(No Model.)

C. W. McDANIEL.

CIRCUIT CHANGER.

No. 368,221. Patented Aug. 16, 1887.

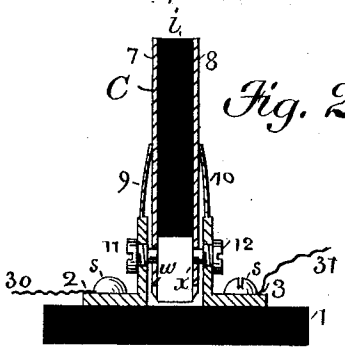


Fig. 2.

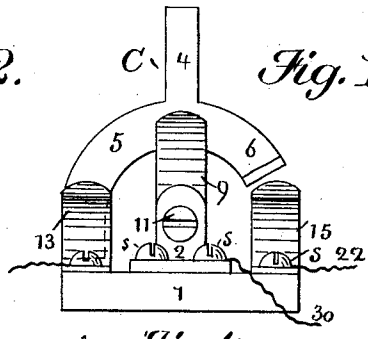


Fig. 1a.

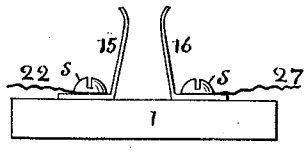


Fig. 3.

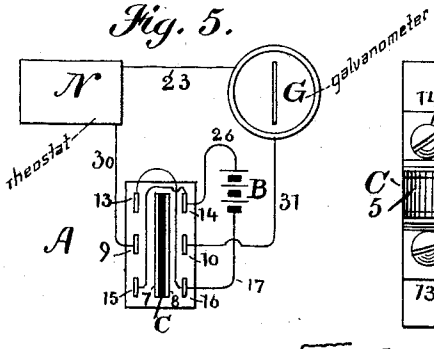


Fig. 5.

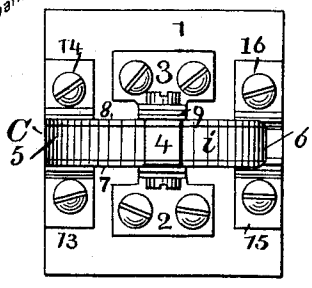


Fig. 4.

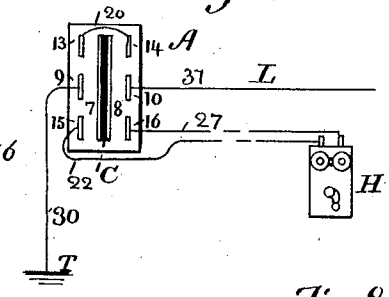


Fig. 6.

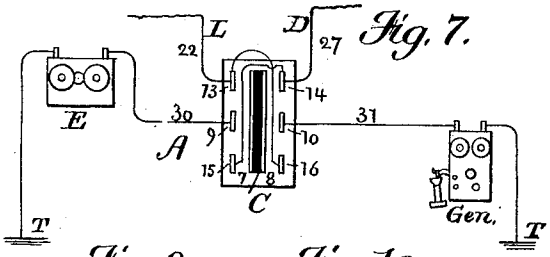


Fig. 7.

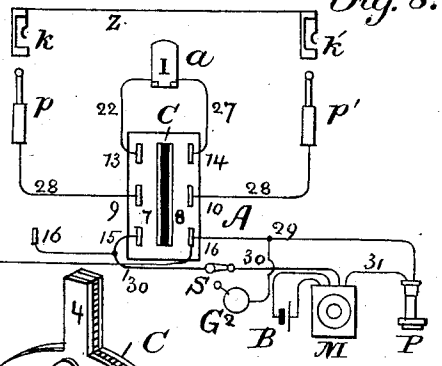


Fig. 8.

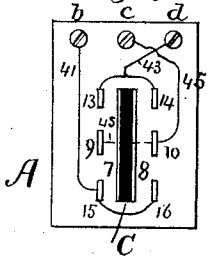


Fig. 9.

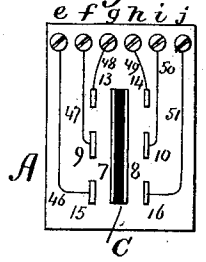


Fig. 10.

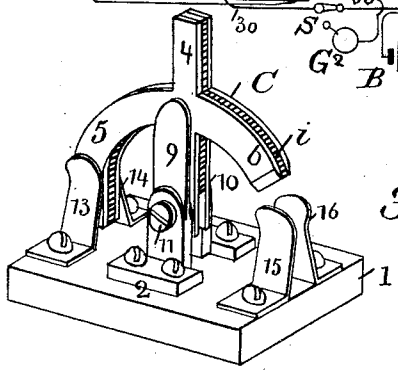


Fig. 1.

Witnesses.

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UNITED STATES PATENT OFFICE.

CHARLES W. McDANIEL, OF KANSAS CITY, MISSOURI.

CIRCUIT-CHANGER.

SPECIFICATION forming part of Letters Patent No. 368,221, dated August 16, 1887.

Application filed February 17, 1887. Serial No. 227,925. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. McDANIEL, of Kansas City, in the county of Jackson and State of Missouri, have invented certain Improvements in Circuit-Changers, of which the following is a specification.

My invention relates to switches or circuit-changers; and its object is to furnish a novel and convenient loop-circuit changer capable of being efficiently used in a large variety of ways in connection with electrical circuits and appliances.

In consists of two segmental faces of metal separated by an insulating medium, which, however, unites the two conducting-faces mechanically, and mounted in pivots or bearings between contact-springs upon a suitable non-conducting base. The metal sides may each, by means of suitable screw or soldered connections, constitute permanently the respective terminals of a loop of an electric circuit or of the two wires of a metallic circuit of any character. Upon the same base, at opposite sides thereof, I mount two pairs of contact-springs, with which the loop-terminals, as represented by the metallic segments, may be brought into contact by swinging the said segments to one side or the other. The two springs of each pair are separated by an air-space slightly less than the thickness of the movable piece, including the two conducting-faces thereof and the insulating-partition, and they slightly flare at the ends, so that the end of said movable piece can be readily inserted between them and force them apart. When swung toward either pair, one of the segments comes into contact with one spring and the other segment with the other spring of a pair. An arm of the two segments and their separating non-conductor extends upward to serve as a handle, whereby the switch may be swung; and an opposite arm extends from the inner side of the segmental curve downward and receives the pivotal screws or bearings on which the segments may be moved. An extra contact-spring extends from each pivot-screw or from the standard thereof, and passes with a rubbing contact upon the metal segments, irrespective of the position thereof. One of the arms of the segment is longer than the other, so that when the switch is turned in one direction the handle, which is thus placed on one side of the center of the segments, will assume a vertical position, which may indicate the normal condition of the switch. When oppositely turned, the handle points to an angle with the base, and in like manner may indicate the abnormal condition of the switch. This switch is readily capable of employment as a pole-changer or current-reverser, a cut-out, a telephone looping-in switch, a single or double ordinary three-point switch, or a switch whereby either of two lines may readily be connected to either of two instruments, or vice versa.

Many other utilizations of my circuit-changer will readily suggest themselves to those skilled in the art.

I have in the drawings which illustrate and constitute a part of this specification shown several views of my circuit-changer and diagrams of different plans of using the same.

Figure 1 is a perspective view, and Fig. 1ª a side elevation, of the circuit-changer. Fig. 2 is a vertical end section of the same, and Fig. 3 an end view of one of the pairs of contact-springs. Fig. 4 is a plan view. Fig. 5 shows the mode of applying my switch as a pole-changer or current-reverser for use in electrical measurements or like applications, and Fig. 6 is a cut-out for electrical communicating apparatus. Fig. 7 illustrates its application for the reciprocal use of two sets of instruments by either of two lines. Fig. 8 shows its application to telephone switch-boards, and Figs. 9 and 10 indicate symbolically and respectively the use of my circuit-changer as an ordinary single or double "three-point" switch.

In describing the construction of the switch, reference will be had to Figs. 1, 1ª, 2, 3, and 4.

In the drawings the appliance is mounted upon a base, 1, of hard rubber, hard wood, vulcanized fiber, or like non-conducting material. Upon this and near the center of its sides a pair of standards, 2 and 3, are attached by screws. Within and upon these standards is hung the movable part C of the circuit-changer, comprising two polished metal conducting-surfaces, 7 and 8, separated from one another electrically by a non-conducting partition, *i*, to which both surfaces are, however, mechanically fixed by machine-screws, or in any preferred way. The shape of this mova-

ble part C is generally segmental; but said part has two vertical extensions, one of which, 4, projects outwardly from the convex side of the segment to serve as a handle, while the other extends downwardly from the concave side of the segment and is mounted on pivots. This second projecting arm does not include the insulating medium, which is cut away, and comprises, therefore, the two metal surfaces only, their ends being indicated by the letters *w* and *x*. Through the vertical portion of the standards 2 and 3 pivot-screws 11 and 12 are inserted, which project into recesses or bearings in the downward extensions *w x* of the metal surfaces 7 and 8 of the switch, and upon the ends of these screws the movable part of the said switch is capable of being rocked by means of the upwardly-extending arm 4, which serves as a handle.

Two metal contact-springs, 9 and 10, are attached (by solder or otherwise, so as to make a good electrical connection) to the upper ends of the brackets or standards 2 and 3, and press at their free ends upon the bright metal surfaces 7 and 8, so that perfect electrical continuity is at all times maintained between the said surfaces and the standards they are pivoted in.

Electrical wires 30 and 31 may be attached to the screws *s*, which secure the standards to the base, and the two surfaces 7 and 8 thus constitute terminal plates for the circuit-loop represented by the said wires. The arms 4 and *w x*, extending from the segmental movable part, do not project from a point equidistant between the two ends of the said movable part, but are much nearer one end of them than the other, as shown. By this construction it is made easy to see at a glance whether the circuit-changer is or is not in its normal position, as when the switch is thrown to one side the arm assumes a vertical position, while when the switch is oppositely placed the arm assumes a position at an angle to the vertical plane. Furthermore, this handle thus divides the segment into two arms, a longer arm, 5, and a shorter arm, 6. At each end of the base, in line with the movable part C, are a pair of spring-jaws, 13 14 and 15 16. These are shown in detail in Fig. 3, and the two springs of each pair are so placed with respect to one another and to the movable part C that when the latter is swung between them it forces their ends farther apart from one another and brings the spring 15, for instance, into frictional contact with the metal surface of the side 8 and the spring 16 into contact with the metal surface 7. The space between the spring ends 15 and 16 is normally smaller than the thickness of the movable part C, which is introduced between them, so that a good electrical union is always maintained. Moreover, the ends of both springs are slightly bent backward, while at the same time the end of the segmental arms 5 and 6 are slightly tapered off at their extremities, so as to facilitate ingress between the springs 15 and 16, or their congeners at the opposite end. Circuit-wires 22 27 are attached to these springs, and the two pairs of springs thus may be made to constitute auxiliary loops, which may include signaling appliances or other instruments, or which may, if desired, form the terminals of extensions of the principal circuit. It is thus evident that by turning the handle 4 in either direction the circuit with which the metal segments are connected may readily be continued through the springs upon that side to an extension-loop for any desired purpose.

I will now describe a few of the uses to which my invention may be applied, having reference to the diagrams, Figs. 5, 6, 7, 8, 9, and 10.

In Fig. 5 its extreme convenience as a quick and efficient current-reverser or pole-changer is manifested. In these diagrams the circuit-changer is shown symbolically. As a whole, the circuit-changer is designated in the diagrams by the letter A. In Fig. 5 a battery, B, has one of its poles united by wire 26 with one of the jaw-springs, 14, at one end and side of the base, and also with a similar spring, 15, at the other end and side of the base. The other pole of the same battery is in like manner united by wire 17 with the remaining jaw-springs, 16 and 13. One of the side springs, 9, is united by wire 30 with one terminal of the rheostat N, while the other side spring, 10, is united by wire 31 with one terminal of the galvanometer G. The remaining terminals of the galvanometer and the rheostat are united by the wire 23. It is obvious that the current of the battery B is readily reversed with respect to the instruments N and G simply by swinging the switch C over from the springs 13 and 14 to the springs 15 and 16, or vice versa. The rheostat and galvanometer are obviously replaceable by any other appliances responsive to changes of direction of an electrical current—such, for example, as a main-line circuit and one or more polarized relays.

In Fig. 6 the operation of the circuit-changer A as a cut-out is exemplified. A is the circuit-changer, C the movable part thereof, 9 and 10 the side springs connecting with the movable conducting-surfaces, and 13 14 and 15 16 the end jaw-springs. A main line, 31, terminates in contact with the side spring, 10, and a ground-wire or return-wire, 30, of the said main line with the side spring, 9. The two jaw-springs 13 and 14 at one end (which end is immaterial) are united by a wire, 20. The two jaw-springs 15 and 16 at the other end are united by wires 22 and 27 with the terminals of the telephone outfit H or any other desired instrument. When the movable part C is turned toward springs 15 and 16, it is clear that the instruments are thereby introduced into the line-circuit, while when the movable part C is turned to the springs 13 and 14 the instruments H are thereby cut out and the two sides of the main circuit are closed through springs 13 and 14 and wire 20. In practice, when employed for this purpose, I

preferably mount the appliance upon the side of the magneto-bell. It is to be observed, moreover, that this device constitutes a perfect cut-out or disconnector, and not merely a shunt-circuit, as is the case in the ordinary plan where a plug is inserted between two contact-plates.

The advantages accruing from the use of my circuit-changer are, first, that the apparatus H may be totally disconnected, and hence is not subject to danger from abnormally strong currents or charges of electricity passing in the main circuit, and, second, that there is no chance for a subscriber to cut out his apparatus (for example, during a thunder-storm) and, forgetting to cut it in again, to assume that his line is out of order, on the ground that as he hears the bell ring when he sends a call his apparatus is in working order. When a short-circuiting plug only is used, this defect necessarily exists; but if the subscriber in using my device forgets to cut in his apparatus his bell will not ring at all when he essays to call a distant station, its circuit being open at the springs 15 and 16; hence his attention is immediately attracted to the cut-out, which he then operates to reconnect his apparatus.

Fig. 7 shows the solution by my circuit-changer of a well-known and ever-recurring problem. It frequently happens that at one sub-station two lines center, with which, for economy, it is desired to associate but one set of telephones. It is, moreover, desirable that the line, which at any moment is disconnected from the principal call-bell, call-generator, and telephone, shall be provided with a call-bell of its own, so that signals coming over that line shall not pass unnoticed. It is also desirable that the act of transferring the telephones from either line to the other shall reciprocally transfer also the auxiliary bell to the line from which the telephones and principal call apparatus are simultaneously withdrawn. In the accomplishment of this end my appliance is a very convenient device. One line, L, connects by wire 22 with the jaw-spring at one end and side, 13, and also with a similar spring, 16, at the other end and side. The other main line, D, is permanently united by wire 27 with the remaining jaw-springs, 14 and 15. The telephone-call generator and principal bell may be connected with one of the side springs, 10, by wire 31, and on the other side with the earth at T, and the auxiliary call-bell E is then united by one terminal through wire 30 with the other side spring, 9, and by the terminal also with the earth at T. Suppose now the circuit-changer is turned toward the springs 13 and 14. The line L may be traced through wire 22 to spring 13, metal surface 7 of the movable part C, spring 9, and wire 30 to the auxiliary call-bell and ground. The other line, D, may be in like manner traced from wire 27 to spring 14, movable conducting-surface 8, side spring, 10, and wire 31 to main call-bell and telephones and thence to earth. Thus the line D is in condition either for signaling or talking, while the line L is in connection with a call-receiving instrument only; but by pulling the handle 4 over toward the springs 15 and 16 the conditions may be reversed, line L being connected with the telephone outfit and line D with the auxiliary bell.

In Fig. 8 my appliance is represented as being utilized as a looping appliance, whereby a double line or two connected lines may be alternatively made to include an annunciator, *a*, or telephones. This organization finds its special field of operation in connection with telephone switch-boards. When two lines are united through a telephone switch-board, or when the lines are at rest, it is often necessary to introduce the operator's instruments into the circuit for the purposes of oral communication, supervision, or signaling. It is also equally convenient, and is, moreover, customary, to provide an annunciator between the two connected line-circuits or between any given line and its return or earth terminal, whereby to receive disconnecting signals. My invention is particularly well adapted for this purpose. Two connecting-plugs, *p p'*, are adapted for insertion into switch-board sockets or spring-jacks, each representing lines, in a manner well understood. The jaw-springs 13 and 14 at one end of the base are united by wires 22 and 27 with the electro-magnet of an annunciator, *a*. The other two jaw-springs, 15 and 16, constitute the terminals of a loop including, by means of the wires 29, 30, and 31, the calling apparatus G^2 and telephones P and M. A small switch, S, determines by its position the alternative use of these instrumentalities. The connecting-plugs *p p'* are united by flexible conductors 28 and 28 with the side springs, 9 and 10. When it is desired to send calls to either line, to speak over either line, or to supervise conversation, the handle 4 of the circuit-changer will be turned toward the springs 15 and 16. The main circuit may then be traced from plug *p via* cord 28 to side spring, 9, metal surface 7, jaw-spring 15, wires 30 and 31, telephone or call instruments, wire 29, jaw-spring 16, metal surface 8, side spring, 10, and flexible cord 28 to plug *p'*. The line 2, connecting the plug-sockets *k k'*, represents the united lines. When the switch is in this condition, communication may be maintained between the central station and the two lines; but when it is desired to withdraw the central telephones from the lines, the handle 4 is thrown over toward the springs 13 and 14, the telephones thus being disconnected and a disconnecting-annunciator, *a*, substituted therefor. In this application of my circuit-changer it is obvious that but one telephone-loop is necessary, extended, as indicated in the drawings, to as many normally-open terminals 15 16 as there are pairs of plugs and cords for connecting.

It will be seen by reference to Figs. 1 and 1^a that the movable conducting-segment C is so

long that it makes contact upon one side before it breaks contact upon the other. This is in many respects advantageous. It prevents a momentary interruption of communication at the instant of change. If employed in systems using heavy currents, it averts all danger of sparking at the contacts, and it enables a telephone-operator, if he so desires, to listen in without breaking the back circuit, thus giving two routes to the talking-current and reducing the resistance, instead of increasing it.

In Figs. 9 and 10 the functions of an ordinary single and double switch are indicated. In the single form, Fig. 9, the main circuit enters at the binding-screw *e*, and leads by wire 45 to both side plates, 9 and 10. One of the branch circuits enters at the binding-screw *b* and leads by wire 41 to the twin jaw-springs 15 and 16, which are electrically united. The other branch circuit enters at *d* and passes by wire 43 to the two opposite jaw-springs 13 and 14. The main wire 45 can thus be put into connection with either branch. Fig. 10 is an extension of the same principle. A side appliance is there, however, made to supply two main circuits, connecting, respectively, with binding-screws *f* and *i*. The main wire 50, leading from and connected with *i*, can be united with either of the branches 49 or 51 at will, and the main line 47, represented by the screw-terminal *f*, may similarly be united with either of the branches 46 or 48. Each spring-contact has in this instance its own screw-terminal.

Many other utilizations will readily occur to practical electricians.

By using two separate loop-levers on separate bases, or upon the same base, a number of other combinations of circuits can be made.

One of the advantageous features of my circuit-changer is that all of the wire attachments are readily made upon its surface and are not concealed in any way, but can be changed with the greatest facility.

I claim as my invention—

1. The hereinbefore-described circuit-changer, comprising a pivoted lever and curved arms and having two conducting-surfaces insulated from one another, brackets or standards in which the said lever is pivoted, each bracket constituting a circuit-terminal and being provided with a spring bearing upon one of the conducting-surfaces of the said lever, and two pairs of contact-springs, one for each lever-arm, each pair of springs being adapted to be connected with one or more independent branch circuits and mounted in the line of movement of the two arms of the said lever, whereby when the said lever is swung on its pivots in either direction its insulated conducting-surfaces are brought, respectively, into electrical connection with the two springs of a pair, substantially as and for the purposes specified.

2. The combination, substantially as hereinbefore described, of a telephone loop-circuit, including telephone or call instruments, a pair of jaw-spring contacts constituting the terminals of said loop-circuit, an independent loop-circuit including an electro-magnetic annunciator, a separate pair of jaw-spring contacts constituting the terminals of the second loop, a movable loop-lever mounted on pivots in standards located at a point midway between the two said pairs of jaw-springs and provided with a handle to move the same in the direction of either pair, the said loop-lever comprising two curved conducting-plates separated from one another and mounted upon an insulating-block, each of the said plates being in permanent contact, as specified, with springs forming the terminals of a third loop-circuit and adapted when moved in either direction to wedge between and make contact, respectively, with the two jaw-springs, which lie in said direction, whereby the third loop-circuit may be united and made homogeneous with the first or second loop-circuits at will, and for the purposes specified.

3. The combination, substantially as herein described, of a non-conducting base, two pairs of conducting-springs mounted thereon and forming loop or branch circuit terminals, as indicated herein, a movable piece mounted on pivots or journals on standards upon the same base between the said pairs of springs and equidistant from each pair, the said movable piece consisting of two flat curved contact-plates attached to the sides of a non-conducting intervening plate and having a handle whereby it may be swung on its pivots in either direction, and being of a length slightly longer than the distance between the pairs of springs, whereby when swung in either direction the curved contact-plates are enabled to make contact with one pair of springs before they are disconnected from the other, and contact-springs constituting the terminals of a separate circuit pressing at all times upon the flat conducting-surfaces of the movable piece irrespective of the position of the said movable piece, for the purposes specified.

4. In a switch or circuit changer, the combination of two pairs of contact-springs mounted upon a common base, the two springs of each pair forming or adapted to form loop or branch circuit terminals, a movable piece consisting of two curved conducting surfaces mounted upon the sides of a similarly conformed non-conducting partition and mechanically united thereby, the said movable piece being hung upon pivots or journals in standards placed intermediately between the pairs of contact-springs, which standards also constitute circuit-terminals, and adapted to be swung in either direction, and thereupon to connect its two conducting-surfaces with the two springs of the pair in such direction and to disconnect them from the other pair, and contact-springs permanently in electrical union with the supporting-standards of the said movable piece and bearing with frictional con-

tact upon the two conducting-surfaces thereof, as described, irrespective of the position of said surfaces, whereby the loops or branches terminating in the paired springs may be connected with or disconnected from the circuit represented by the movable piece, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 9th day of February, 1887.

CHARLES W. McDANIEL.

Witnesses:
RODNEY FERGUSON,
C. D. CRANDALL.