(No Model.) 2 Sheets—Sheet 1.

V. WILLIS.

DEVICE OR MEANS FOR MAKING AND BREAKING ELECTRIC CIRCUITS.

No. 342,157. Patented May 18, 1886.

Fig. 1.

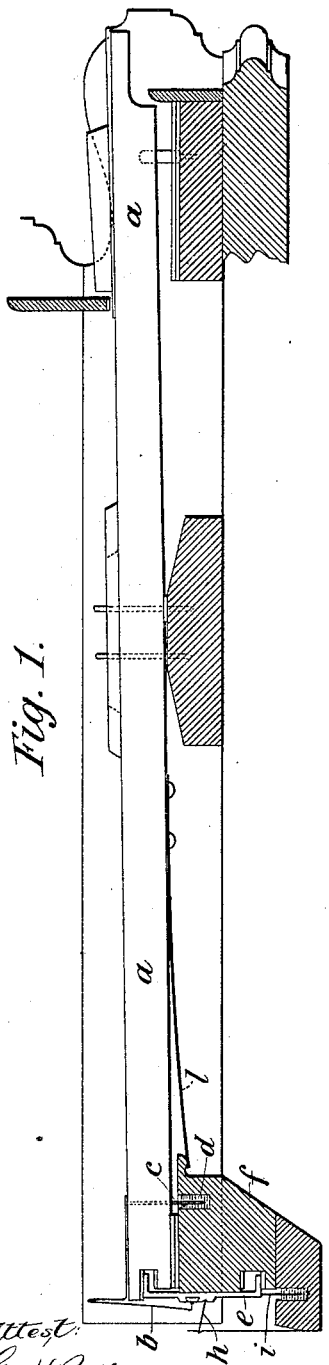


Fig. 4.

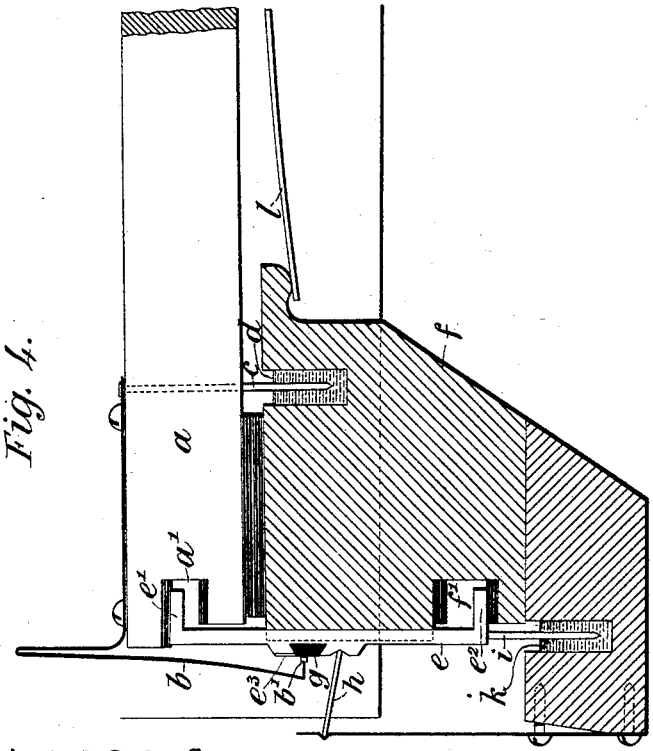


Fig. 3.

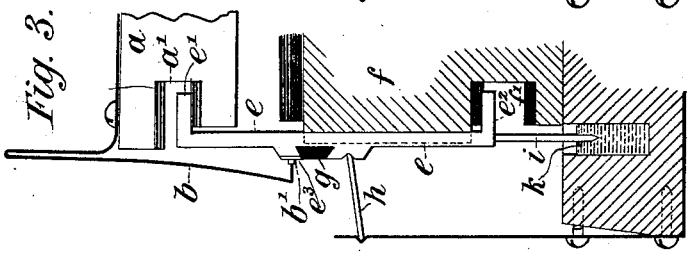
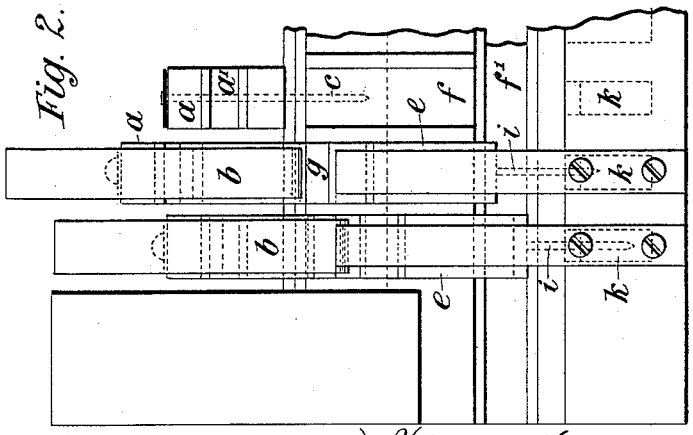


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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DEVICE OR MEANS FOR MAKING AND BREAKING ELECTRIC CIRCUITS.

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Fig. 6.

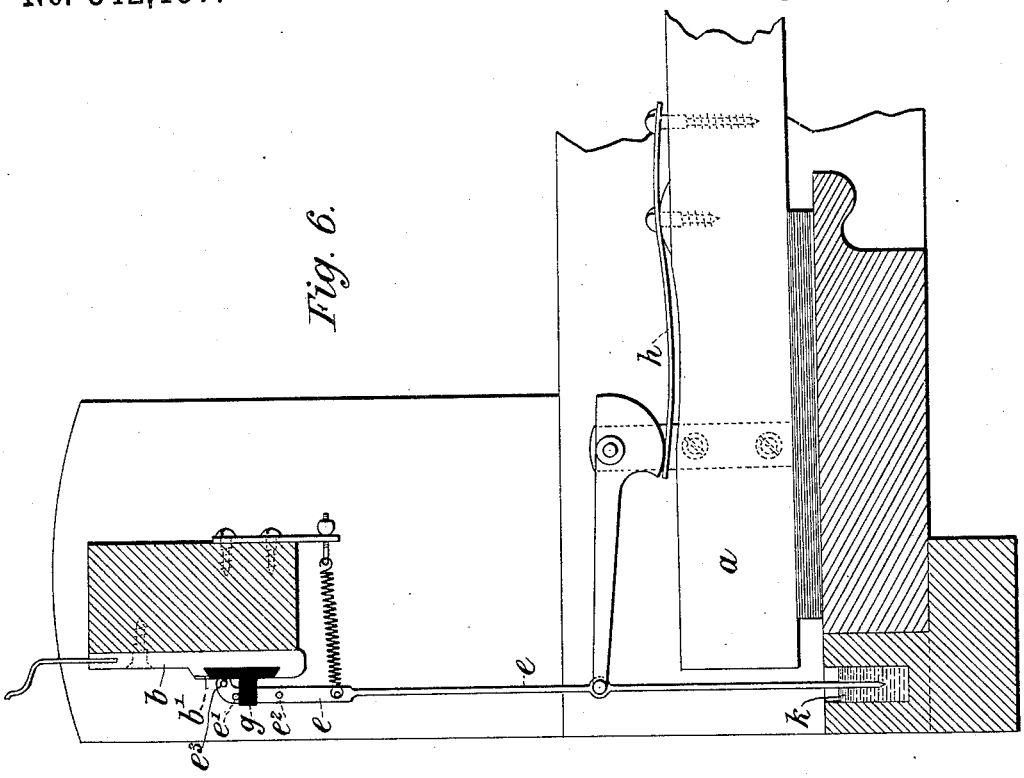
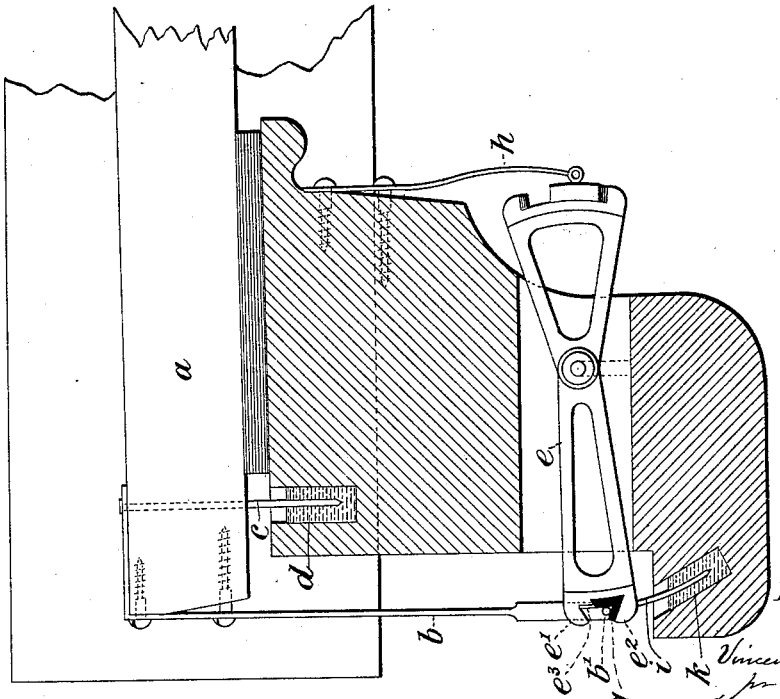


Fig. 5.



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UNITED STATES PATENT OFFICE.

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DEVICE OR MEANS FOR MAKING AND BREAKING ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 342,157, dated May 18, 1886.

Application filed June 5, 1885. Serial No. 167,721. (No model.) Patented in England January 20, 1885, No. 819.

To all whom it may concern:

Be it known that I, VINCENT WILLIS, of 9 Rochester Terrace, Camden Town, in the county of Middlesex, England, organ-builder, have invented certain new and useful Improvements in Devices or Means for Making and Breaking Electrical Circuits, (for which I have obtained a patent in Great Britain No. 819, bearing date January 20, 1885, and sealed October 6, 1885,) of which the following is a specification.

The present invention relates to an improved mode of making and breaking electric circuits, and thereby transmitting electrical impulses to a distance, and to various kinds of apparatus or mechanism from an operating piston, key, or lever, having a definite, and, it may be, a comparatively wide range of movement, the object in view being to make the apparatus or mechanism with which such circuit is connected respond promptly to each impulse transmitted to it, and to allow it sufficient time for recovering or resetting itself in readiness for promptly responding to another impulse. To attain this end it is necessary that the contact shall be effected and the circuit completed so soon as or immediately after the movement of the operating piston, key, or lever in one direction has begun, and that the contact shall be maintained during the completion of the said movement. It is also necessary that the electrical circuit shall be broken so soon as the reverse movement of the key or lever has commenced, and that the circuit shall remain broken during the completion of the said reverse movement. Such a mode of making and breaking electrical circuits is capable of many applications, and is especially useful and desirable in connection with apparatus or mechanism in which either from convenience to the operator or from necessity a key or lever having a definite and sometimes considerable range of movement is employed to transmit electrical impulses to, and so set in motion or discharge, other mechanism or trains of mechanism requiring an appreciable time to reset themselves after action, and so to prepare for the repetition of such action, inasmuch as by this new mode of making and breaking electric circuits the contacts are made or broken by the lever or key at the beginning of its stroke in one direction or another, and the apparatus or mechanism to which the impulse has been transmitted has consequently time to respond fully thereto before the completion of the positive movement of the operating-key, while during the completion of the reverse stroke of the said key time is given to the train or mechanism, of whatever kind controlled by the electric circuit, to recover or reset itself in preparation for a prompt repetition of its action on the next positive movement of the operating-key. In order to attain these important results I cause the operating key or lever by which the contacts are made or broken so to shift or act upon one or other of the contact or terminal pieces in the circuit that the said terminal pieces at the conclusion of each stroke or movement of the key or lever shall be put or held in the most advantageous position for promptly breaking or making contact at the beginning of the reverse movement of the operating-key.

My invention therefore consists in the combination, with an electric circuit and a key, lever, piston, or equivalent device under the control of the player or operator for transmitting electrical impulses along such circuit, of a pair of contact points or surfaces adapted to be brought together and complete the circuit directly the key is moved in one direction, and to remain in contact during the completion of the said movement of the key, and to be separated to break the said circuit directly the key is moved in the reverse direction, and to remain separated during the completion of this reverse movement. The sliding or yielding contact may be carried on or by the operating lever or key, and the other contact-plate and guide-pins or stops may be fixed, in which case a yielding arm upon the operating-lever carrying one terminal plate, and adapted to be held rigid while and until contact is fully established or broken between it and the other terminal point, and thereafter to yield to allow of the operating-key continuing its movement throughout its entire range,

may be employed; but I prefer to mount one terminal point or plate in the form of a spring-arm rigidly upon the operating key or lever, and to arrange a sliding or rocking piece carrying the other terminal point or plate in such a manner with respect to the said key or lever and the spring-arm thereon, that toward or at the completion of its movement in one direction or the other the said lever or its spring-arm shall engage with the said sliding or rocking piece and shift it and its terminal plate or point into position for at once making or breaking contact at the beginning of the movement of the key in the reverse direction, the sliding or rocking piece being, as before explained, held motionless by a suitable spring pressure-pad or friction device during the act of making and breaking contact.

My invention is illustrated in the accompanying drawings, in which Figure 1 is a sectional side view of part of the key-board of an instrument—such as an organ—with my invention adapted thereto. Fig. 2 is a rear end elevation of three keys with their fittings about their actual size. Figs. 3 and 4 are sectional side views, on the same scale as Fig. 2, of the rear end of a key and its fittings, illustrating the positions assumed by the parts in two extreme positions of the said key. Fig. 5 is a sectional side view of a similar combination of parts embodying the same principle of action, the yielding contact-piece being mounted to rock instead of to slide; and Fig. 6 is a similar view illustrating an arrangement embodying my invention, in which the positions of the contact-surfaces are reversed, the sliding or yielding contact-piece being mounted upon or carried by the key and movable therewith, while the other contact-piece, which is not directly connected with the key, is fixed.

The same letters of reference indicate like or corresponding parts in all the figures.

a is the key, or its equivalent, by which the circuit is controlled. A key—such as is used in an organ—is shown in Fig. 1, as the invention is of especial value as applied to such instruments when arranged to be operated by electricity; but it is obvious that the key might be that of any electrical instrument from which electrical impulses have to be transmitted.

b is a contact-piece mounted on the rear end of the key and in unbroken electrical connection with one pole of the battery by a metal pin, *c*, dipping into a trough of mercury, *d*, which extends lengthwise of the key-board. The contact-piece *b* preferably takes the form of a spring tongue or arm, as shown in Figs. 1, 3, and 4, and is tipped with platinum or equivalent incorrodible metal, as at *b'*.

e is the other contact-piece, preferably consisting of a strip of metal with bent ends or projections *e' e²*, which engage with notches *a'* and *f'* in the key *a* and the end bar or frame, *f*, respectively, for a purpose which will be hereinafter explained. The contact-piece *e* is provided with an ivory, glass, or equivalent insulating plate or surface, *g*, and also with a platinum contact-surface, *e³*, as shown best in Figs. 3 and 4. The piece *e* is free to be moved up and down by the key, and is acted upon by a spring-strut, *h*, by which it is caused to retain any position to which it has been moved until again shifted by a fresh movement of the key. This piece *e* is in permanent electrical connection with the other pole of the battery by means of a pin, *i*, and mercury-cup *k*, each piece *e* having its own separate mercurial connection in the case of an organ, in which separate electro-magnets have to be excited. When the platinum point *b'* is brought by the depression of the front and the elevation of the rear end of the key in contact with the platinum surface *e³* on the piece *e*, the electrical circuit is made, and the current is able to pass to the mechanism which it is to operate, which, in the case of an organ, will be usually a train comprising an electro-magnet and one or more pneumatic levers, and when the platinum point *b'* is moved from off the platinum surface *e³* onto the insulating-surface *g* (whether of ivory, glass, or other suitable substance) the circuit is broken and the electro-magnet or mechanism of whatever kind controlled by the electrical current becomes inoperative, and the train which it controls resumes its normal position.

In many electrically-actuated key-board instruments the circuits are not fully made or broken until the key, piston, or lever controlling the contact-pieces has completed one-half its stroke, and there is thus loss of time in obtaining response from the mechanism to which the electrical impulse is transmitted, and also a delay in releasing the said mechanism from its controlling current. Now, by my invention I am enabled to fully complete the contact and transmit the current by giving to the key a movement of it may be only an eighth of an inch in one direction, and to fully break contact by a similarly small range of movement in the reverse direction, and this with a key having a definite, wide, or comparatively large range of movement, and at any position of the said key. In practice I arrange the contact-surfaces to make full contact with a movement of the key of about one-sixteenth of an inch, and to fully break contact with a movement of the key of about one-eighth of an inch. I am thus enabled to transmit rapid electrical vibrations by corresponding movements of the key at any position thereof, extreme or intermediate, or to take full advantage of the wide range of movement of the key, of which musicians will appreciate the importance, while experiencing none of that sense of drag which is felt in playing electrical organs as hitherto constructed. I attain these novel results by the use of the sliding or yielding contact-piece *e*, which readily yields or shifts its position when pressure is applied to it, but which, under the influence of a light spring, friction device, or brake of any suitable kind, such as *h*, remains

steady or quiescent in the position to which it has been moved.

Referring now more particularly to Fig. 4, it will be seen that directly the rear end of the key begins to rise contact between the parts b' and e^3 is made, and that immediately after such contact has been fully established the lower part of the notch a' in the key a, (which is clothed with felt or other suitable material) will strike against the upper bent end e' of the sliding piece e, and will carry that piece up with it during the completion of its stroke, the extent of contact between b' and e^3 remaining unchanged and the contact-surfaces ceasing to move, the one with respect to the other, so soon as full contact is established. There is thus no necessity to employ contact-surfaces of large extent. At the conclusion of the full stroke of the key the parts will be in the positions shown in Fig. 3. When pressure on the key is relaxed the rear end of the key a will descend under the influence of the spring l, and the platinum point b' will at once slide onto the insulating-surface g, and the circuit will be broken. The upper part of the felted notch a' in the key a will then engage with the top of the bent end e' of the sliding contact-piece e, and both contact-pieces will descend or move together during the completion of the return-movement of the key, the circuit remaining broken.

The spring-strut h consists of a double-pointed pin or rod, one end of which engages with a notch or hollow in the sliding piece e, and the other end rests in a depression or hole in a flat vertical spring secured to the back rail or other convenient point of attachment. In its extreme positions, when the spring is weakest, the inclination of the pointed pin or strut h is greatest, and effectually holds the piece e steady while the platinum point b' moves onto or off from the contact or insulating-surfaces e^3 and g, respectively, while, should the key be vibrated in an intermediate position, the strut will be held by the spring at its greatest power and with the same practical result. So little pressure on the piece e suffices to hold it steady until directly moved up or down by the key itself that it is possible and desirable to back the metal strip e, where it touches the back rail, with glass, ivorine, or some other easily-applied and non-corrodible substance, with the view of insuring smoothness of action.

The precise construction and arrangement of the yielding or sliding piece e may vary according to the build of the instrument and the mechanism with which it is connected. Thus the piece e may be mounted to rock on a fulcrum and be normally held quiescent by a friction pad or brake, h, as shown in Fig. 5, the principle of action of the parts remaining identically the same as before; or the position of the fixed and sliding contact-pieces may be reversed—that is, the contact-piece carried by the key may be arranged to yield or shift, and the contact-piece which is not attached to the key may be fixed, as in Fig. 6. In this arrangement the spring h holds the yielding contact-piece e, carried by the key a, steady until its platinum point or surface e^3 has made contact with the contact-surface b', as in the preceding examples, after which, on the further upward movement of the rear end of the key a, the point or pin e^2, engaging with a projection or shoulder on the terminal piece b, the contact-piece e will yield, thus presenting no appreciable resistance to the completion by the key of its full stroke. On releasing the key its rear end will descend, as before, under the influence of a spring, (not shown in the drawings,) and the contact-piece e being firmly held by the pressure of the spring h on the arm or support by which the said piece is connected to the key, its platinum point e^3 will first be slid onto the insulating-surface g, and then the point or pin e' engaging with the projection or shoulder on the terminal piece b its further movement will be arrested. The key, however, will be free to complete its return stroke, owing to the yielding of the contact-piece e, in precisely the same manner as already above described.

It is obvious that various forms of shoulders, projections, or pins may be used as stops for the purpose of effecting the shifting of the movable terminal; and also that many well-known forms of frictional devices may be used in lieu of the frictional spring-strut described herein for holding the movable terminal steady until contact between it and the fixed terminal has been made or broken.

Although I prefer to connect the wires attached to the above-named terminal plates with their respective circuits by means of pins dipping into mercury, other well-known means might be used for this purpose. Thus, without interfering in any way with the desired range of movement of the operating key or lever, I am able to instantly make or break the circuit during the first part of the movement of the key in one direction or another, and thereby instantly to start the train or mechanism and allow it ample time for getting to work while the key completes its movement, or as instantly to release it and give it time to reset itself in readiness for the next impulse while the key completes its return or reverse movement.

In no other electrical make-and-break device with which I am acquainted is it possible to make contact at one point or position of the parts and to break contact at another point or different position of the said parts; but by my invention this is rendered practicable. Such a mode of controlling the making and breaking of electric circuits may be used in connection with the operating-keys of telegraphic and time-signaling apparatus, in which clock-work and other trains are used, and will also be found very valuable for electrically operating pneumatic levers or trains of levers from a key-board, as it affords the necessary time for the said levers to collapse or inflate, as the

case may be, between the electrical impulses, and so to be in a position to promptly respond to the touch of the operator, whereas in apparatus hitherto constructed for transmitting electric impulses to such mechanism the contact is both made and broken at about the same point in the travel of the lever, the result, as regards organs, being an appreciable and disagreeable sense of drag to the player in both making and breaking the contact.

From the foregoing it will be obvious that the contact sliding piece may be made double-acting by causing a pendent contact-lever to swing between two contact-surfaces on the slide, and thereby to complete the circuit at every movement either to the right or to the left.

Having now fully described my invention, what I desire to claim is—

1. In an electrical circuit in which one terminal is carried by a key, a piston, or an equivalent device, the combination, with such device, of a second terminal, as e^3, fitted with an insulator for the first terminal to bear upon, such second terminal being supported by a frictional device and so connected with the key as to receive an endwise motion therefrom on the rising or depression of the key without following it through the whole of its movements, as and for the purpose above set forth.

2. The combination, in an electrical circuit, of two contact-surfaces or terminals, as b' e^3, arranged so as to be brought together and separated by means of a key, lever, piston, or other operating device, as a, one of said terminals, as e^3, being arranged so as to be moved with the key and also independently thereof, substantially as described.

3. The combination, in an electrical circuit, of two contact-surfaces or terminals, as b' e^3, arranged so as to be brought together and separated by means of a key, lever, piston, or other operating device, as a, one of said terminals, as e^3, being mounted independently of said key or lever and movable therewith, substantially as described.

4. The combination, in an electrical circuit, of two contact-surfaces or terminals, as b' e^3, arranged so as to be brought together and separated by means of a key, lever, piston, or other operating device, as a, having a given definite range of movement, one of said terminals, as e^3, having a definite range of movement less than the operating device, being mounted independent of said device and movable therewith, substantially as described.

5. The combination, with a key, such as a, of a terminal point or surface, b', a shifting or yielding terminal point or surface, e^3, and projections e' e^2, for effecting the shifting or arresting the movement of the yielding terminal to allow the key or lever to continue or complete its movement in one direction or the other without altering the relative positions assumed by the said contact-surfaces at the commencement of the said movement, and pressure-springs, such as h, or equivalent means for holding the yielding contact steady on or against its support while the circuit is being made or broken, as set forth.

6. The combination, with a piston, lever, or key, of a pair of contact-pieces or terminals, one or both of them movable or yielding, a spring-strut or pressure-pad for holding one or both of the said movable contact-pieces or terminals steady upon its support until contact is fully made or broken, and shoulders, stops, or studs for effecting the shifting or yielding of the movable contact piece or pieces after such contact has been fully made or broken, for the purpose set forth.

7. The combination, with a key, lever, or piston, as a, located in an electrical circuit having a given definite range of motion and provided with and carrying a contact-surface or terminal, b', of a second contact-surface or terminal, e^3, arranged independent of said key or lever and adapted to be moved therewith, substantially as described.

8. The combination, in an electrical circuit, with two contact-surfaces or terminals, b' e^3, arranged so as to be brought together and separated by a key, lever, or piston, one of which terminals is mounted on said key and the other independently thereof, of connections between the operating-key and one of the terminals, as e^3, whereby the terminals are brought together to make the circuit in one position of the operating-key and separated to break the circuit at another position of said key, substantially as described.

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