(No Model.) 2 Sheets—Sheet 1

R. CALLENDER.

ELECTRICAL CIRCUIT CONTROLLER.

No. 515,108. Patented Feb. 20, 1894.

Fig. 1.

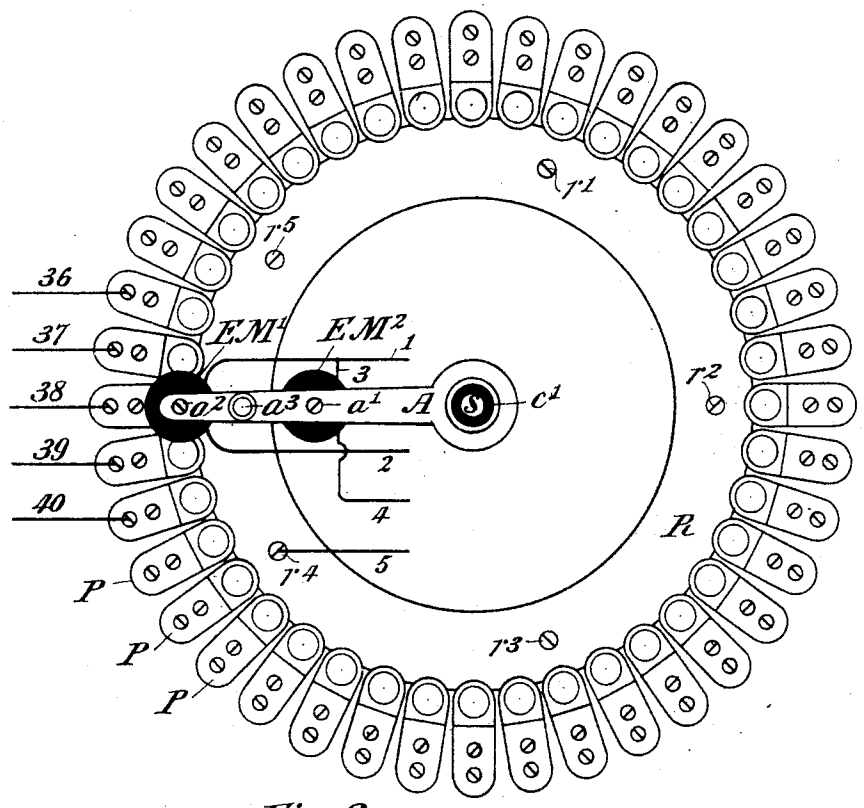

Fig. 2,

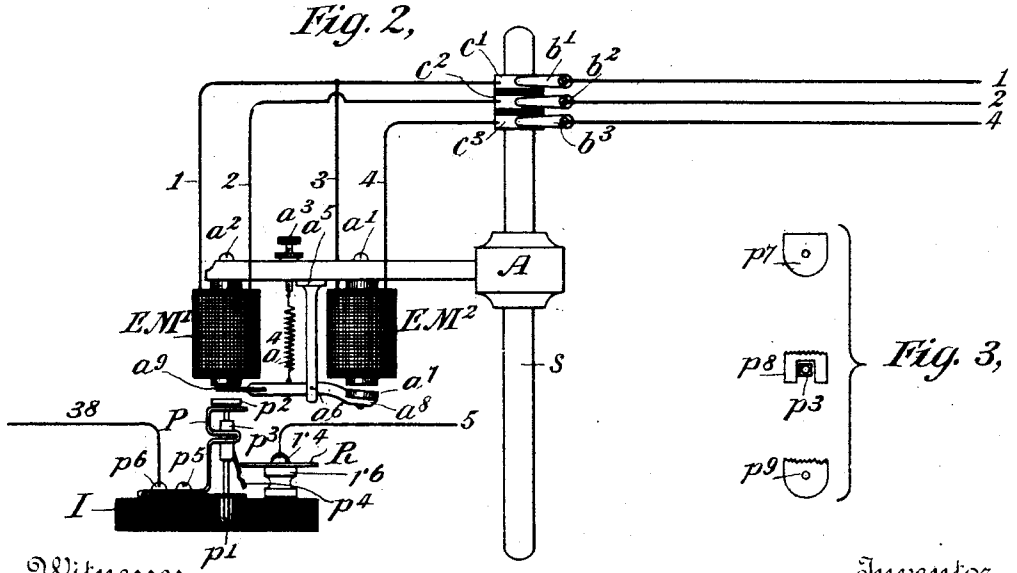

Fig. 3,

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(No Model.) 2 Sheets—Sheet 2.

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ELECTRICAL CIRCUIT CONTROLLER.

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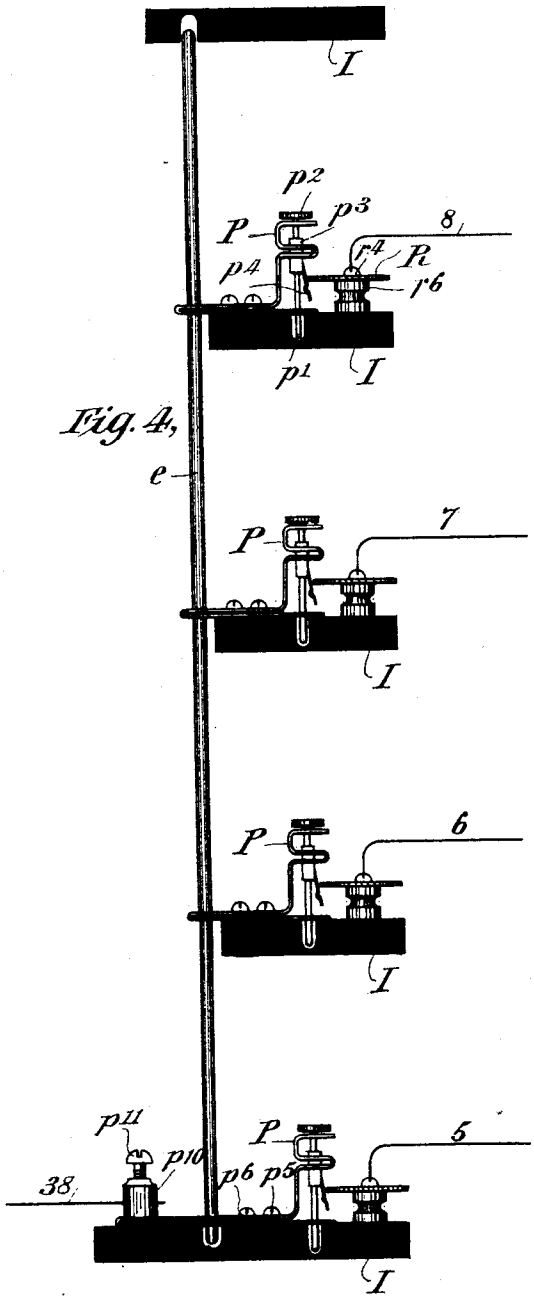

Fig. 4,

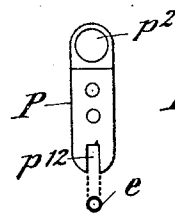

Fig. 5,

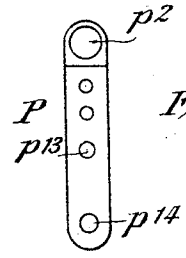

Fig. 6.

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UNITED STATES PATENT OFFICE.

ROMAINE CALLENDER, OF BRANTFORD, CANADA.

ELECTRICAL-CIRCUIT CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 515,108, dated February 20, 1894.

Application filed November 2, 1893. Serial No. 489,876. (No model.)

To all whom it may concern:

Be it known that I, ROMAINE CALLENDER, a subject of the Queen of Great Britain, residing at Brantford, in the Province of Ontario, Dominion of Canada, have made a new and useful invention in Electrical-Circuit Controllers for Automatic Telephone-Exchange Systems, of which the following is a specification.

The present invention is directed to improvements in that form of circuit controllers described by me in a prior application for a patent on an improved telephone exchange system, filed May 12, 1893, and bearing Serial No. 474,024.

In Figures 3, 10 and 12 of the drawings accompanying the specification just referred to I show what I have there denominated as a "circuit selector" and the improvement forming the subject matter of the present application is directed particularly to that part of the apparatus.

The object of the improvement is to simplify the construction of said apparatus and at the same time to render it more efficient.

Fig. 1 is a diagrammatic plan view showing the circuit selecting arm and the relation of the line connectors with one common conducting ring. Fig. 2 is a side elevational view of the selecting arm, a line connector and a conducting ring. Fig. 3 is a plan view of three portions of a line connector guide showing the upper, middle and lower portions of one of said guides. Fig. 4 is a side elevational view of an arrangement by which several series of line connectors are placed one over the other, and are connected in multiple by a vertical metallic conductor. Fig. 5 is a plan view of a line connector guide having a slotted end adapted to engage with the vertical metallic conductor. Fig. 6 is a plan view of another form of line connector guide adapted to engage with the foot of the vertical metallic conductor and to be placed in electrical connection with a line conductor by means of a binding post as clearly shown at the foot of Fig. 4.

Referring to Fig. 1 of the drawings:—P, P, P are the line connectors supported on a suitable insulator, and each having a vertically movable armature plunger adapted to bring it into electrical connection with a common conducting ring R. r', r^2, r^3, r^4, r^5 are screws for holding the common conducting ring in position on the insulator supporting the line connectors. S is a vertical shaft adapted to rotate and carry with it the selecting arm A. E M′ is the electro-magnet for raising the movable armature plungers and E M^2 is the electro-magnet for restoring said armature plungers to their normal positions. a^2 and a' are screws securing the electro-magnets E M′ and E M^2 in connection with the rotary arm A. c' is a conducting ring and a^3 a regulating screw, both shown more clearly in Fig. 2. 1 is a feed conductor having a branch 3, and 2 and 4 are the return conductors from the electro-magnets E M′ and E M^2. 36, 37, 38, 39 and 40 are conductors leading to the individual circuits, and 5 is the common conductor adapted to be placed in electrical connection with the conductors 36, 37, 38, 39, 40, &c.

Referring now to Fig. 2: b', b^2 and b^3 are brushes connecting the conductors 1, 2 and 4 to the electro-magnets E M′ and E M^2 through the intermediation of the conducting rings c', c^2 and c^3. a^5 is a support for holding the lever a^8 pivoted at a^6. The lever a^8 carries an armature a^7 at one end and a thin strip of metal a^9 at its other end. The retractile spring a^4 normally holds the end a^9 of the lever a^8 against the core of the electro-magnet E M′. I is an insulating substance having attached to it the line connector P and also the common conducting ring R by suitable standards r^6. p^2 is the armature head of the vertically movable plunger, and p^3 is a guide block of rectangular form adapted to slide freely in a guide slot as shown more clearly in Fig. 3. p^4 is a yielding metallic spring adapted to be maintained in electrical connection with the common conducting ring R, when in its uppermost position, through the instrumentality of the notch shown in the lower end of said yielding spring p^4. p' is the lower part of the movable plunger playing freely in a guide hole or perforation made in the lower portion of the line connector P. p^5 and p^6 are screws for holding the line connector in position. 38 is a conductor adapted to be brought into electrical connection

with the conductor 5 through the instrumentality of the line connector P and common conducting ring R.

In Fig. 3, p^7 shows the upper, p^8 the middle and p^9 the lower parts of those portions of the line connector P used as guides for the several parts of the vertically movable plunger held in the line connector P.

In Fig. 4, I, I, I, I, I are the insulating substances for supporting the several tiers of line connectors. *e* is a metallic conductor connecting corresponding line connectors on the several tiers to the lowest line connector at the bottom of the figure. p^{10} is a binding post and p^{11} a screw in same. 38 is a conductor adapted to be secured in said binding post and to be brought into electrical connection with any of the conductors 5, 6, 7 and 8 through the mediation of the several line connectors P, P, P, P and the metallic conductor *e*.

Referring to Fig. 5: P is a line connector of the form used where a number of tiers are used, one over the other. p^2 is the armature head of the vertically movable plunger. p^{12} is a slot so proportioned to the diameter of the metallic conductor *e* that when the latter is pressed into the slot it will be held there by friction and will also make a perfect electrical connection between the two parts.

In Fig. 6 which shows the form of line connectors P used on the lowest tier, p^2 is the armature head of the vertically moving plunger. p^{13} is a hole or perforation for receiving the lower end of the metallic conductor *e*. The hole p^{13} may be tapped; in which event the lower end of the metallic conductor *e* would have a screw thread on its lower end adapted to screw in said tapped hole p^{13}. Or it may be constructed as shown in the drawings where the lower end *e* would be slightly tapered so as to make a binding fit when pressed down into the hole p^{13}. p^{14} is the perforation through which the end of the binding post p^{10} passes, enabling said binding post to be secured to the insulating substance I and to secure it in perfect electrical connection with the lowest line connector and the corresponding line connectors on the several tiers through the metallic conductor *e*.

The operation of the apparatus is as follows:—The arm A is kept in continuous rotation by an electro-motor or other converter of energy. An electrical circuit is presumed to have been momentarily closed, through conductors 1, 2 shown in Figs. 1 and 2, when the electro-magnet E M′ was immediately over that one of the line connectors P it was desired to bring into electrical connection with the inner conducting ring R and the conductor 5. I have not shown any apparatus for governing the selection of any particular line connector or for preventing more than one line connector at a time from being connected to the inner conducting ring R. Neither have I shown apparatus for reversing the condition of any particular line connector after it has been raised into engagement with the inner conducting ring R, as these features are all clearly shown in my application Serial No. 470,024 previously referred to, and inasmuch as the present improvements relate only to the mechanism of the rotating selector and to its manner of construction in tiers, without any reference to any special method of individual control, I have not deemed it advisable to illustrate more than the actual improvement. The circuit therefore has been closed momentarily at the time the electro-magnet E M′ was passing over the particular line connector P that was desired to be selected; for example, that line connector to which is attached conductor 38 in Figs. 1 and 2. The closure of the circuit energizes the electro-magnet E M′. This attracts the armature p^2 (Fig. 2) and raises the plunger into its uppermost position. As it is raised into this position the yielding spring p^4 attached to the rectangular guide block p^3 is brought into electrical connection with the inner conducting ring R, and by means of the tension of the spring p^4 and the locking notch on the lower part of said spring, the plunger is held locked in its uppermost position. The line connector P, Fig. 2, is thus caused to connect conductor 38 with the conductor 5 and their electrical connection is maintained by the action of the notch in the yielding spring p^4 and its engagement with the common conducting ring R until the plunger is restored to its normal position by action that will be described later. The object of the selecting arm being to place any selected one of the line connectors P, P, &c., into electrical connection with the common conducting ring R it follows from the previous description that what has been described as having been done in connection with the line connector of conductor 38, may also be done with any of the remaining conductors attached to the line connectors surrounding the selector ring and placed under the path of the electro-magnet E M′ carried by the revolving arm A, all shown in Fig. 1. The conductor 5 leads to any apparatus that is to be controlled or operated by all of the conductors 36, 37, 38, &c., in common; and this conductor 5, after leading to said apparatus, has its return conductor united to all of the return conductors of the inleading conductors 36, 37, 38, &c.

I will now describe the means for returning the plungers to their normal condition. To effect this it is necessary to close a circuit over conductor 1, 4 shown in Figs. 1 and 2. This being done at the proper time to affect the line connector that is to be restored to its normal condition, that is to say, when the electro-magnet E M′ is passing directly over it, the following action ensues. The electro-magnet E M^2 being energized as a consequence of the circuit closure over conductors 1, 4, attracts the armature a^7 of the lever a^8 causing the thin strip a^9 between the core of

electro-magnet E M′ and the armature head p^2 to be depressed with sufficient energy to press down the plunger, which it will be remembered was held in its uppermost position by the action of the notched spring p^4. This action restores the line connector to its normal condition, that shown in Fig. 2 of the drawings and the retractile spring a^4 causes the thin strip to fall back to its normal position against the core of the electro-magnet E M′ as soon as the electro-magnet E M^2 is demagnetized. As only one line connector at a time is intended to be in contact with the inner conducting ring R it is not likely that the thin metallic plate a^9 will catch under or against any of the remaining plunger armature heads p^2. To render this impossible, however, I give an upwardly extending curve to the thin metallic plate a^9 on that side of it that points in the direction of its rotary motion as it is carried round by the rotary arm A. Should an extra plunger be in its uppermost position, the thin metallic plate, if depressed when passing to it and over it, would present its upwardly extending curvature in such a manner as to gradually press down the said plunger and return it to its normal condition.

In my previous application already referred to, I describe my tier system of percentage connection by means of which a number of duplicate common conductors similar in function to R in Figs. 1, 2 and 4 of the present application are caused to give connecting facilities to a large number of conductors similar to 36, 37, 38, &c., Fig. 1 of the drawings now under description. That is to say as many tiers of mechanism are provided similar in function to the one tier shown in Fig. 1, as will give a tier for each one of that number of conductors 36, 37, 38, &c., as are likely to be in use simultaneously. To illustrate fully the improvements described in the present specification, I have shown this tier system in Fig. 4. It will there be noticed that the conductor 38 is connected in multiple to its individual line connector on each of the tiers, by the metallic conductor *e*. This is for the purpose of enabling each conductor 36, 37, 38, &c., to be in constant electrical connection with its individual connectors, so that if any tier with its inner conducting ring R is in use by some one conductor, the remaining conductors have access by means of the metallic conductor *e* to the other tiers, the inner conducting rings R of which are not being used. I have only illustrated four tiers of line connectors but it will be obvious that a larger number can be used, one tier over the other, as shown. When the number of tiers becomes greater than can readily be superposed, all that is necessary in order to place the conductors 36, 37, 38, &c., in operative connection with the extra tiers of line connectors is to take branch lines from each conductor where it enters the binding post p^{10} and lead off to the corresponding connection on the additional group of tiers, wherever that may be placed. It will also be seen that by prolonging the metallic conductor *e* through the top of the highest insulating substance I (see Fig. 4) and by providing it with suitable means there such as a thread and nut the connections can be led off by branch conductors gathered compactly in a cable if desired. A reference to Figs. 1 and 2 will show that when a connector is in its uppermost position it may be used to complete a circuit through conductors 38 and 5 for instance, instantaneously; or by including extra circuit closers of any desired form in any or all of the conductors 36, 37, 38, &c., the action of the line connector P may be to close a circuit at that point as a preparatory step to closing it subsequently at some other point or points in the individual circuits 36, 37, 38, &c.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. An electrical circuit controller having a series of radially disposed plungers adapted to be moved into electrical connection with a common conductor, in combination with a revolving arm carrying an electro-magnet adapted to raise any of said plungers into their uppermost position.

2. An electrical circuit controller provided with a common conducting ring having a series of individual plunger connectors arranged around its circumference, said plunger connectors being insulated from each other and normally electrically disconnected from the common conducting ring, in combination with a revolving arm carrying an electro-magnet provided with circuit connections for bringing any of the plungers into electrical connection with the common conducting ring.

3. An electrical circuit controller having a series of vertically movable plunger connectors arranged radially on an insulating substance, a revolving arm carrying an electro-magnet adapted to raise any of the plunger connectors into their uppermost position, means for automatically locking the plunger connectors when raised and additional means for unlocking them and restoring them to their normal condition.

4. Two or more series of notched connector plates held on different planes or tiers having wires or other metallic conductors electrically connecting like connector plates on the several tiers or planes, a series of plunger pins on each of the tiers in constant electrical connection with the notched connector plates, and a common conductor on each tier contiguous to and normally disconnected from the plunger pins, together with means whereby the plunger pins are caused to bring the wire or other metallic conductor into electrical connection with any of the common conductors.

5. An electrical circuit connector consisting of a plunger pin having an armature head and a notched contact spring, together with a

metallic guide frame for holding said plunger pin and for allowing it to move in the direction of its length.

6. An electrical circuit connector consisting of a plunger pin having an armature head and a notched contact spring together with a metallic guide frame for holding said plunger pin and for allowing it to move in the direction of its length; in combination with a metallic conductor, contiguous to the plunger pin, adapted to engage with the notched contact spring and to maintain electrical connection with it whenever said plunger pin is moved into its operative position.

In testimony whereof I have hereunto subscribed my name this 31st day of October, 1893.

ROMAINE CALLENDER.

Witnesses:
C. J. KINTNER,
M. M. ROBINSON.