, it is usual, especially in equipments for automobiles and motor boats, to provide a motor starter which may be of the electric, air, spring, or other type. However, it sometimes happens that the self starter fails, and in that exigency the engine is generally started by hand using the hand-crank for the purpose. The speed at which the engine is turned over by either starting device, the motor starter or the hand-crank, is considerably lower than the normal speed of operation of the engine and in fact is merely that speed at which the engine starts to operate under its own power and continues to accelerate up to its normal speed. The speed of starting depends not only upon the frequency of impulses occurring in the engine cylinders, but also upon the force of the impulses which depends to some extent upon the effectiveness of the ignition. Hence, where a magneto or other running ignition system, dependent upon the speed of the engine for its effectiveness, is used for ignition during the running period of the engine, a starting ignition system independent of the speed of the engine for its effectiveness is provided for ignition during the starting period. This starting system becomes unnecessary after the engine attains that speed at which the running ignition system is effective for the purpose, and is usually disconnected at that time in order to conserve the charge of the battery supplying the starting ignition apparatus. Thus, equipments of this kind have a starting ignition system which is normally disconnected from the spark plugs of the engine, and which must be rendered effective during the starting period of the engine whether the engine is preliminarily turned over by the motor starter or by the hand-crank.

It has been customary heretofore to provide a separately operable switch for rendering the starting ignition system effective during starting of the engine, and for disconnecting it after the running ignition system becomes effective. If the switch is not closed during the starting period, continued failure to start results, and if the switch is not opened after the starting has been effected, the battery supplying the starting ignition apparatus may be drained of its charge and the main source of ignition may be interfered with during the running period.

The present invention is applicable to an internal combustion engine having two starting devices and a starting ignition system, and is directed to means in such an organization for automatically rendering the starting ignition system effective whenever either starting device is operatively connected to start the engine, and for automatically disconnecting the starting ignition system when the starting device used at that time is operatively disconnected. Hence, not only is the starting operation smiplified, but failures in starting and running are obviated. Where an electric motor is used for starting the engine, the battery which supplies the starting current to the motor, preferably supplies the starting ignition apparatus also; and where a resistance step is used to give the starting motor an initial slow speed of rotation, the starting ignition apparatus is not connected to the battery in the preferred embodiment until the resistance is cut out of circuit.

The accompanying drawing is diagrammatic and shows the preferred embodiment of the invention.

The running ignition system for igniting the combustible mixtures during the running period of the engine, comprises an engine driven magneto having a primary winding 1, a secondary winding 2, a mechanical interrupter 3 with the shunted condenser 4, and the distributer 5 for distributing the ignition currents to the spark plugs 6 of the engine. The starting ignition system includes an electromagnetic vibrator 7, supplied with current from the battery 10 and connected to the magneto. The windings of the magneto form an induction coil capable of generating effective ignition currents during the starting

period of the engine when supplied with interrupted currents coming from the electromagnetic vibrator. The series starting motor 11 is arranged in geared relation with the crank-shaft of the engine and is supplied with current from the battery 10 when it is to start the engine. The hand-crank 12 is provided for starting the engine by hand.

The motor starting switch 13 is adapted to connect the battery to the starting motor first through a resistance and then directly, and also to connect the battery to the electromagnetic vibrator 7 when the resistance is cut out of circuit. The switch is closed by depressing the foot pedal 14 against the tension of the spring 15, which tends to hold the switch open. The pivot of the switch is connected to the battery by the wire 16, while the contact 17 is connected through the resistance 18 to the contact 19 and to the starting motor by the wire 20. The contact 21 of the switch is connected to the electromagnetic vibrator 7 by the wire 22. The bridge 23 of the hand-crank switch is adapted to engage the contacts 24 and 25 when the hand-crank is operatively connected to the crank shaft for starting the engine, and is disengaged therefrom when the hand-crank is in inoperative position. The contact 24 is connected to the pivot of switch 13 by the wire 26 and the contact 25 is connected by the wire 27 to the wire 22, leading to the electromagnetic vibrator. The electric circuits are completed by the ground connection 28 as shown.

The operation of this arrangement is as follows: When the operator desires to start the engine from rest, he depresses the foot pedal 14. The starting motor 11 is first supplied from the battery 10 with current limited in strength by the resistance 18, whereupon the motor starts into slow rotation. Thereafter the switch blade engages the contacts 17 and 21, the starting motor then being supplied with current of full strength to bring the engine up to starting speed. At the same time, the electromagnetic vibrator 7 is supplied with current from the battery 10 and ignition currents, for effectively igniting the combustible mixtures drawn into the engine cylinders, are distributed to the spark plugs 6 from the secondary winding of the magneto. As soon as the engine has attained that speed at which it runs under its own power and drives the magneto at high enough speed to generate effective ignition currents, the foot pedal is released to cut off the current from the battery to the starting motor and the electromagnetic vibrator. If, for any reason, the starting motor does not start the engine, the hand-crank is pressed into operative engagement with the crank-shaft of the engine, thereby closing the circuit from the battery to the electromagnetic vibrator, and the hand-crank is turned to bring the engine up to that speed at which it will continue the acceleration under its own power up to its normal speed. Upon releasing the hand-crank, the starting ignition system is disconnected. The switch 29 is provided for rendering the running ignition system inoperative by short circuiting the primary winding 1 of the magneto.

The connection between the running and starting ignition systems shown herein is not essential to the invention. For instance, the starting ignition system may be connected to separate spark plugs in the engine cylinders, or any other suitable arrangement may be used. Furthermore, the connection between the switches and the elements of the starting ignition system may be variously modified without departing from the spirit of the invention, the essential idea being that a normally-disconnected starting ignition system is automatically rendered effective for ignition during the starting period of the engine upon operatively connecting either starting device to start the engine, and is automatically rendered inoperative when the starting device used at the time is disconnected.

Having thus described my invention, what I claim is:

1. In a starting system for internal combustion engines, the combination with a starting hand-crank normally-disconnected from the engine, a starting motor normally-disconnected for operation, and a normally-disconnected starting ignition system, of alternative means for automatically rendering the starting ignition system effective for ignition during the starting period of the engine, comprising an electric circuit which is closed either by operatively connecting the hand-crank to start the engine, or by operatively connecting the starting motor to start the engine.

2. In a starting system for internal combustion engines, the combination with a starting hand-crank normally-disconnected from the engine, a starting motor, a source of starting power normally-disconnected from the motor, and a normally-disconnected starting ignition system, of alternative means for automatically rendering the starting ignition system effective for ignition during the starting period of the engine, comprising a switch which is closed by operatively connecting the hand-crank to start the engine, and a second switch which is closed by operatively connecting the source of starting power to the motor to start the engine.

3. In a starting system for internal combustion engines, the combination with a starting hand-crank normally-disconnected from the engine, an electric starting motor,

a battery normally-disconnected from the motor, a motor switch for connecting the battery to the motor, and a normally-disconnected starting ignition system, of alternative means for automatically rendering the starting ignition system effective for ignition during the starting period of the engine, comprising a switch which is closed by operatively connecting the hand crank to start the engine, and contacts which are connected by closing the motor switch to start the engine.

4. In a starting system for internal combustion engines, the combination with a starting hand-crank normally-disconnected from the engine, an electric starting motor, a normally-disconnected battery, and a normally-disconnected electromagnetic vibrator, of alternative means for automatically rendering the vibrator effective for ignition during the starting period of the engine, comprising a switch which is closed by operatively connecting the hand-crank to start the engine, and a second switch which connects the battery to the vibrator and to the motor to start the engine.

5. In a starting system for internal combustion engines, the combination with a starting hand-crank normally-disconnected from the engine, an electric starting motor, a battery normally-disconnected from the motor, a motor starting switch for starting and running the motor from the battery, and a normally-disconnected starting ignition system, of alternative means for automatically rendering the starting ignition system effective for ignition during the starting period of the engine, comprising a switch which is closed by operatively connecting the hand-crank to the engine, and contacts which are connected by moving the motor starting switch to that point at which the motor receives full current from the battery to start the engine.

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