R. W. VALLS.

LIMIT SWITCH.

APPLICATION FILED OCT. 15, 1917.

1,369,147.

Patented Feb. 22, 1921.

3 SHEETS—SHEET 1.

Fig. 1.

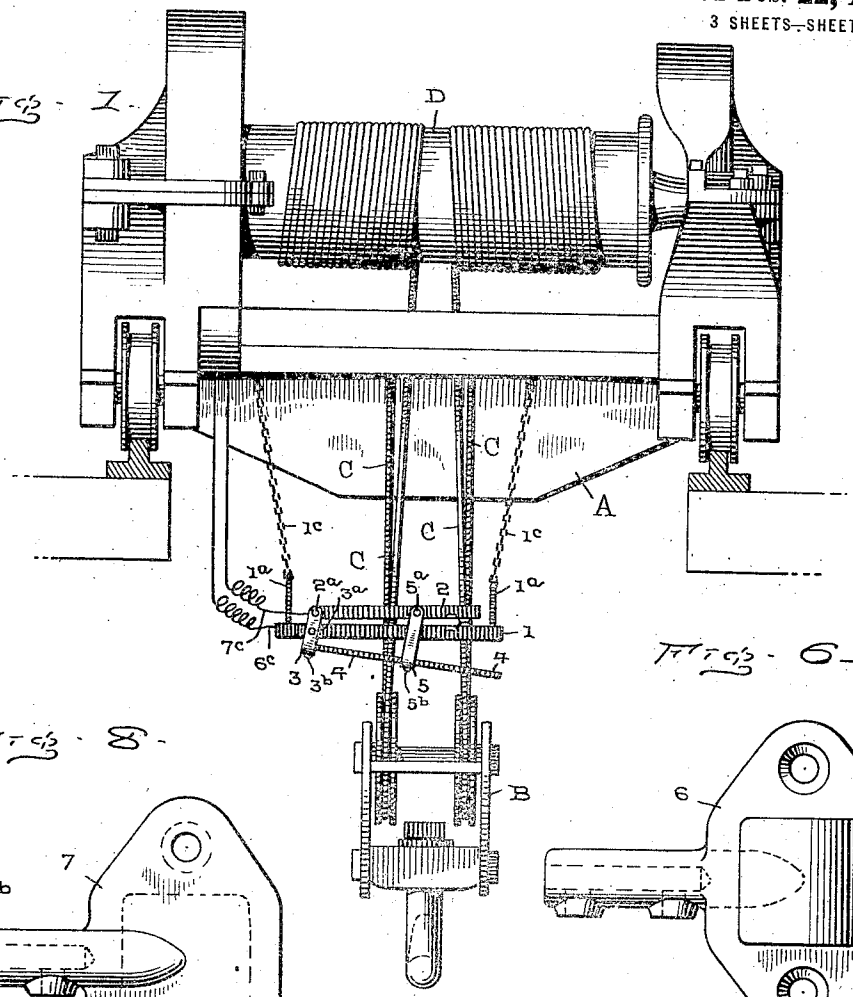


Fig. 6.

Fig. 8.

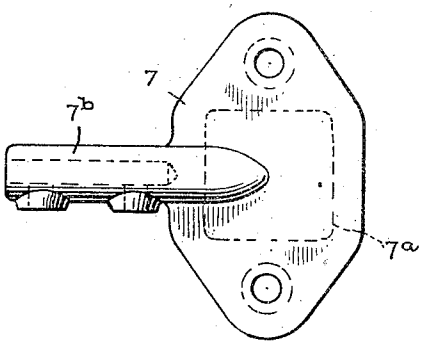


Fig. 7.

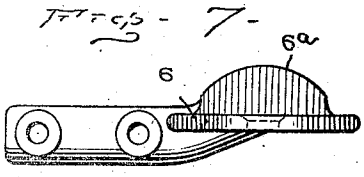
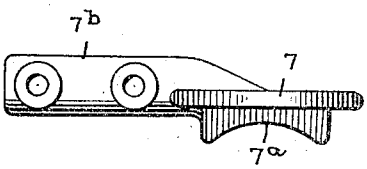


Fig. 9.



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3 SHEETS—SHEET 2.

Fig. 2.

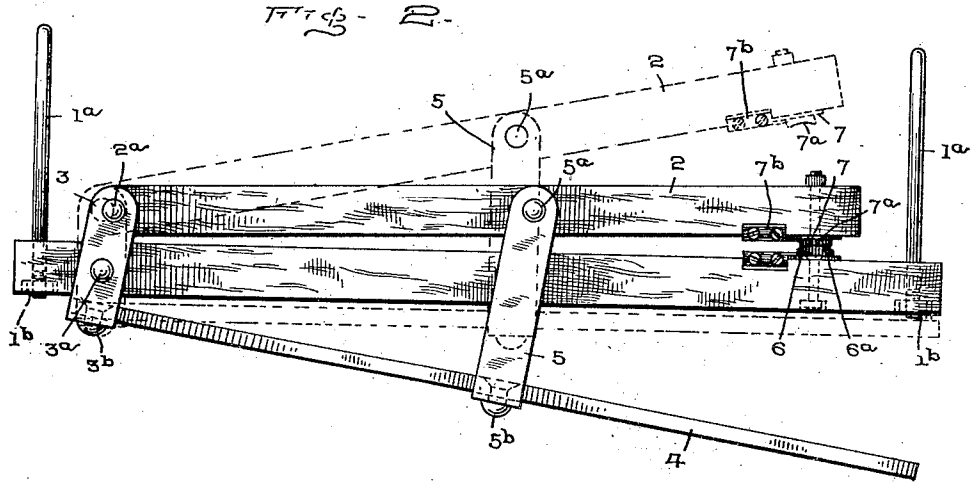


Fig. 3.

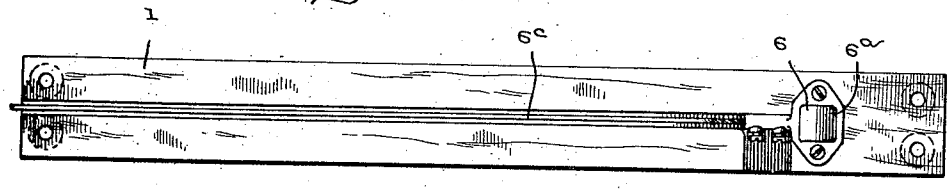


Fig. 4.

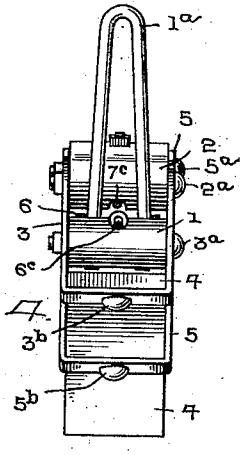
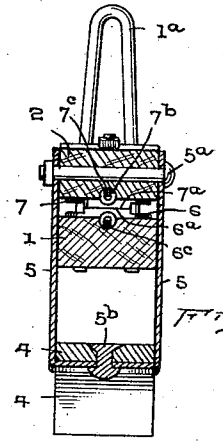


Fig. 5.



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3 SHEETS—SHEET 3.

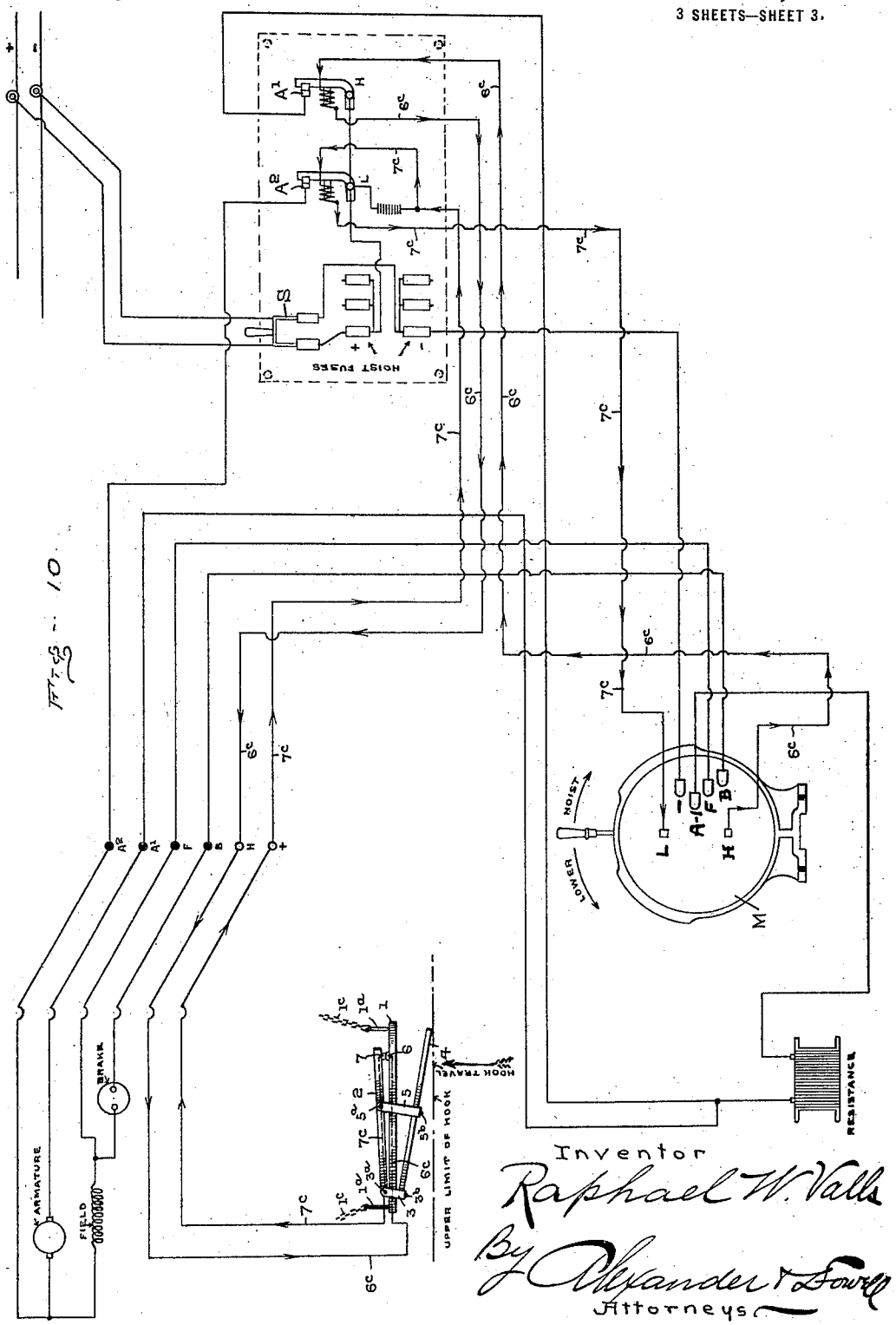


Fig. 10.

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UNITED STATES PATENT OFFICE.

RAPHAEL W. VALLS, OF KENTON, OHIO, ASSIGNOR TO THE CHAMPION ENGINEERING CO., OF KENTON, OHIO, A CORPORATION OF OHIO.

LIMIT-SWITCH.

1,369,147. Specification of Letters Patent. Patented Feb. 22, 1921.

Application filed October 15, 1917. Serial No. 196,705.

To all whom it may concern:

Be it known that I, RAPHAEL W. VALLS, a citizen of the United States, residing at Kenton, in the county of Hardin and State of Ohio, have invented certain new and useful Improvements in Limit-Switches; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is a novel improvement in so-called "limit switches" or "limit stops" used in connection with power operated lifting cranes or block-and-tackle to prevent overhoisting or undue lifting of the hook block, such as might cause injury to or dangerous breaking of the apparatus.

In order to prevent accidents and damage due to over traveling of the crane hook in the hoisting direction, that is, what is commonly called "double-blocking" various devices generally termed "limit switches" or "limit stops" have been heretofore used with indifferent success, such devices have either utilized the rotary motion of the drum or the travel of the lower blocks to operate knockout blocks or knife switches, and such "limit switches" have been adjusted to either make or break electric connections, depending upon whether a normally open or normally closed circuit system is used.

The present invention is of the so-called "knock-out" type of limit switches, in which the upward travel of the hook block is utilized to operate the switch. In my invention as applied to an overhead crane or hoisting mechanism using blocks and tackle the hoist mechanism is provided with an automatic switch, limiting the upper travel of the hook block to prevent damage due to the overhoisting or "double blocking." The device or limit contact is actuated by the hook-block itself if it passes the predetermined limit. The motor for operating the hoisting devices is controlled by a circuit including a magnetic switch which is itself normally held closed by a shunt circuit in which my limit switch is included. The magnetic switch is normally closed and held in closed position so long as the limit switch is closed, and is opened whenever the shunt circuit is interrupted by opening the limit switch. In other words, in my invention the safety hoist limit-switch operates by "breaking" and not by "making" a circuit, which latter method cannot be done with certainty.

I will explain the invention with reference to the accompanying drawings and set forth in the claims the essentials, and novel features and combinations of parts, for which protection is desired.

Figure 1 illustrates a limit switch embodying the invention and mode of using same in connection with an overhead crane which is conventionally illustrated therein.

Fig. 2 is an enlarged side view of the limit switch detached, showing it in normal closed position in full lines, and in open position in dotted lines.

Fig. 3 is a top plan view of the supporting member of the limit switch.

Fig. 4 is an end view of Fig. 2.

Fig. 5 is a cross section of the limit switch.

Figs. 6, 7, 8 and 9 are detail views of the limit switch contact pieces.

Fig. 10 is a diagrammatic view illustrating one arrangement of electrical circuits and connections for an overhead crane equipped with my limit switch.

In Fig. 1 of the drawings I have indicated a traveling crane A which may be of any suitable construction, being indicated as constructed like the so-called "Champion" cranes, which are provided with winding mechanism, and with a lower hook block B suspended from and connected with the winding drum D by a cable C usually of steel. The drum is customarily operated by an electric motor provided with proper controlling switches, and the operator by shifting a controlling lever can raise or lower the hook block B, and anything suspended thereon, at will. All these parts and their operation are well known and may be of any suitable or preferred construction, and need no detailed description or illustration.

Suspended from and beneath the frame of the crane is my novel limit switch, which as shown, preferably consists of a supporting member or bar 1, a switch bar or member 2, both of which may be of wood, or other suitable material, and a trip bar or member 4 preferably of metal.

As shown bar 1 is provided at its ends with bails or hangers 1^a, preferably formed of bent rods having their ends engaged with

holes in the ends of bar 1 and secured by nuts 1^b. These bails are connected with chains or other suitable means 1^c attached to the crane frame and by which the limit switch is suspended beneath the frame above the block B, and in such position that if the block is raised too high it will contact with and lift the trip member 4 as hereinafter explained.

The switch member 2 is arranged above the supporting bar 1 and preferably hinged thereto at one end; and as shown it may be hinged on a rod 2^a transfixing the end of bar 2 and engaging the ends of a U-shaped strap 3 pivoted to bar 4 as shown at 3^a.

The trip bar member 4 is arranged below bar 1 and is preferably of metal and is hinged at one end to bar 1, adjacent the hinged end of bar 2. The bar 4 may be conveniently hinged to bar 1 by attaching the end of bar 4 to the strap 3, as shown at 3^b. The free end of the trip bar 4 is supported and arrested when in lowermost position (see Fig. 2) by a yoke strap 5 attached to bar 4 as at 5^b and embracing and extending above bar 1 and hingedly connected to bar 2 by a bolt 5^a transfixing bar 2 as shown in Figs. 2 and 5.

When the limit switch is properly suspended or supported in normal position, bar 2 lies upon bar 1, and the trip bar 4 is suspended beneath bar 1, and the lowermost free end of bar 3 projects into the path of the hook block B, but will not interfere with the usual movements of said block and will not be affected thereby unless the block is elevated beyond the desired limit of upward movement, in which case it would engage the trip bar 4 and lift it.

To the upper face of bar 1 is attached an electrical contact piece 6 (see Figs. 6 and 7), which is preferably provided with a convex boss 6^a that projects above the face of the bar 1, and to the shank of this contact piece is connected an electrical conductor 6^c which forms part of a shunt circuit (see Fig. 10) that includes a magnetic switch A^1 controlling the main circuit to the motor that operates the block B. The conductor 6^c may be secured in a groove in the top of the bar 1, as shown.

To the lower face of the bar 2 is attached a contact piece 7 (see Figs. 8 and 9) which is preferably provided with a concave boss 7^a adapted to contact with the boss 6^a when the limit switch is closed, (see Fig. 2). The shank 7^b of contact 7 is connected to a conductor 7^c that may be placed in a groove in the bar 2 as shown, and which forms part of the aforesaid shunt circuit, said shunt circuit being closed while the contacts 6 and 7 are in engagement.

The contacts 6 and 7 are normally in engagement and held in engagement by the weight of the bar 2 and the weight of the trip bar 4 which is partly suspended from and connected with the bar 2 by yoke 5 as shown.

Fig. 10 shows a diagram of the method of wiring the so-called "Champion" crane to which the limit stop is indicated as attached in Fig. 1. By referring to this figure it will be seen that the limit stop is included within and forms part of a shunt circuit (indicated by the lines 6^c and 7^c) which includes the magnets of spring-opened magnet-closed switches A^2 and A^1, which may be of any suitable well-known construction, and control the main line circuits through the armature, field, and brake devices of the crane motor.

When the main circuit switch S is closed the main circuits are established through the controller M, and the shunt circuit is simultaneously established through the limit switch and said magnetic switches A^1 A^2, the limit switch being normally closed and remaining closed so long as the trip-bar 4 is not engaged and raised by excessive upward movement of hook block B. Upon any such excessive movement of the block the trip bar would be engaged and raised by block B and when the trip bar raises it lifts bar 2 separating contacts 6 and 7 and thereby breaking or "opening" the shunt circuit (as indicated in dotted lines in Fig. 2), and when the shunt circuit is broken the magnet-closed switches A^1 and A^2 are deënergized and said switches immediately opened by the springs, thus breaking the main circuits and stopping the motor and elevation of the block before injury is caused thereby. When the block is lowered below the excessive point the limit switch will be automatically closed by gravity.

My limit switch possesses the advantages of previously known types of switches without their disadvantages. It utilizes the bottom block to break a contact if the block passes a predetermined limit. The contact being broken the shunt coil of the magnetic switch at the cage (which is normally closed) is deënergized and the main contact is broken. The advantage of this type of limit switch is that it is operated by "breaking" and not "making" a circuit which latter method cannot be done with certainty. It also possesses the advantage that the stretching of the cable has no relation to the operation of the limit switch. It is always positive the moment the block reaches the predetermined point, and it breaks a shunt current which hardly exceeds three amperes in place of making a circuit which may carry the full load of the hoist motor.

My limit switch is of the normally closed type for the reason that the shunt circuit which the limit switch interrupts when the hook arrives at the predetermined position is normally closed and receives its current

from the main armature circuit of the hoist motor instead of carrying a large current. This shunt current is usually as low as one quarter of an ampere. This shunt current energizes the magnet coils on the switches A^1 and A^2, Fig. 10, and when such coils are energized they close the switches A^1 A^2 overcoming the resistance of the springs and closing the main circuits. If the block passes the predetermined point it raises the trip bar thereby breaking the shunt circuit and deënergizing the magnets on the switches A^1 and A^2, permitting the springs to act and open the switches through which the hoist motor receives its power, thereby stopping the hoist motor and stopping further progress of the hook in an upward direction before any injury is caused.

Preferably with my limit switch no circuit of any kind is made, but on the contrary a normally made shunt circuit is broken. It is easier and more effective and certain to break an electrical circuit than to make one, particularly the making of a circuit carrying heavy current.

In my limit switch the contacts are normally closed, and open infrequently and only when the crane block exceeds its limit of travel, and closes again as soon as the block lowers. If any dust could gather on the contact of my limit switch (which could take place only after the circuit had been broken by over travel) so that the shunt circuit could not be established, the switches A^1 and A^2 could not be closed, for lack of such shunt current, and the crane could not be operated until the contacts were cleaned.

While I have described the invention as applied to one type of crane, it is obviously not restricted to use with any particular type of cranes, but is generally useful wherever block-and-tackle hoists are operated by electrically controlled means; and while I have illustrated one form of electrical connections in Fig. 10, this is merely illustrative and not definitive of the invention, as my novel normally closed limit switch can be used with other systems of wiring or controls.

I claim:

1. In a limit switch for use in connection with electrically controlled hoisting blocks; the combination of a supporting member carrying an electrical contact; a second member pivoted on said supporting member and carrying an opposed electrical contact, said contacts being normally held closed or in contact by gravity; and a third member pivoted to and below the supporting member and connected with the second member, with means to suspend said supporting member so that the third member will be in the path of the hoisting block and be engaged and raised by the block if it passes above a predetermined limit, thereby causing the second member to raise and break the electrical circuit.

2. A limit switch, comprising a supporting member having an electrical contact on its upper face; a second member above and hingedly connected to said supporting member at one end, and having an electrical contact on its under face adapted to engage the contact on the supporting member by gravity; a trip bar arranged below and hingedly connected to the supporting member; and link connections between the trip bar and the second member for operating the latter from and by the former.

3. A limit switch for electrically controlled overhead cranes having a vertically movable hook block; comprising a supporting member having an electrical contact attached to its upper face; a second member above and hingedly connected to said supporting member, and having an electrical contact on its under side adapted to engage the contact on the supporting member by gravity; a trip bar below and hingedly connected to the supporting member; and connections between the trip bar and second member for operating the latter from and by the former; with means for supporting the switch in the path of the movable block so that the trip bar will be engaged and lifted by said block, if the latter is excessively moved, and thereby cause the second member to raise and open the switch.

4. A limit switch for electrically controlled overhead cranes having a vertically movable hook block; comprising a supporting bar; a switch-bar above and hinged at one end to the supporting bar; a trip-bar below and hinged at one end to the supporting bar; a link connection between the trip-bar and switch-bar whereby they are caused to move together and their free ends are kept separate and divergent; and opposed contacts respectively attached to the opposed faces of the supporting member and switch-bar adapted to be held normally in contact by gravital action of the trip bar; with means for yieldingly supporting the switch in the path of the movable block so that the trip bar will be engaged and lifted by said block, if the latter is excessively moved, and thereby cause the second member to raise and open the switch.

5. In a limit switch for use in connection with electrically controlled hoisting apparatus having a movable block; the combination of a member carrying an electrical contact; a second member carrying an opposed electrical contact, said contacts being normally held in contact; and a third member depending below the first member and connected with the second member; with means for yieldingly suspending the set of members below the hoisting apparatus and above and in the path of said block, whereby the

third member will be engaged and raised by the block if it passes above a predetermined limit; said third member when raised by the block causing said second member to break the electrical circuit.

6. In a limit switch for use in connection with electrically controlled hoisting apparatus having a movable block; the combination of a supporting member carrying an electrical contact; a second member movably mounted on said supporting member and carrying an opposed electrical contact, said contacts being normally held closed or in contact by gravity; a third movable member below the supporting member and means connecting the third member with said second member and assisting in normally holding the switch closed by gravity; with means for yieldingly suspending the set of members below the hoisting apparatus and above and in the path of said block; whereby said third member will be engaged and lifted by the movable block if it passes above a predetermined limit and thereby cause the second member to swing upward and break the electrical circuit.

In testimony that I claim the foregoing as my own, I affix my signature.

RAPHAEL W. VALLS.