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W. L. BLISS.

MEANS FOR EXCITING DYNAMO ELECTRIC GENERATORS.

APPLICATION FILED FEB. 26, 1902.

NO MODEL.

Fig. 1.

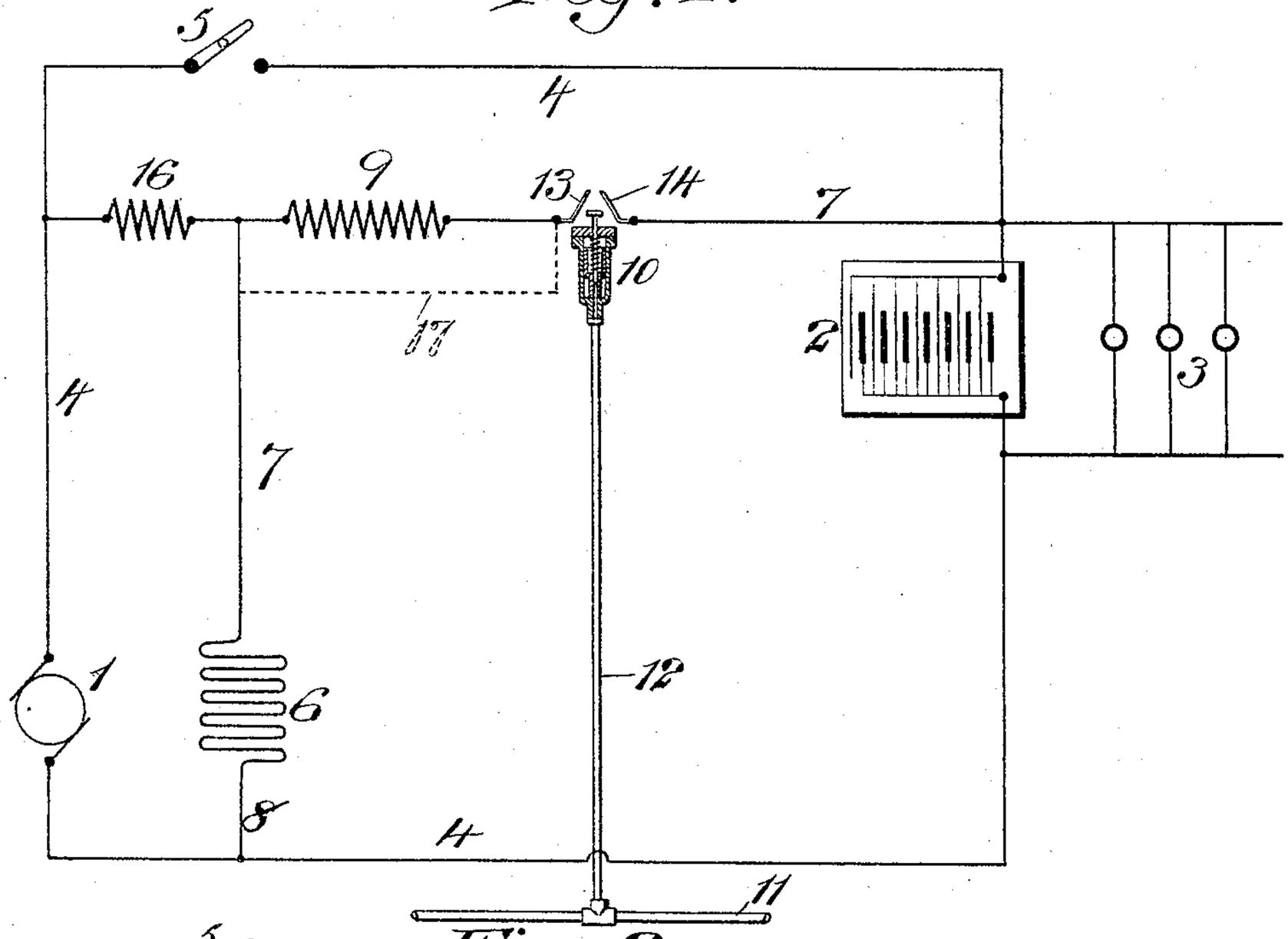
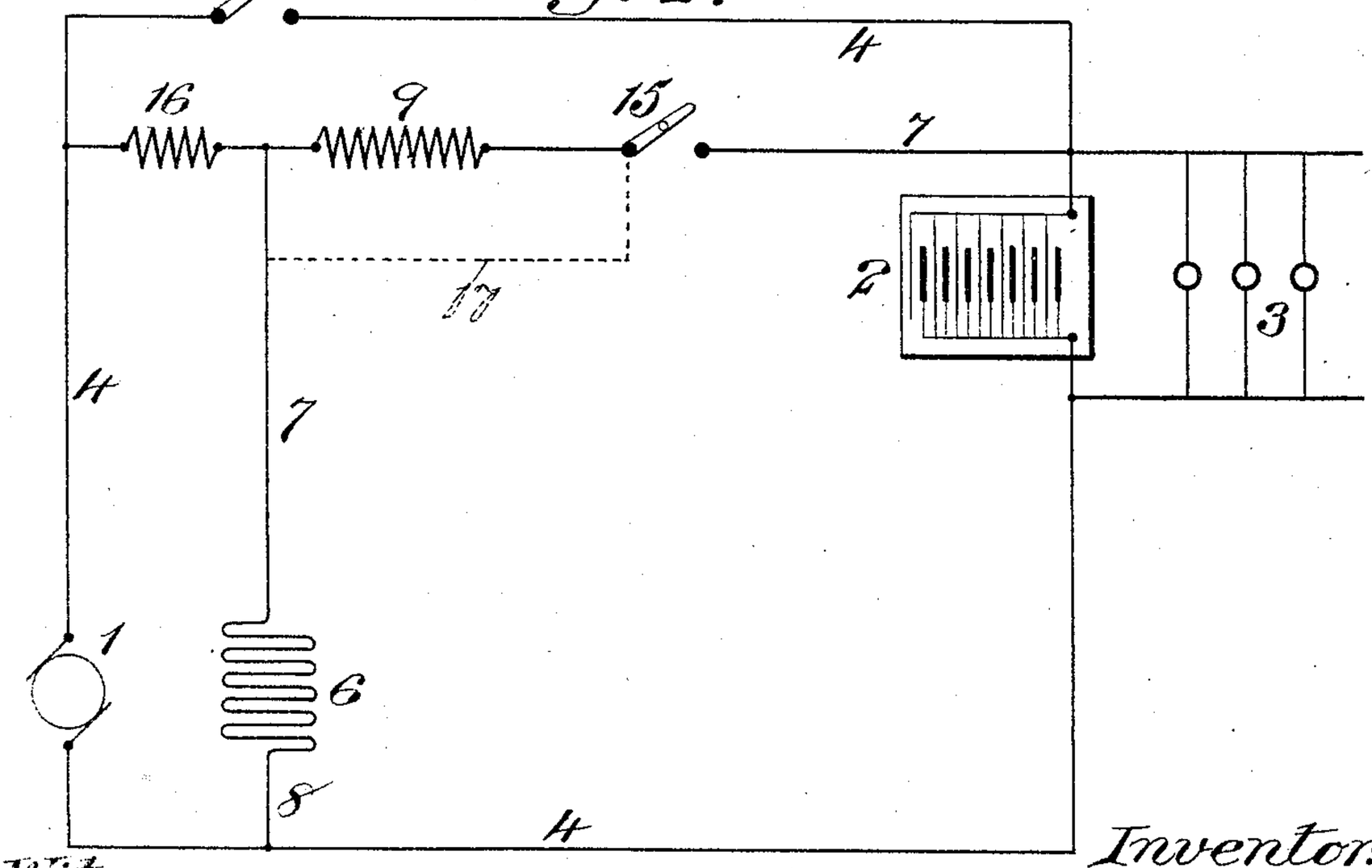


Fig. 2.



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No. 773,918. Patented November 1, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM LORD BLISS, OF BROOKLYN, NEW YORK, ASSIGNOR TO BLISS ELECTRIC CAR LIGHTING COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

MEANS FOR EXCITING DYNAMO-ELECTRIC GENERATORS.

SPECIFICATION forming part of Letters Patent No. 773,918, dated November 1, 1904.

Application filed February 26, 1902. Serial No. 95,741. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM LORD BLISS, a citizen of the United States, and a resident of the borough of Brooklyn, in the city and State of New York, have invented a new and useful Improvement in Means for Exciting Dynamo-Electric Generators, of which the following is a specification.

My invention relates to an improvement in means for exciting dynamo-electric generators, and has for its object to provide a simple and reliable means for furnishing the excitation of a dynamo-electric machine or generator by causing a current to flow through the field-magnet coil of said generator from some external source of supply in the peculiar and novel manner to be hereinafter set forth.

A further object is to provide a device suitable for use in connection with car-lighting systems in which a resistance is interposed between the dynamo-circuit and the field-circuit leading from a storage battery, together with an automatic switch which is under the control of the fluid-pressure within the supply pipe or reservoir carried by the car for controlling the current through the field-circuit.

A further object is to provide a device in which a resistance is interposed between the battery and the field-coil, and a second resistance of less than the first is interposed between the field-coil and the dynamo.

Practical embodiments of my invention are represented in the accompanying drawings, in which—

Figure 1 represents so much of a car-lighting system as will give a clear understanding of the operation of my improved means for exciting dynamo-electric generators, showing an automatic switch under the control of the pneumatic signal-pipe of the car for controlling the field-circuit; and Fig. 2 is a similar view showing a manually-operated switch for controlling the field-circuit.

The dynamo-electric machine or generator is denoted by 1, the storage battery by 2, and the translating devices by 3. The dynamo-circuit wire which leads through the battery is denoted by 4, and there is interposed in the same a switch 5, which may be automatic in its action or manually controlled, as found more desirable, the function of the said switch being to open or close the circuit from the dynamo to the battery whenever the voltage of the dynamo is lower or higher than that of the battery. The field-coil is denoted by 6, and the circuit-wire leading from the storage battery thereto is denoted by 7. A wire 8 connects the other end of the said coil with the dynamo-circuit wire 4. A resistance 9 is located in the field-circuit wire 7 between the battery 2 and the field-coil 6. A switch is located in the field-circuit wire 7 between the resistance 9 and the storage battery 2, which switch may be automatic in its action or manually operated, as may be found desirable. In the form shown in Fig. 1, in which a car-lighting system is illustrated, the automatic switch is denoted by 10, which switch is controlled by the fluid-pressure in the signal pipe or reservoir 11, having a branch pipe 12 connected to the switch. This serves to make and break the field-circuit through the contact-points 13 and 14, the construction of the switch shown herein being shown, described, and claimed in United States Letters Patent No. 735,452, dated August 4, 1903. In Fig. 2 I have shown a manually-operated switch 15 for opening and closing the field-circuit 7. A resistance 16, considerably less than the resistance 9, connects the dynamo-circuit wire 4 to the field-circuit wire 7 between the field-coil 6 and resistance 9.

To enable a clear understanding of the obstacles to be overcome and the advantages arising from overcoming them, the following points should be kept in mind. It is a well-known fact that a dynamo-electric machine or generator, particularly of the direct-current class, will excite itself or will "pick up," as it is commonly styled. This is equally true of a series, shunt, compound or differentially wound machine and depends upon the existence of a certain amount of residual magnetism permanently existing in the iron of the field-magnet. If there be no residual mag-

netism present, the dynamo cannot excite itself, no matter how fast it may be driven. If residual magnetism be present, the dynamo when driven acts as a weak magneto-machine, and a small voltage is generated in the armature of the same. If the field exciting-coil be properly connected with the brushes of the dynamo, this initial voltage due to the residual magnetism will cause current to flow through the field-coil, which in turn will produce more magnetism in the field, and this increased magnetism will cause a greater voltage to be generated in the armature and cause a greater current to flow through the field-coil, and so on until a certain maximum voltage has been generated and a strong field-current forced through the exciting-coil. An analytical exposition of this phenomena, commonly called "picking up" or "self-excitation," would be out of place here; but it may be proper to state what conditions influence or prevent this very useful property of a dynamo-electric machine or generator. Self-excitation depends upon the speed of rotation of the armature, the resistance of the circuits, and the magnetic condition of the iron of the field-magnet. Confining myself to the action of a shunt-dynamo, although the same argument applies with a slight modification to all types of direct-current machines, it is known that at a given speed the dynamo will excite, first, if there be enough residual magnetism; second, if the resistance of the shunt field-circuit be low enough, and, third, that if the external circuit be connected to the brushes the resistance of the said external circuit shall not be so low as to act as a short circuit upon the armature, thus preventing the slight current which is produced by the residual magetism flowing through the field-coil and augmenting the magnetism of the same. It is also a well-known fact that a dynamo will generate voltage and force the current through any external circuit at any speed if current be supplied to its field magnet-coil from some external source of electric energy—such, for instance, as another dynamo or a primary or secondary battery. A dynamo thus excited is said to be "separately excited," and in this case the residual magnetism plays no part. A dynamo just completed generally requires to be separately excited in order to establish the residual magnetism of its field. A dynamo having its residual magnetism established and having excited itself repeatedly may at some future time fail to excite at the desired speed and may even fail to excite at any speed. The cause of such failure to excite (not considering actual injury) will generally be found in a loss of residual magnetism, a reversal of the same, or an increase in the shunt-circuit resistance, or a decrease in the external circuit resistance. A frequent cause of this increase in the shunt field-circuit resistance is to be found in a bad contact of the brushes on the commutator, particularly when carbon brushes are employed. In cases where the dynamo is started up only at long intervals or where an attendant can rectify any difficulty the dynamo may experience in exciting itself no special means may be supplied for making the action more certain; but in certain classes of work, particularly in car-lighting systems where the dynamo is driven from the car-axle and must start and excite itself as often as the car starts and no attendant is permissible, a means of absolutely insuring the picking up of the dynamo is of the greatest importance. In such a system a storage battery always plays an important part, and from it current can be taken to excite the field of the dynamo.

Proceeding to describe the operation of my invention: If the switch in the field-circuit is open, the dynamo is connected as an ordinary shunt-machine and would excite itself under the conditions above mentioned, the resistance 16, which is small comparatively, simply being in circuit with the field-coil 6. If the resistance 16 were removed and the switch closed, the dynamo would be separately excited, the storage battery 2 supplying the current through the field-coil 6. The resistance 9 would limit the strength of the current flowing through the field-current 6 and would have to be short-circuited or removed by the equivalent of the dotted wire 17. If wire 17 remained permanently in place, the switch would have to break the full strength of the field-current through the coil 6, which would be undesirable, and, furthermore, when the dynamo is not running the switch should be open, so as to avoid wasting the battery-current through the field-coil 6. The resistance 9 might be short-circuited automatically, so as to get the full excitation on the field-coil 6; but the simplest manner of doing this is by introducing and connecting in the manner shown the resistance 16.

Under certain conditions the resistance 16 may be made very low and consist of simply a connecting-wire. This arrangement may be considered as a combination of self and separate excitation, employing but one field-coil 6.

The novel and advantageous features of my invention may be summed up as follows:

First. But one field-coil is required.

Second. Separate and certain excitation is secured.

Third. The field-switch does not need to be designed to break heavy currents.

Fourth. After the dynamo has developed a stable voltage the field-switch may be opened with impunity without disturbing the excitation.

The special function of the resistance 9 is to reduce the current to be broken by the switch 15 or 10 and to reduce the wasteful discharge of the battery when the apparatus

is at rest, but the above-mentioned switch still closed.

The special function of the resistance 16 is to prevent the armature from acting as a short circuit to the field and diverting the current from the battery from said field.

Supposing the resistance of the battery 2 to be negligible, of the dynamo 1 very small, of the field-coil about one hundred times as great as the dynamo 1, the resistance 16 to be very small, and the resistance 9 about equal to the coil 6, the switch 5 in the dynamo-circuit being also supposed to be opened. When the switch in the field-circuit is closed, current will flow from the battery 2 through the switch and the resistance 9. It will then divide, and the greater portion—say ninety-nine per cent.—will flow through the resistance 16 and dynamo 1, while the balance—say one per cent.—will flow through the field-coil 6. As the total current through the resistance 9 is not great, the current flowing through the field-coil is very little, practically zero. Therefore the resistance 16 may need to have a finite value to prevent all of the current coming from the battery through the resistance 9 from being short-circuited through the dynamo and from the field-coil 6. The little current which does flow through the field-coil 6 is effective and useful in creating a definite field for the dynamo, and the larger current flowing through the resistance 16 and the dynamo is useful to a certain extent in producing a field, since the current which is flowing through the dynamo will tend to drive it as a motor. The back ampere-turns of the armature-windings on the dynamo will therefore produce some useful magnetizing effect in the same direction as and serving to aid the field-coil 6. When the dynamo is revolved, it will generate a little voltage, which will tend to prevent the current from the battery flowing through the resistance 16 and the dynamo and cause more of the current to flow through the field-coil 6. The dynamo 1 now begins to excite in true self-exciting style, and a time quickly comes when the total current through the resistance 9 flows through the field-coil 6 and no current flows through the resistance 16 or dynamo 1, being kept out by the voltage generated in the armature. The excitation is now perfectly stable and presently current is flowing through the field-coil 6, coming from the battery by way of the resistance 9, and also by way of the resistance 16 from the armature of the dynamo. When the dynamo 1 is generating the same voltage as the battery, the field-circuit will be as strong as if supplied directly with the battery, with the resistance 16 and 9 omitted and the wire 17 in place. The switch 5 may now be closed and the switch in the field-circuit may be opened or closed without affecting the operation. In fact, the field-circuit switch might be opened any time after the dynamo shows a good voltage; but to leave the switch closed does no harm and absolutely insures the stable excitation of the dynamo.

What I claim is—

1. In a system of electrical distribution, the combination with a normally open armature-circuit of a dynamo having a shunt-field, of a storage battery for supplying current to said shunt-field and a resistance interposed between the shunt-field and armature-circuit.

2. In a system of electrical distribution, the combination with a normally open armature-circuit of a dynamo having a shunt-field, of a storage battery for supplying current to said shunt-field, a resistance interposed between the shunt-field and armature-circuit and a switch interposed between the storage battery and the shunt-field.

3. In a system of electrical distribution, the combination with a normally open armature-circuit of a dynamo having a shunt-field, of a storage battery for supplying current to said shunt-field, a resistance between the shunt-field and battery and a second resistance less than the first-named resistance located between the shunt-field and armature-circuit.

4. In a system of electrical distribution, the combination with a normally open armature-circuit of a dynamo having a shunt-field, of a storage battery for supplying current to said shunt-field, a resistance between the shunt-field and battery, a second resistance less than the first-named resistance located between the shunt-field and armature-circuit, and a switch interposed between the storage battery and shunt-field.

5. In a system of electrical distribution, the combination with a normally open armature-circuit of a dynamo having a shunt-field, of a storage battery for supplying current to said shunt-field, a resistance interposed between the shunt-field and armature-circuit and an automatic switch located between the storage battery and shunt-field.

6. In a system of electrical distribution, the combination with a normally open armature-circuit of a dynamo having a shunt-field, a storage battery for supplying current to said shunt-field, a resistance interposed between the shunt-field and armature-circuit, of a fluid-supply pipe or reservoir and a switch located between the storage battery and shunt-field, said switch being under the control of the fluid-pressure in said pipe or reservoir, for making and breaking the circuit through the shunt-field.

7. In a system of electrical distribution, the combination with a normally open armature-circuit of a dynamo having a shunt-field, a storage battery for supplying current to said shunt-field, a resistance between the shunt-field and battery and a second resistance less than the first-named resistance located be-

tween the shunt-field and armature-circuit, of a fluid-supply pipe or reservoir and a switch under the control of the fluid-pressure in said pipe or reservoir for making and breaking the circuit through the shunt-field and first-named resistance from the battery.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 8th day of February, 1902.

WILLIAM LORD BLISS.

Witnesses:

FREDK. HAYNES,

HENRY THIEME.