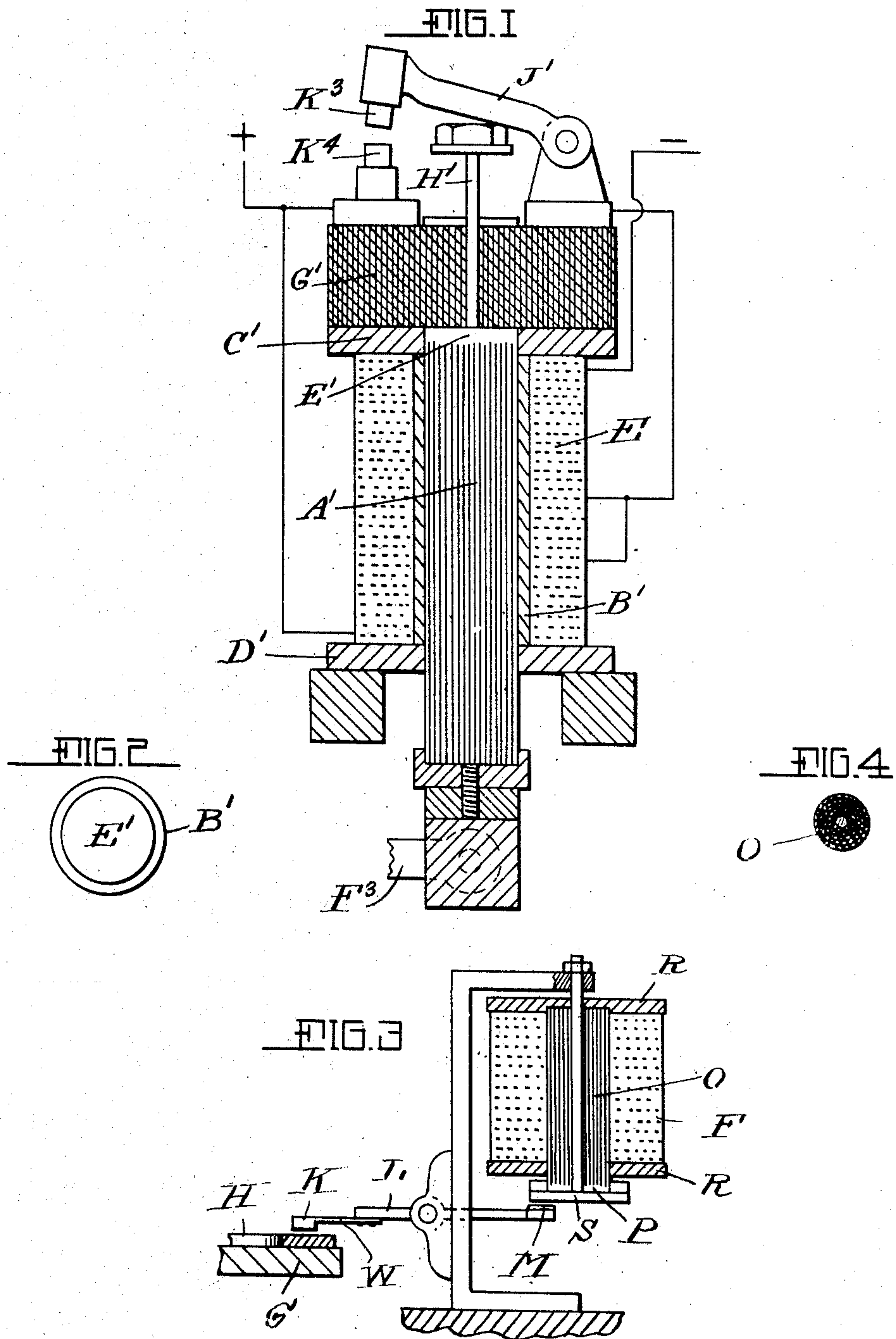


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H. ROWNTREE.  
ELECTROMAGNET.  
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# UNITED STATES PATENT OFFICE.

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## ELECTROMAGNET.

No. 886,869.

Specification of Letters Patent.

Patented May 5, 1908.

Application filed June 23, 1905. Serial No. 266,542.

*To all whom it may concern:*

Be it known that I, HAROLD ROWNTREE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Electromagnet, of which the following is a specification.

This invention relates to electro magnets.

The object of the invention is to provide an electro magnet wherein the pull exerted on the core will not be weakened by induced currents.

A further object of the invention is to provide a construction of electro magnet wherein quietness of action without the generation of heat is secured.

In a more restricted recitation of the object of the invention, such invention has for its object the provision of an electro magnet having a laminated core, the laminations being in open magnetic circuit with respect to each other at one end, and in closed magnetic circuit with respect to each other at the other end.

A further object of the invention is to provide an electro magnet in the form of a solenoid, in which induced deterring effects at the commencement of the movement of the core thereof are minimized, while a strong induced deterring effect is produced at the completion of the movement of such core thereby reducing the current.

A further object of the invention is to provide an electro magnet of the character above referred to, wherein windings or coils, into which the core enters, are out of circuit at the beginning of the operation, and are cut into circuit at the end or completion of the movement.

A further object of the invention is to provide an electro magnet of the character referred to, wherein the induced current is accentuated as the solenoid core is drawn into its coils.

A further object of the invention is to provide an electro magnet specially designed for use in connection with alternating currents.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and relative arrangement of parts all as will more fully appear hereinafter, as shown in the ac-

companying drawings and finally pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference signs appearing thereon Figure 1, is a view in section of an electro magnet in the form of a solenoid embodying the principles of my invention. Fig. 2, is an end view of the core of the solenoid shown in Fig. 1, and showing the solid end of such core. Fig. 3, is a view similar to Fig. 1, showing the application of another form of electro magnet embodying the principles of my invention. Fig. 4, is a transverse section showing the construction of core employed in the magnet shown in Fig. 3.

The same reference sign is used to designate the same part wherever it occurs throughout the several views.

The theoretically perfect solenoid, and designed to use alternating current, should have such construction and arrangement of the parts thereof that the plunger or core would be almost entirely outside of the coils or windings at the commencement of the solenoid action, and almost entirely inclosed by such coils or windings at the completion of the solenoid action, so that there would be no induced deterrent effects at the outset, and there would be a strong deterrent effect reducing the current at the end of the action or travel of the core. This theoretically perfect condition is difficult if not impossible to attain, in practice, for many reasons, with the ordinary construction of solenoid. Moreover, it is important and desirable to avoid the heating effect of the current employed in the solenoid windings, and also, it is desirable to obtain quietness in the operation of the electro magnet. It is also very desirable, in order to secure economy of operation, that the amperage passing through the solenoid be cut down to the lowest possible point, thereby economizing in the consumption of current without weakening the action of the electro magnet.

It is among the special purposes of my present invention to accomplish these and other results.

In carrying out my invention, therefore, I propose in a broad statement of the objects and purposes of my invention when embodied in the form of a solenoid, to provide means for accentuating or increasing



the induced current as the core or plunger of the solenoid is drawn into its coils or windings, or this may be expressed in another way, as for instance, the induced retroactive effect increases abnormally as the plunger or core of the solenoid is drawn further into the coils or windings. These objects and purposes may be accomplished in a wide variety of different constructions and arrangements. While, therefore, I have shown and described one construction and arrangement for accomplishing the objects and purposes stated, my invention in its broadest scope is not to be limited or confined to the specific arrangement shown and presently to be described.

The difficulty heretofore encountered in the use of electro-magnets and solenoids employed in connection with alternating currents, has been the noise caused by the alternating release and attraction of the armature with each reversal of the direction of the current, thereby causing an exceedingly objectionable chattering. This difficulty would be overcome by using a solid core since such a core presents a solid unbroken pole surface with which the armature may make efficient contact, and the residual magnetism thereof is sufficient to prevent the release of the armature at each reversal of the direction of the current. When a solid core is employed, however, another and an equally, if not more serious objection is encountered, namely, the heating of the core. It is among the special purposes of my present invention to provide an electro magnet wherein heat as well as noise or chattering are avoided. In accomplishing the objects and purposes of my invention, in this respect, I propose to combine into one structure the advantageous features of a solid core to prevent noise or chattering, and a laminated core to prevent heating and to that end, in the construction of my electro magnet I propose to employ a core made up of laminations, the laminations being preferably, though in this respect my invention is not to be limited or restricted, of soft iron wire, the laminations being in open magnetic circuit with respect to each other at all points except at one extreme end, where such sections are united to form a closed magnetic circuit. This construction may be embodied in a variety of ways and whether in a solenoid or in other forms of electro magnets. I do not desire, therefore, to be limited or restricted in this respect.

Referring to the solenoid construction shown in Figs. 1, and 2, it will be seen that the magnet comprises a coil inclosing core or plunger A<sup>1</sup>, inclosed within a non-metallic tube B<sup>1</sup>, the coils E, being held between non-metallic end plates C<sup>1</sup>, D<sup>1</sup>. The core A<sup>1</sup>, comprises laminations or strips bundled together, and preferably in parallel relation with respect to each other. Preferably I em-

ploy iron wire in place of iron plates, thereby rendering the laminations much more perfect. These iron wires are assembled into a mass of cylindrical form and at one end of the core or plunger, the laminations or strips are brazed, welded or otherwise formed into an integral mass or connection, or secured together as indicated at E<sup>1</sup>, and for only a short length as indicated, the individual strands, plates, wires or laminations remaining disconnected from each other throughout the remaining portion of the length thereof. To that end of the core or plunger where the ends of the laminations thereof are disconnected from each other, may be attached a lever F<sup>3</sup>, or other connection through which the action of the movements of the plunger or core may be utilized for operating switches or for any other purpose for which the electro magnet is adapted. If desired, and in order to concentrate the pull exerted by the solenoid as the core thereof approaches the limit of its movement under the action of the energization of the coils or windings thereof, I mount a laminated block G<sup>1</sup>, over the end of the solenoid, toward which the closed magnetic end of the core moves.

In order to secure the desired abnormal increase of the induced retroactive effect, or to accentuate the action of the induced current as the plunger or core is drawn into its coils or windings, in the particular form of embodiment of this idea as shown in the drawings, to exemplify the broad principles of my invention in this respect, such coils or windings are preferably wound in multiple coils, being in series one with the other. If desired, a small switch may be placed in convenient relation with respect to the solenoid core to be operated by a rod H<sup>1</sup>, connected to such core, and which, when the core is drawn into the coils, eventually strikes a pivoted arm J<sup>1</sup>, thereby separating contacts K<sup>3</sup>, K<sup>4</sup>. This switch is so connected that when the contact points K<sup>3</sup>, K<sup>4</sup>, are closed upon each other, the lowest section of the solenoid winding is short circuited, but as soon as the switch is opened between the contacts K<sup>3</sup>, K<sup>4</sup> by the plunger or core being drawn into its coils, this short circuit is broken, and therefore the energizing current passes through all the sections of the solenoid winding. The action of cutting in this extra coil of the solenoid winding, after the plunger or core has been drawn into such winding, has not only the effect of cutting down the amperage passing through the solenoid to the extent of the additional resistance which is offered by that much additional wire, but it has a very largely enhanced effect in cutting down the amount of amperage owing to the effect produced on the current passing through this additional coil, by its being placed around the plunger or core of the solenoid. I have found in practice that a very slight addi-



tional coil in this position will very materially cut down the consumption of current without materially weakening the solenoid action after the plunger or core has come in contact with the laminated block G<sup>1</sup>. In other words, the induced effect is abnormally increased as the core or plunger is drawn further into its windings, by reason of the induced current becoming accentuated. As above indicated, this result may be accomplished in a wide variety of different forms of apparatus, and in the broad scope of my invention, therefore, I do not desire to be limited or restricted to the particular form shown.

In Figs. 3, and 4, I have shown my invention as embodied in another form of electro magnet, in which is employed a coil F, inclosing a core O, said core being composed of laminations or sections as above described with reference to the core or plunger A<sup>1</sup>. The laminations or sections composing the core are in similar manner to that above described welded or otherwise formed into an integral mass or connection at one end thereof, as indicated at P, the individual strands or laminations remaining disconnected from each other the remaining portions of the lengths thereof. The ends of the coil F, are held by non-metallic plates R. The welded or otherwise connected ends of the core is provided with a pole piece S, designed to exert its magnetic influence upon an armature in the performance of the functions of the electro magnet. The electro magnet embodying this construction is designed for use in any connection or situation where such use is required or desired. I have indicated an arrangement wherein the pole piece of the magnet exerts its magnetic influence upon an armature M, carried by a lever L, for operating a contact device K, to open or close electric circuit between the same and a conductor strip H, carried by a support G. If desired, the contact K, may be connected to the lever L, by a spring W. My invention, however, is not to be limited or restricted in any respects to these details of contact mechanism to be operated by the magnet, the important and valuable feature of which is the provision of a core comprising numerous sections or laminations, preferably sections of round wire, though in this respect the invention is not to be limited or restricted, such sections being united solidly together, to form the closed magnetic circuit at one end thereof, and being disconnected at all points of transverse sectional area throughout the remaining portion of the length thereof, whereby quietness of operation is attained without heat.

In the case of the solenoid shown in Figs. 1, and 2, the solid brazed, welded or otherwise connected end of the core or plunger is faced smooth in order to meet the smooth face of

the laminated block G<sup>1</sup>, thereby making a sufficiently good contact to prevent fluctuations of current, which might otherwise cause mechanical vibration. In any case, whether in the form of a solenoid or some other form of electro magnet, the solid welded portion should extend a comparatively limited distance of the length of the laminations, as any excess of closed magnetic circuit at this point would result in the formation of eddy currents, the effect of which would be to produce considerable heat.

From the foregoing description it will be seen that I provide an exceedingly simple construction of electro magnet wherein the core, whether fixed as in the case of the electro magnet shown in Fig. 3, or in the form of a plunger for a solenoid as in Fig. 1, is laminated in all transverse directions except at one extreme end thereof, at which end such laminations are formed into a closed magnetic circuit. It will also be seen that an electro magnet embodying the features of construction described may be used in any situation for operating switches, or for other purposes wherever desired.

The electro magnet embodying the principles of my invention is specially designed for use in connection with alternating current, particularly one phase alternating current. In this respect, however, I do not desire to be limited or restricted.

Having now set forth the objects and nature of my invention, and various forms in which the broad principles thereof may be embodied, I desire it to be understood that many variations and changes in the details of construction and arrangement might readily occur to persons skilled in the art and still fall within the spirit and scope of my invention. I do not desire, therefore, to be limited or restricted to the exact details shown and described, but

What I claim as new and useful and of my own invention and desire to secure by Letters Patent is

1. In an electro magnet, for use with alternating currents, said magnet having a core formed of laminations, said laminations being united into a solid mass to form a closed magnetic circuit at one end, and being disconnected with respect to each other at all other points.

2. An electro magnet, having a core composed of laminations assembled together in parallel relation, said laminations being united in a solid mass at one end of the core, and disconnected from each other at all other points.

3. An alternating current solenoid, having a plunger composed of laminations united solidly together at one end, and disconnected at all other points.

4. An electro magnet, for use with alternating currents, said magnet having a core



consisting of sections of soft iron wire assembled together, and united into an integral mass at one end of the core, and disconnected at all other points.

5 5. An electro magnet, for use with alternating currents, said magnet having a laminated core, the laminations of such core being formed into a solid mass to form a closed magnetic circuit with respect to each  
10 other at one end, said laminations being in open magnetic circuit at all other points.

6. In an alternating current solenoid, a plunger or core in combination with coils or windings, surrounding the same and so arranged that the induced retroactive effect is  
15 abnormally increased as the plunger is drawn into said coils or windings.

7. An alternating current solenoid, having a core in combination with means for increasing the number of turns of wire surrounding the core whereby the induced current is accentuated as the core is drawn into the coils.  
20

8. In an electro magnet, for use with alternating currents, said magnet having a laminated core, the laminations being united into a solid mass to form a closed magnetic circuit with respect to each other at one end, said laminations being in open magnetic circuit  
25 at all other points, and a magnetic mass

mounted adjacent to the closed magnetic circuit end of the core.

9. A solenoid, for use with alternating currents, said solenoid having a movable laminated core or plunger, the coils or windings  
35 of said solenoid being sectional, means for short circuiting a portion of said windings or coils, and means actuated by the movement of the solenoid for breaking the short circuit.

10. In an alternating current solenoid, a laminated core, the laminations being solidly united into closed magnetic circuit relation with respect to each other at one end only, and a laminated magnetic mass mounted adjacent to said end.  
40 45

11. In an alternating current solenoid, a movable core or plunger, windings or coils, therefor, said windings or coils being in sections, a switch normally short circuiting a portion of such coils, and means actuated by  
50 the movement of the core into the coils for operating said switch to break the short circuit.

In witness whereof, I have hereunto set my hand this 21st day of June, 1905, in the presence of the subscribing witnesses.  
55

HAROLD ROWNTREE.

Witnesses:

CHAS. H. SEEM,

ERNEST A. BAUGHMAN.