N° 29,944 A.D. 1909

Date of Application, No. 29,944, 22nd Dec., 1909
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Complete Specification Left, 16th Mar., 1910
(Section 16 of the Patents and Designs Act, 1907)
Complete Specification Accepted, 22nd Dec., 1910

PROVISIONAL SPECIFICATION.

No. 29,944, A.D. 1909.

Improvements in the Electrical and Automatic Control of Engines, Dynamos and Batteries.

We, LEO SUNDERLAND & GILBERT CECIL PILLINGER, of 39, Victoria Street, Westminster, Electrical Engineers, do hereby declare the nature of this invention to be as follows:—

This invention has for its object the saving in labour in running an electrical installation and reducing the cost of accumulators for lighting or power or any current consuming device and may be worked by internal or external energy.

In connection with the wiring section of an installation, we employ a combination of differential relay, solenoids and electromagnets. The wiring is so arranged that when lamps are switched on, current is obtained from accumulators but the switching on of more than the pre-determined number of lamps operates a relay and actuates a solenoid motor starter which may or may not be fed from the accumulators.

This starts up a dynamo as a motor which being coupled up to an engine having electric ignition causes the engine to rotate and subsequently generate power, having attained its proper speed, current is generated by the dynamo which overcomes the back electro motive force of the accumulators and their charging proceeds together with the simultaneous lighting of the lamps and the working of any other current consuming device connected to the system.

In addition to the foregoing, if during periods of disuse or for any other reason the terminal voltage of the battery falls below a pre-determined figure, the differential relay starts up the plant in the manner hereinbefore described and the charging of the battery proceeds until the terminal voltage has risen to a pre-determined figure when the differential relay automatically switches off the dynamo and the engine also stops running.

Dated the 21st day of December, 1909.

LEO SUNDERLAND.
G. C. PILLINGER.

PROVISIONAL SPECIFICATION.

No. 6531, A.D. 1910.

Improvements in the Electric and Automatic Control of Engines, Dynamos and Batteries.

We, LEO SUNDERLAND, and GILBERT CECIL PILLINGER, both of 39, Victoria Street, Westminster, London, S.W., Electrical Engineers, do hereby declare the nature of this invention to be as follows:—

Our invention relates to certain improvements based upon the invention

described in our Provisional Specification No. 29,944 of 1909, in which a battery circuit with a predetermined terminal voltage, or a predetermined load may, upon variation of either of these values, actuate a relay, which in turn operates a motor starting switch, starting a dynamo as a motor for the purpose of affording the initial rotation of an internal combustion engine, which upon ignition and explosion drives the dynamo at a speed rate which overcomes the back electromotive force of the accumulators, and charges them, and fulfils the requirements of the extra load of the circuit.

In order that such engine should automatically complete its cycle as a driving motor, when receiving its initial rotation, we prefer to hold the exhaust, air, or separate valve open by a slide acting upon a collar on the valve spindle. Said slide is attached to, or forms part of a forked crank lever, normally held fixed by a spring or solenoid, but which may be withdrawn by the action of a spring or solenoid, when the ordinary action of the exhaust or other valve may take place in accordance with the cycle of the engine, and by means of the cam gear or like mechanism therefor. The solenoid is energised by the current from the battery, switched on simultaneously with the starting of the dynamo as a motor to give the initial rotation to the engine.

The essential feature of our invention is to automatically start or stop, and also throw the engine out of action by releasing or holding the compression in the engine, in combination with the utilisation of the dynamo or battery as a starting device.

Although we have described one application of our invention, it is understood that we do not confine it to that alone, but it is applicable for use with all other internal combustion engines used for the same or other purposes.

Dated this 15th day of March, 1910.

KINGS PATENT AGENCY, LIMITED,
165, Queen Victoria Street, London, E.C.,
Agents for Applicants.

The common seal of Kings Patent Agency, Limited, was this day hereto affixed in presence of:—

BENJ. T. KING,
Director,
Chartered Patent Agent.

COMPLETE SPECIFICATION.

Improvements in the Electrical and Automatic Control of Engines, Dynamos and Batteries.

We, LEO SUNDERLAND, and GILBERT CECIL PILLINGER, both of 39, Victoria Street, Westminster, London, S.W., Electrical Engineers, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Our invention relates to automatic electric generating systems of the kind in which a prime mover drives a dynamo which supplies current to a battery which is in parallel with the lamps or other consumption circuit, the prime mover being started and stopped automatically by electrical devices operated by the battery which device may also control the supply of motive fluid, according to the variation of the voltage of the battery. Our invention is especially useful when used with that variety of the above

described type of generating system in which the prime mover is an internal combustion engine or any other kind requiring a certain impetus to start it and in which the battery is employed, when the drain upon the system reaches a certain point, to drive the dynamo as a motor to give an initial impetus to the prime mover.

A further part of our invention is especially useful when the prime mover is an internal combustion engine.

The main object of our invention is to produce a system in which:—Firstly, the battery is reduced to the smallest dimensions possible; and, secondly, its voltage is kept at a nearly constant maximum. The advantages of such a system over those heretofore existing being in the first place a reduction in the cost and weight of the battery and secondly an increase in efficiency because as the current from the dynamo is supplied (in a sense) direct to the lamps or other current consuming device, the battery as far as possible merely performing starting functions.

Our invention consists in means for automatically starting up the prime mover directly a small proportion of the load is exceeded or a diminution in the electromotive force of the battery (which may in consequence be made very small) is exceeded. We employ a differential switch somewhat like that described in our Specification No. 13,185 of 1908 but we arrange one coil in shunt across the battery, and the other in series with the lamp or other consumption circuit. A single armature may be used or as hereinafter illustrated the armatures of these coils are connected together in such a manner and the coils are so proportioned, that when the current supply in the lamp circuit and consequently in the series coil exceeds a predetermined very small proportion of the total lamp capacity of the system the armature is lifted by the series coil against the pull of the shunt coil and closes the circuit of a relay motor-starting-coil which by operating a spring or gravity held armature throws the current from the battery into the dynamo and starts it as a motor, and at the same time closes another relay circuit which operates a valve to enable the prime mover to draw from its source of energy. If the lamp supply circuit is switched off entirely the series coil releases its armature and the other coil of the differential switch which is in shunt across the battery is enabled by means of its armature, which is connected to the armature of the series coil, to pull the latter armature away from its coil and open the relay circuit of the motor-starting-coil at the same time opening the relay circuit of the valve so as to deprive the prime mover of its source of energy. On the other hand if the lamp supply circuit is not entirely cut off but is reduced to that necessary to run a proportion of lamps lower than that which would operate the series coil and start the engine, then the e.m.f. of the battery will gradually and substantially fall to a point which is sufficiently low to allow the pull of the shunt coil to become so weak that the connected armatures yield to the pull of the series coil and the engine is started.

That part of our invention which relates to the valve operating mechanism which is suitable for use with internal combustion motors will be explained later.

The accompanying drawings illustrate the manner in which our invention is carried into effect:—

Figure 1 is a diagram of the various connections and apparatus.

Figure 2 is an end elevation; Figure 3 a side elevation; and Figure 4 a plan view of an exhaust valve lifter appertaining to an internal combustion engine in connection with the arrangement.

Referring to Figure 1, we will first describe the differential relay.

The coil A is in series with the lamp circuit X.

The coil B is in shunt across the battery Y and as elsewhere in this diagram relay circuit wiring is shown in thin lines.

The coil A is provided with an armature *a* pivoted at its centre, and the coil B with an armature *b* pivoted at one end and the two armatures are connected by a link. When the coil A is the stronger the armatures assume the position shown

in full lines,—when the coil B is the stronger they assume the position shown in dotted lines. When less than the predetermined small proportion of lamps is switched on, the current is obtained from the battery through the leads 1 and 2, but the series coil A is not sufficiently energised to overcome the pull of the coil B, and the armatures retain the position shown in dotted lines. In the case of more than this small proportion of lamps being switched on the coil A is sufficiently energised to pull the armatures into the position shown in full lines. The armatures, or one of them, are connected so as to form part of the relay circuit of the coil C which is energised from the battery by the leads 3 and 4 and when the armatures are in the position shown in full lines the relay circuit is closed and the coil C lifts its core *c* and raises the contact lever D against the action of a spring or gravity from the position (off) indicated in dotted outline, to the position shown across the rheostat contacts which closes the circuit of the dynamo Q through the leads 5, the contacts and rheostat lever D, the lead 4, the battery Y and the leads 3 and 6 thus causing the dynamo Q to rotate as a motor and imparting the necessary initial movement to the prime mover P by means of the belt *p* as shown. At the same time a contact piece d^1 on the rheostat lever D comes into contact with a contact piece *h* and completes the relay circuit of the solenoid H which controls the valve of the prime mover P. When the prime mover is an internal combustion engine as indicated we may make use of a part of our invention to be hereinafter described. When the engine is thus automatically started and its speed is sufficient to rotate the dynamo as generator and thus overcome the e.m.f. of the battery any charging of the battery which may be necessary proceeds, the dynamo simultaneously taking up the load of the extra lamps switched on, and the working of any other current consuming device connected to the system. When the lamp circuit is switched off the coil B causes the relay circuit of the coil C to be opened, cutting the motor off from the battery and opening the relay circuit of the valve coil to stop the engine.

Should less than the predetermined small proportion of lamps be switched into the circuit and allowed to burn indefinitely the coil A will not be sufficiently energised to start the generating plant and the lamps will in that case derive their current from the battery whose e.m.f. will substantially fall until the pull of the shunt coil will be reduced below that of the series coil and the engine will be started. It is clear that the coils A and B must be so proportioned that the shunt coil armature is released before the e.m.f. of the battery falls so low as to be too weak to actuate the dynamo as a motor.

Referring to Figures 2, 3 and 4, a method of operating the valve mechanism of the prime mover is illustrated which is applicable to internal combustion motors. The object of this part of the invention is to ensure that the engine should automatically complete its cycle as a driving motor when receiving its initial rotation and by the same means immediately to prevent the engine from drawing a charge into the cylinder when the automatic apparatus is operated to cut off the engine.

The solenoid H (shown also in Figure 1) has a core h^1 which is jointed to a lever M mounted fast on a spindle N supported by a bearing bracket O. The opposite end of the spindle carries a crank R which is pivoted to a bar S. This bar S is pulled to the left in Figure 3 by a spring T and passes between guides U and is forked to embrace without touching the exhaust valve spindle V at the lower end of the latter in order not to interfere with its sliding. The bar S is provided with a raised portion S^1 which is adapted to pass beneath a collar V^1 fast on the valve spindle and hold the valve up from closing when the solenoid H is not in operation and the bar S is pulled by the spring T. When the relay circuit of the solenoid H is closed the bar and the raised portion S^1 are withdrawn and the valve is permitted to close, enabling the engine to compress its charge. So long as the exhaust valve is open the engine can neither draw nor compress a charge and is out of operation.

The solenoid H may be used to operate any other suitable valve device. For example, when we employ a steam engine or steam turbine the arm of the solenoid is used to operate the main steam valve or any suitable form of relay coupled thereto.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In an automatic electric generating system of the type described means for automatically starting up the prime mover directly a small proportion of the load is exceeded and directly a substantial diminution occurs in the electro-motive force of the battery.

2. In an automatic electric generating system of the kind described, a differential switch consisting of the combination of a coil in series with the lighting circuit proportioned and adapted to operate an armature to close the circuit of a switch to start the prime mover immediately a small proportion of the load is exceeded in the lighting circuit, and a coil in shunt across the battery tending directly or indirectly to oppose the movement of the armature by the series coil proportioned and adapted to yield to the series coil if the electro-motive force of the battery is substantially diminished.

3. In an automatic electric generating system of the kind described in which the battery is employed to drive the dynamo as a motor to impart an initial impulse to the engine, the following combination:—A coil in series with the lighting circuit proportioned and adapted to operate an armature to close the circuit of a motor-starting relay immediately a small proportion of the load is exceeded in the lighting circuit, a coil in shunt across the battery tending directly or indirectly to oppose the movement of the armature by the series coil and adapted to yield to the series coil if the electro-motive force of the battery is substantially diminished, and a motor-starting switch adapted to throw current from the battery into the dynamo to drive it as a motor and to operate a valve to allow the engine to obtain power.

4. In an automatic electric generating system of the kind described in which the battery is employed to drive the dynamo as a motor to impart an initial rotation to an internal combustion engine, the following combination:—A coil in series with the lighting circuit proportioned and adapted to operate an armature to close the circuit of a motor-starting relay immediately a small proportion of the load is exceeded in the lighting circuit, a coil in shunt across the battery tending directly or indirectly to oppose the movement of the armature by the series coil and adapted to yield to the series coil if the electro-motive force of the battery is substantially diminished, a motor-starting switch adapted to throw current from the battery into the dynamo to drive it as a motor, together with means operated by the motor-starting switch to relieve the compression in the cylinder of the engine when the motor-starting switch is off and to withdraw such relief when the switch is on.

5. In an antomatic electric generating system of the kind described and claimed in Claim 1 in which an internal combustion engine is employed, means for relieving the compression in the cylinder consisting of a relay coil operating a bar which holds up the exhaust valve until the bar is withdrawn by the relay coil when the engine is to be started.

6. In an electric generating system of the kind described, the automatic arrangements for starting the prime mover when a small proportion of the load is exceeded and if the e.m.f. of the battery is substantially reduced substantially as described with reference to Figure 1 of the drawings.

7. In an electric generating system of the kind described and claimed in Claim 1 in which an internal combustion engine is employed, a relay coil, operated when a small proportion of the load is exceeded and if the e.m.f. of the

battery is substantially reduced, to relieve the compression in the cylinder substantially as illustrated in Figures 2, 3 and 4.

Dated the 12th day of March, 1910.

KINGS PATENT AGENCY, LIMITED,
165, Queen Victoria Street, London, E.C.,
Agents for Applicants.

The common seal of Kings Patent Agency Limited was affixed hereto in presence of:—

BENJ. T. KING,
Director,
Chartered Patent Agent.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1911.

A.D. 1909. Dec. 22. N° 29,944.

SUNDERLAND & *another's* Complete Specification.

(2 SHEETS)

SHEET 1

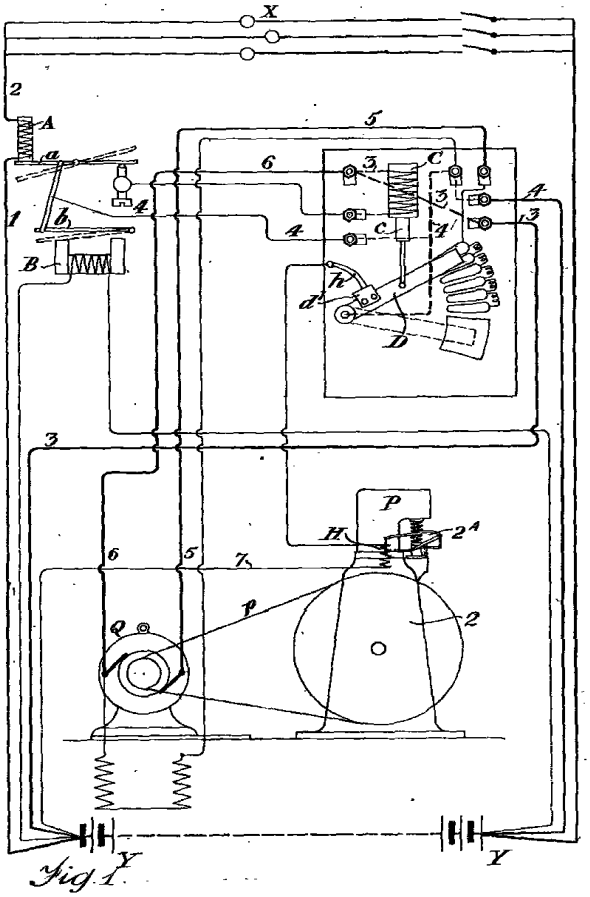

Fig. 1.

SHEET 2

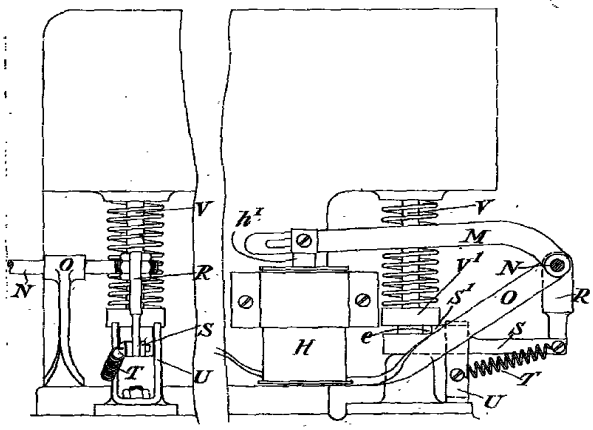

Fig. 2. Fig. 3.

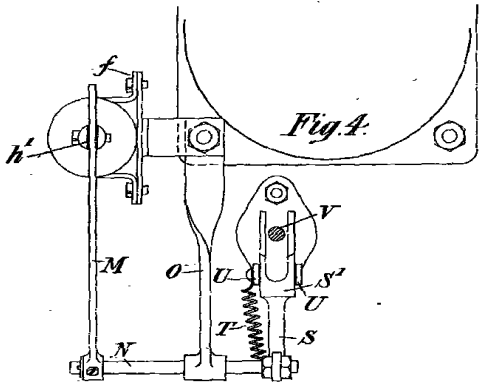

Fig. 4.

Malby&Sons Photo Litho

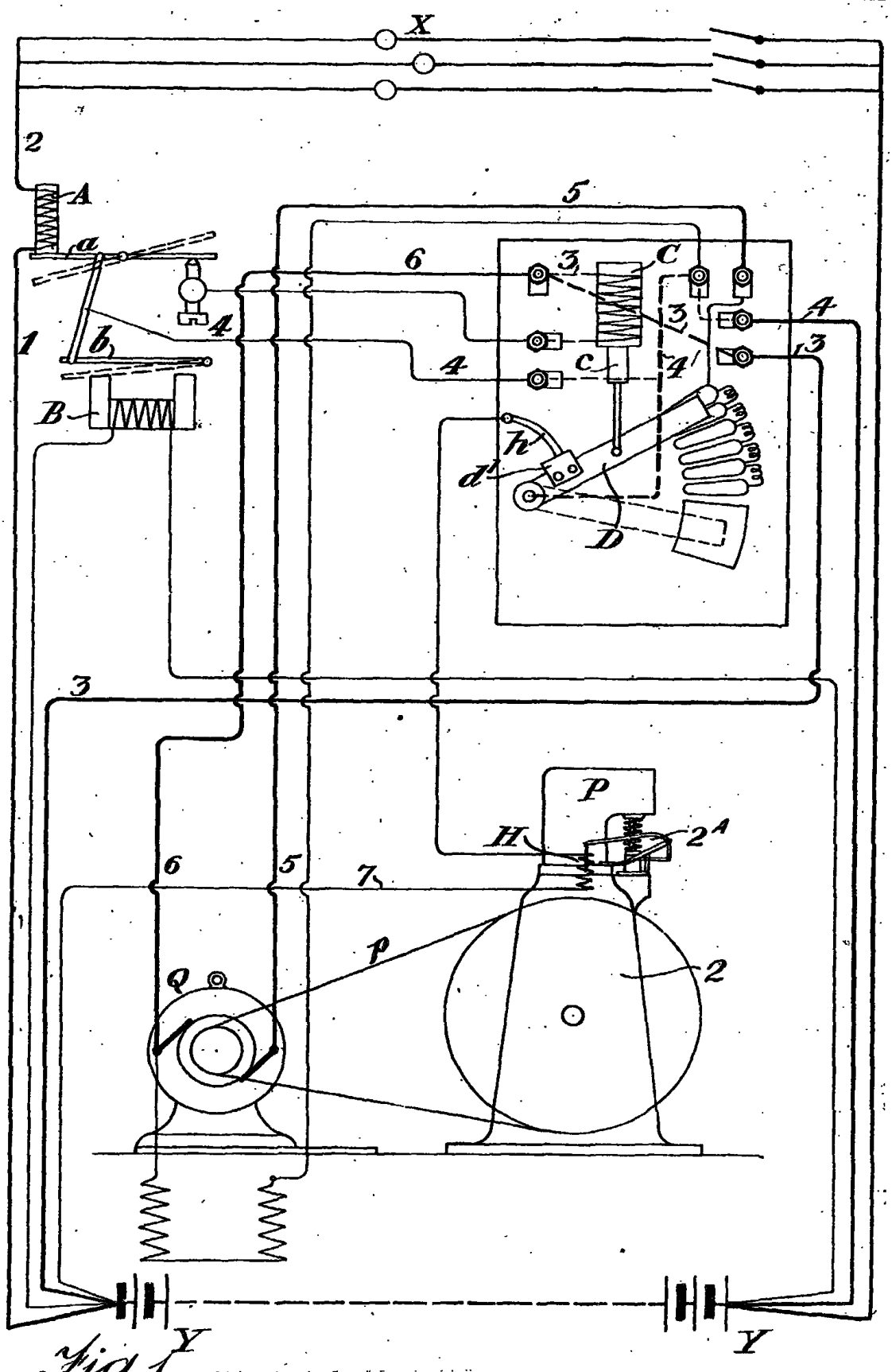

Fig. 1.

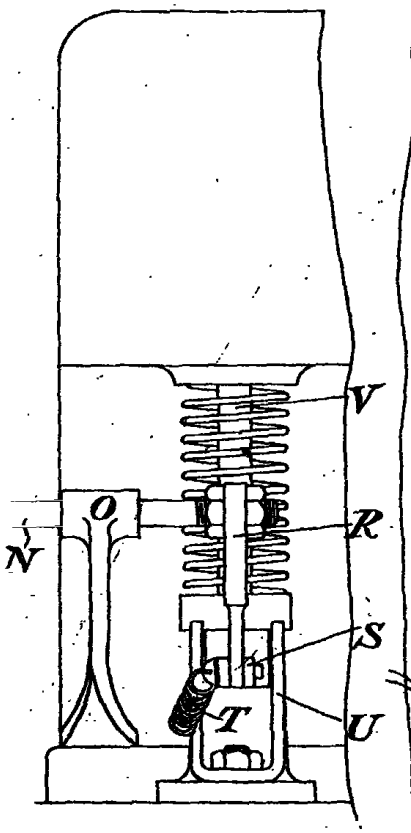

Fig. 2.

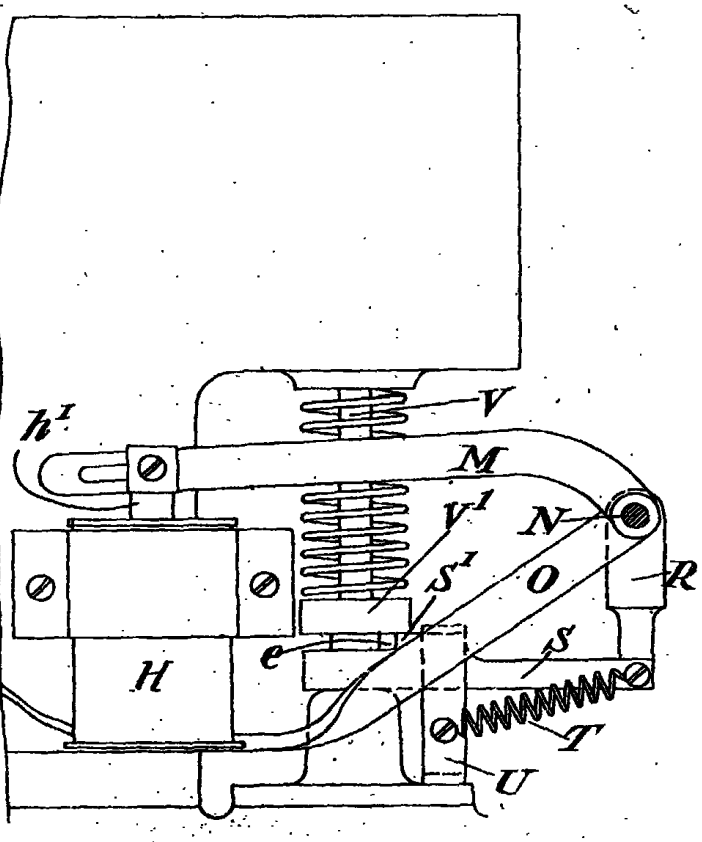

Fig. 3.

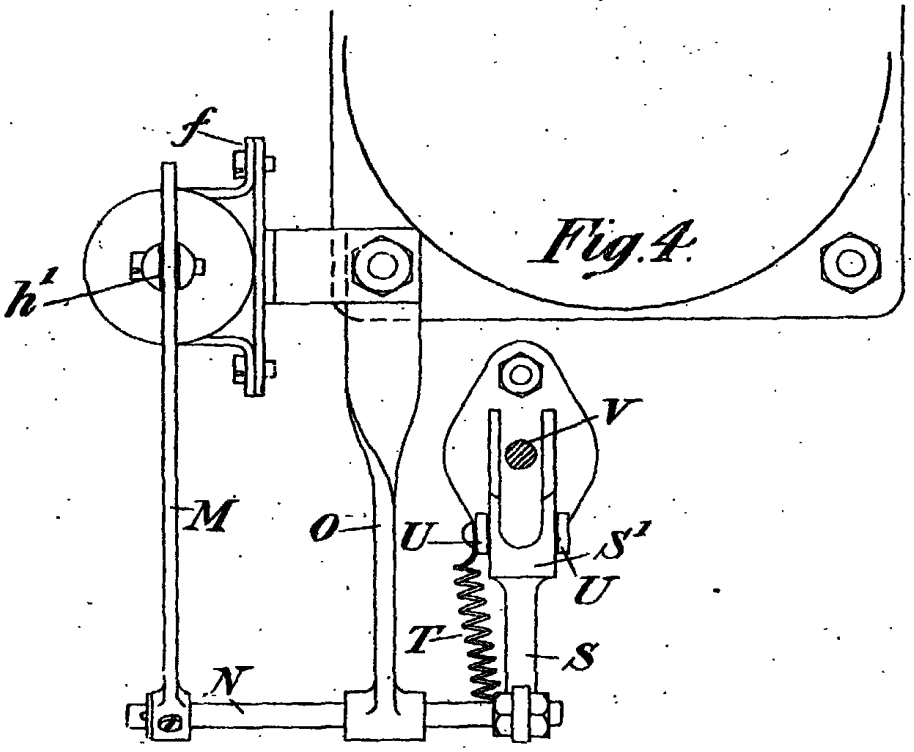

Fig. 4.

Malby & Sons. Photo-Litho.