

(No Model.)

2 Sheets—Sheet 1.

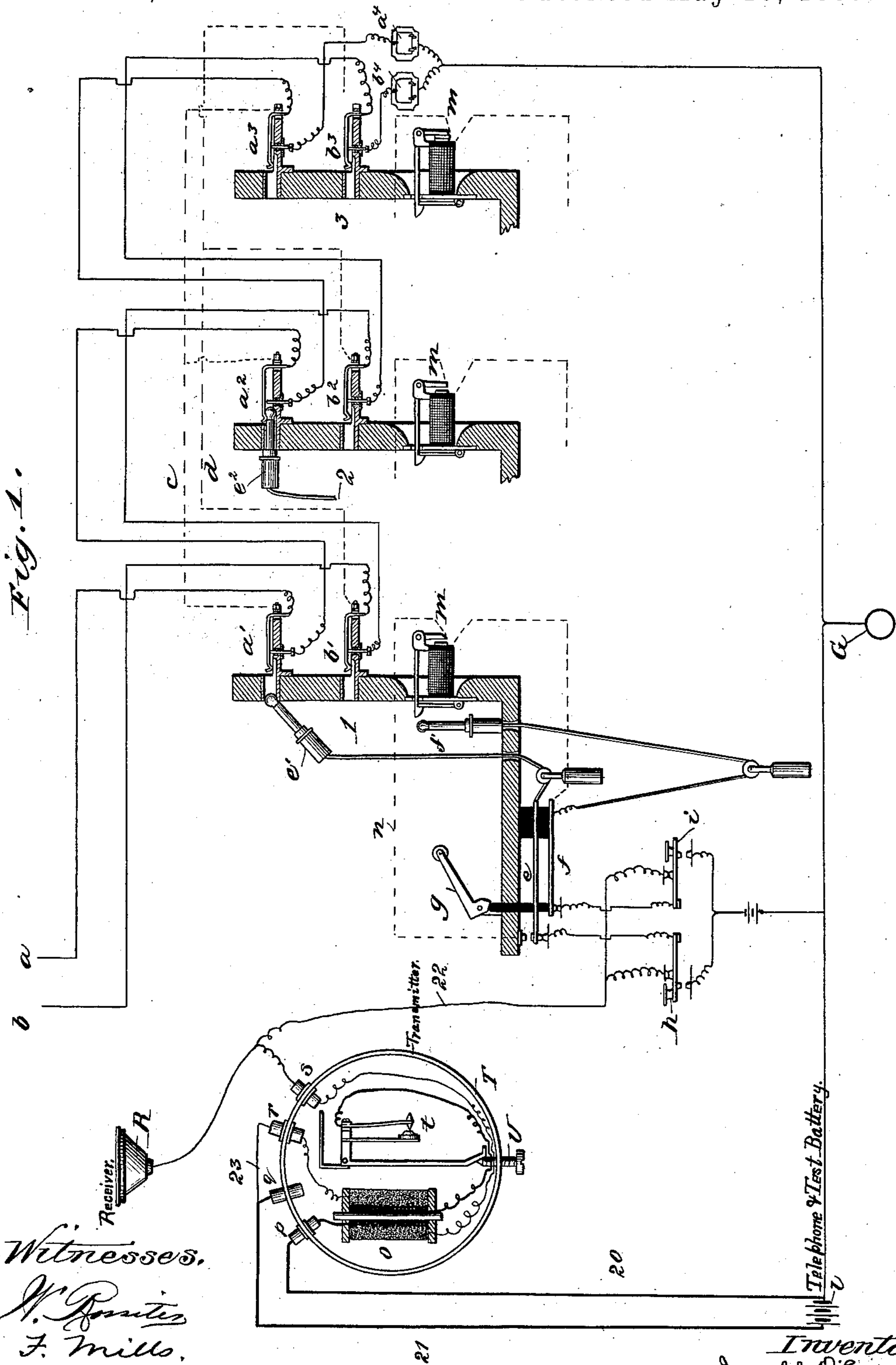
J. J. O'CONNELL.

TESTING APPARATUS FOR TELEPHONE EXCHANGE SWITCHES.

No. 362,652.

Patented May 10, 1887.

Fig. 1.



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(No Model.)

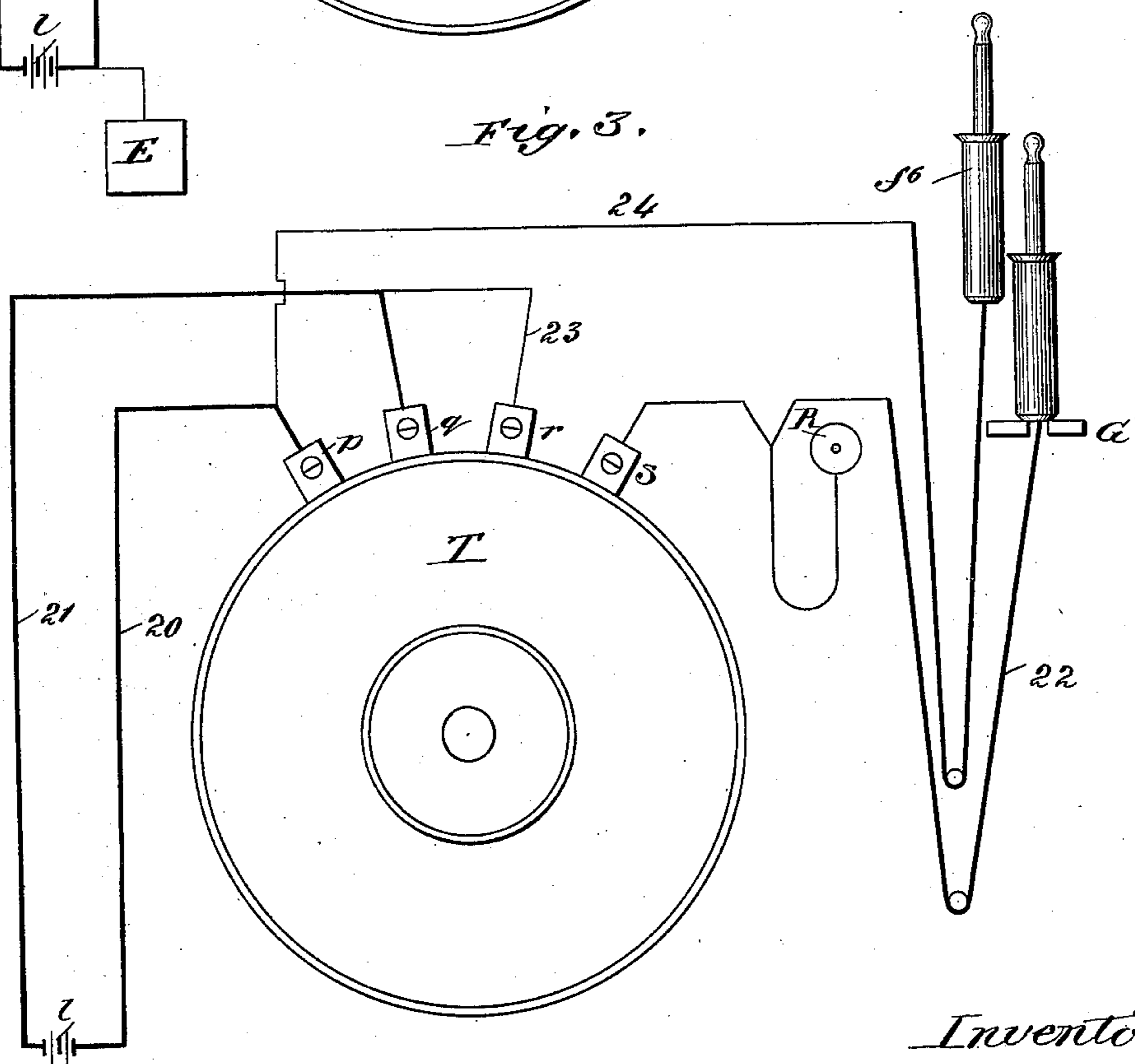
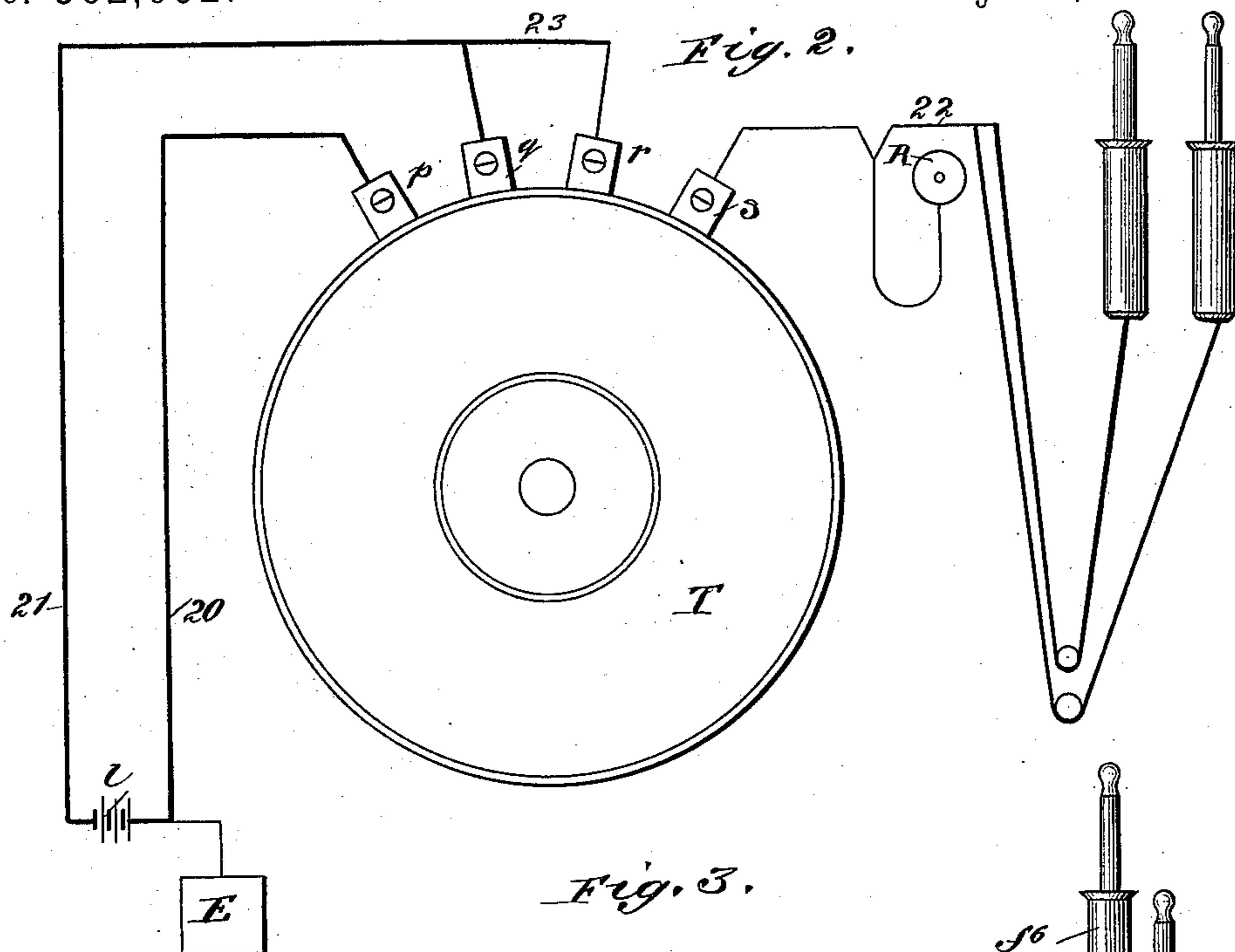
2 Sheets—Sheet 2.

J. J. O'CONNELL.

TESTING APPARATUS FOR TELEPHONE EXCHANGE SWITCHES.

No. 362,652.

Patented May 10, 1887.



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UNITED STATES PATENT OFFICE.

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TESTING APPARATUS FOR TELEPHONE-EXCHANGE SWITCHES.

SPECIFICATION forming part of Letters Patent No. 362,652, dated May 10, 1887.

Application filed January 14, 1887. Serial No. 224,335. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH J. O'CONNELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Testing Apparatus for Telephone-Exchange Switches, of which the following is hereby declared to be a full, clear, and exact description, sufficient to enable others skilled in the art to make and use the same.

In multiple switch-boards for telephone-exchanges the subscribers' lines are in closed connection with each board of the series, the annunciators, however, pertaining to the several lines being usually distributed in sets or subdivisions at the different boards and there grounded, so that the operator at any given board may have before her only the drops of those lines the calls from which are assigned to her board. By this arrangement the operator, in response to a drop-call coming from any one of the lines allotted to her charge, may ascertain what line it is with which connection is desired; and because in the construction named all of the subscribers' lines have terminals at each board of the multiple series, the operator would be able, ordinarily, by plug-switch or like appliance, to establish circuit at once with the terminal of the particular line to which the call is directed; but, as frequently happens, such line may be then in use through some other board of the set beyond her observation and quite unknown to the operator, so that on "going in" with the switch device she would break and interrupt a closed connection already established. To avoid this inconvenience, provision has been made whereby the operator, without disturbing the circuit existing, may ascertain the fact that the desired line is busy, although its connection has been made at some multiple board other than that which she attends. Where spring-jack or like plug switches at the various boards constitute in closed connection the several terminals for each telephone-line, this preliminary test for busy lines is effected through the expedient of a normally-open supplemental circuit established between all of the switches in the series pertaining to the particular line. In each plug-switch the terminal spring and contact-

point are insulated from the body or frame of the switch, and operate together in maintaining the closed connection to the subscriber's line until such time as the plug is inserted to separate the spring and point. It is between each switch-body of the series that said normally-open supplemental circuit is made. The receiver or ear-phone of the operator's telephone outfit is in direct circuit with the cords and switch-plugs and with a test-battery especially provided for the purpose, the latter being entirely distinct from the usual battery, which, as well understood, is employed in connection with the primary of the transmitter-telephone. If the switch-plug forming, as stated, a part of this local test-battery system be applied by the operator to the body of that switch which on her board belongs to the telephone-line to be called, all the switches corresponding thereto on the other boards will thereupon, through their supplemental connection, be at once included in the same circuit with the test-battery. No result would ensue unless the subscriber's line to be called were already in use through some one of the switches in the set. Should such condition exist, however, the current from the test-battery, passing by the operator's plug and switch-body, would find outlet to the line, and thence to ground at the subscriber's station, through that switch of the set in which a plug had been previously inserted to establish the subscriber's line in circuit. A sharp click in the ear-phone of the operator, due to the influence upon the telephone-receiver of the current passing from the test-battery to line, would apprise her immediately that a cross existed between the main line and the switch-bodies of the set in supplemental circuit, so that these, instead of being open, as in normal condition, would be closed to line. In short, the operator would know that the subscriber to be called was already busy, so that in consequence she would abstain from inserting the plug into its switch-seat, thus leaving the main-line circuit unbroken and undisturbed.

My invention relates to "busy-line" testers, and, although particularly useful in connection with multiple switch-boards, is applicable also to exchanges having but one board,

or, again, between several telephone-lines having switch-connection in common.

The purpose of the invention is to dispense with the extra or test battery which has heretofore been used in direct circuit with the telephone-receiver to produce the "click" signal therein by the passage of a current from such battery onto the busy line. The trouble and cost of maintaining this extra battery, (usually of two cells for each operator or telephone) is an important item, especially in large exchange-offices having many switch-boards, either single or multiple, in active use.

The invention consists in combining the receiver-telephone in direct circuit with the transmitter-battery, so that such battery, in addition to its ordinary function in furnishing electric impulses to the primary of the transmitter-telephone, may also sensitize the receiver under proper conditions, producing the click-signal therein by flow of current from the battery directly through the receiver onto the busy-line circuit. In other words, the transmitter, receiver, and usual transmitter-battery are connected together and with the line-switch in such wise that the receiver is influenced not only by the derived current in the secondary wire of the transmitter, but directly by the current of the transmitter-battery, to produce the click signal, whereby the extra-battery cells heretofore deemed necessary for such latter-named purpose are entirely dispensed with, the double duty being performed by the transmitter-battery alone.

In the accompanying drawings, forming part of this specification, Figure 1 shows in cross-section three multiple switch-boards of well-known form, to which are connected two telephone-lines, *a* and *b*. These telephone-lines are connected to spring-jacks *a'* *a''* *a'''* and *b'* *b''* *b'''* on the different boards, and thence through the annunciators *a''* *b''* to ground in the usual manner. Figs. 2 and 3 are conventional views of the telephone outfit and switching appliances arranged according to my invention.

The operator's telephone outfit and connections are shown at board 1, Fig. 1, although in practice similar apparatus will be provided at each of the boards or switches. The telephone-transmitter T (represented conventionally) is of the usual form, connected up with its battery *l*, so that closed circuit will be established by wire 20 and set-screw *p* through primary of the induction-coil *o* to the variable resistance *t*, and thence by adjusting-screw U on the case of the transmitter to set-screw *q* and wire 21, returning to the battery *l*. Set-screw *p*, together with the companion screws *r* *s*, pertaining to the secondary of the induction-coil *o*, is insulated, as shown, from the case of the transmitter T, while the set-screw *q* is not. The receiving-telephone R is connected by a "third leg," 22, with the ordinary calling-keys, *h* *i*, and at *s* with the terminal of the secondary wire of the spool *o*. The terminal *r* of such

secondary is in electric connection by wire 23 and 21 with the battery *l*, so that if proper "ground" be afforded at some place beyond the telephone-receiver R an electric impulse will pass directly from battery *l* and secondary of spool *o* through the bobbin of the receiver R, and thence to ground, producing a click signal in such receiver R, as desired. By such provision and arrangement of the various electric connections the battery *l*, in addition to its ordinary function, in conjunction with the primary of the transmitter-telephone, operates directly also through the receiver R to furnish the requisite signal. Although the invention is not restricted in benefit to the particular kind of multiple switch-board shown, or, indeed, to multiple switch-boards generally, it will be convenient to describe the operation of the invention in conjunction with such multiple boards as exhibited in the drawings. The switch-plugs *e'* *f'* are connected by the usual flexible cords to independent spring-strips of a loop-key, which is adapted to be held positively in either position by means of a cam-lever, *g*, or equivalent device. The metal frame of each spring-jack switch is insulated from its spring and contact-point, so that the circuit of the telephone-line through its several spring-jacks does not include said metal frames. All the frames, however, of the spring-jacks belonging to one telephone-line are connected together in a series, forming an open circuit, as indicated by dotted lines *cd*. When a plug is inserted in a spring-jack—for example, plug *e''*—as shown at board 2, a connection is established between the spring and metal frame of the said spring-jack, as well as with its cord, thus crossing the telephone-line connected to said spring-jack with the line which connects the series of metallic frames.

If a connection is to be made at any board, the operator takes either plug of a pair—for instance, plug *e'* at board 1—and inserts it in the spring-jack of the telephone-line to be connected. If the said telephone-line—for example, line *a*—is in use at any other board, at the first contact of the plug *e'* with the metal frame of spring-jack *a'*, the transmitter-battery *l* will find circuit through the secondary of the transmitter-spool, and through the receiver R by key *h* and spring-strip, and thence through plug *e'*, spring-jack *a'*, and line *c* to the cross established at spring-jack *a''* by the plug *e''*, and from thence by telephone-line *a* to ground at the subscriber's station. A click will thus be produced in the operator's telephone R, and she, listening, will know at once that the line is in use. If the line be not in use at any other board, the transmitter-battery will not find circuit at the first contact of the plug with the spring-jack frame, and no click will be given. The operator will therefore press the plug into the spring-jack. The same result will follow no matter which plug of a pair is used, and the result will be the same whether one plug of a pair is already inserted in a spring-jack or not. In case one plug of a pair has already

been inserted in a spring-jack, a constant current from battery *l* will flow through this connection; but if, upon testing with the other plug, another outlet for the battery *l* is established by means of a cross, as before described, the battery-current will divide, and sufficient current will pass through the new outlet to produce a click in telephone R, as before. It will thus be seen that a test will always be made by the operator while in the act of making a connection at the first contact of either plug of a pair with a spring-jack at either board.

When a connection has been established between two subscribers, the cam-lever *g* will be thrown up and the spring-strips *e f* will close the circuit of the connected subscribers through the clearing-out annunciator *m*, as indicated by dotted lines *n*, and at the same time cam-lever *g*, as it is thus thrown down, will disconnect the calling-keys, the operator's telephone outfit, and the battery *l* from the circuit.

From this arrangement of the several parts it is manifest that the battery *l*, without impairing its function in connection with the primary of the transmitter T, serves also to furnish directly the necessary electric impulses for actuating the receiver R in effecting the click signal, thus dispensing with the extra battery heretofore employed therefor and very materially lessening the cost of maintenance which had been necessary.

Instead of grounding the battery L, as at G, Fig. 1, or E, Fig. 2, the telephone transmitter and receiver and the battery may be connected up with each other and with the switch-plugs, as shown in Fig. 3—that is, the common connecting piece or strip G', upon which the switch-plugs rest when not in use, may furnish outlet to ground at one side while the circuit is completed on contact of the testing-plug—for example, *f*^c—when raised from the connecting-piece and brought to bear upon the switch-frame crossed with the subscriber's line.

The same connections thus far detailed for the operator's outfit at the exchange end of the line, whereby the local battery, the primary of the telephone-transmitter, and the receiver there situated are all included directly in one circuit, may be adopted with like result by reversing the situation of the outfit—that is to say, by arranging the same in lieu of the usual form at the subscriber's end or line station. In such event the operator's telephone outfit will be of the ordinary type—that is to say, will not require to be modified so as to bring the receiver in direct circuit with the primary of the transmitter and with the transmitter-battery. None the less, the click signal will be produced at the subscriber's receiver on grounding his battery by the switch at the exchange, so that the operator, being then in circuit through the switch, will hear such signal at her receiver and know that the line is in use.

Manifestly, the subscriber's transmitter-bat-

tery thus performs the additional function of directly sensitizing his receiver, which prior hereto had required a separate test-battery employed only at the exchange end. By having the modified outfit described at the subscriber's station the operator at the exchange gets the click signal before she has actually broken the circuit, if any then exist between two subscribers, so that without interrupting their conversation she may ascertain whether the lines are still in use. Were they not in use, the subscriber's outfit-switch has grounded the main line through the calling-bell, thus shutting off the subscriber's receiver, transmitter, and battery from circuit, so that no click occurs when the operator comes in at the exchange.

The invention is not limited in practice to any particular form of telephone transmitter or receiver, and, as appears, is not dependent upon any one special mode of connection, so long as the transmitter-battery and switching appliance are included directly in the same circuit with the telephone, so that the impulses from such battery directly sensitize the receiving-telephone, in addition to performing the ordinary function of sensitizing the induction-coil of the transmitter.

Instead of using spring-jack switches with insulated frames, an open line independent of the switches may be used with each series of switches, said line being adapted to form a cross with a telephone-line belonging to said series whenever a connection is made at any switch of the series.

Not limiting myself to the particular construction set forth, and having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a testing apparatus for telephone-switches, the combination, with the telephone-line and with the switch appliance, of the local battery, the telephone-transmitter having its primary in direct circuit therewith, and the telephone-receiver included in circuit with said battery, substantially as described.

2. In testing apparatus for multiple-switch-board telephone-exchanges, the combination, with the set of switches for each telephone-line having a normally-open supplemental connection between the switches of the set, of a local battery, the telephone-transmitter having its primary in direct circuit therewith, and the telephone-receiver included in circuit with said battery, substantially as described.

3. In testing apparatus for multiple-switch-board telephone-exchanges, the combination, with the switches having insulated metallic frames, the frames of all of the switches of one telephone-line being connected together in a set, of connecting-cords with terminal plugs arranged in pairs, of a local battery, the telephone-transmitter having its primary in direct circuit therewith, and the telephone-receiver included in circuit with said battery, substantially as described.

4. In testing apparatus for multiple-switch-

board telephone-exchanges, the combination, with the spring-jacks having insulated metallic frames, the frames of all of the jacks of one telephone-line being connected together in a
5 set, of connecting-cords with terminal plugs arranged in pairs, a switch-key for each pair of plugs, and a local battery, the telephone-transmitter having its primary in direct cir-

cuit therewith, and the telephone-receiver included in circuit with said battery, substantially as described.

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