

No. 645,572.

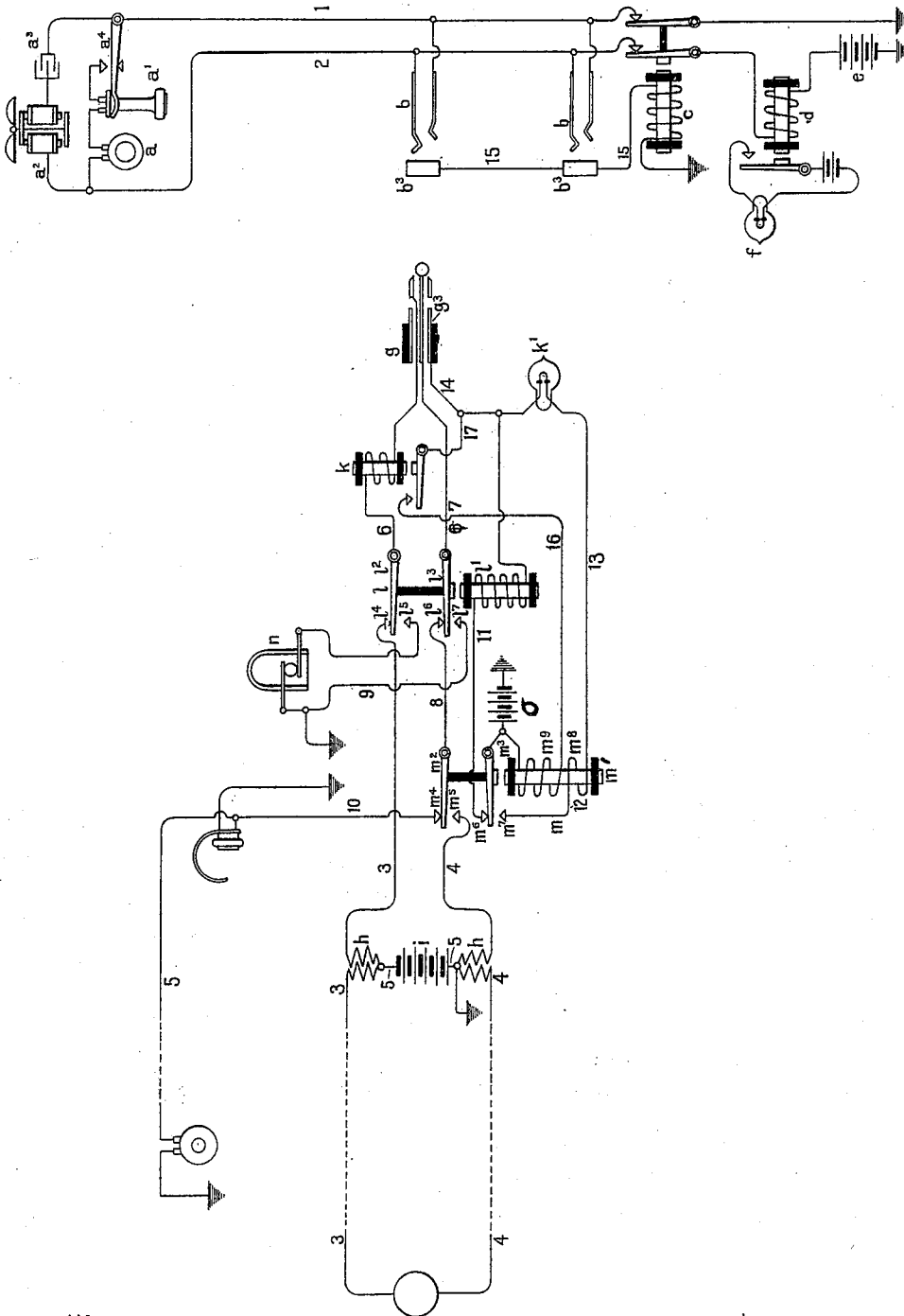
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C. E. SCRIBNER.

AUTOMATIC CALLING APPLIANCE FOR TELEPHONE TRUNK LINES.

(Application filed Mar. 9, 1898.)

(No Model.)



Witnesses:

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# UNITED STATES PATENT OFFICE.

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AUTOMATIC CALLING APPLIANCE FOR TELEPHONE TRUNK-LINES.

SPECIFICATION forming part of Letters Patent No. 645,572, dated March 20, 1900.

Application filed March 9, 1898. Serial No. 673,206. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Automatic Calling Appliances for Telephone Trunk-Lines, (Case No. 461,) of which the following is a full, clear, concise, and exact description.

10 This invention applies to incoming trunk-lines for use in making connection with telephone-lines provided with means for altering the resistance of the line-circuit in the use of the telephone. The purpose of the invention  
15 is to provide simplified apparatus and circuits for applying and removing the operator's telephone or other testing appliance, for applying and withdrawing a source of calling current, for ringing the bell at the station to  
20 be called, and for controlling the display of a signal-lamp associated with the trunk-line in the switchboard.

In many exchanges of modern equipment the circuit of each line is so arranged at the  
25 substation thereof that the line is normally open, but becomes closed through the agency of the telephone-switch while the receiving telephone is in use. With such lines supervisory signals are employed in the telephone-  
30 switchboard to indicate the closed or open condition of the line-circuit, whereby the attendant may infer the condition of use or disuse of the line and may perform any necessary acts of supervision or disconnection.  
35 The mechanism of the supervisory signal commonly comprises a source of current in the line, a relay in the line responsive to current therein while the telephone is in use, and a signal-lamp in a local circuit controlled  
40 by the relay, the signal-lamp being associated with the connecting-plug or link-conductor by means of which connection is established between different lines. The link-conductor may of course be either a trunk-line between  
45 different exchanges terminating as an incoming trunk-line in a switchboard of the relay type here referred to or a pair of plugs with their plug-circuit within the switchboard; but inasmuch as the advantages of automatic  
50 ringing are more pronounced when the ringing mechanism is applied to trunk-lines I

shall describe my invention in connection with the apparatus and operation of trunk-lines. It will be understood that the same apparatus may be used in connection with  
55 plug-circuits complete within a single switchboard.

In a relay-switchboard, such as that herein described, the functions of the attendant having charge of incoming trunk-lines con-  
60 sist in receiving orders for connections, testing the lines called for, making the required connections, transmitting calling currents to the stations called for, and removing the connections in accordance with the display of  
65 the supervisory signals.

The present invention provides for the automatic connection and disconnection of the operator's telephone for testing, the automatic connection of the source of calling-  
70 current and its disconnection when the called party responds to the signal, and the extinction of the supervisory signal until such response. To this end it comprises a group of  
75 switch-springs adapted normally to break the circuit of the trunk-line and to connect the operator's telephone or other testing instrument with the testing-contact of the terminal  
80 plug, an electromagnet adapted, when excited, to disconnect the telephone and to apply the source of calling current to the terminal plug, and means for exciting the magnet in making connection with the line, the  
85 supervisory relay, a second electromagnet, means for controlling the same through the agency of the supervisory relay, the second magnet being adapted to deprive the first-mentioned magnet of current, and to close  
90 the break in the trunk-line, means for maintaining the continued excitement of the second-mentioned magnet when it has been operated, a local circuit including the supervisory signal-lamp, and means for breaking  
95 the circuit while the source of calling current is applied to the line. The specific construction of this apparatus and arrangement of the circuits for these purposes are shown in the attached drawing. This drawing represents a telephone-line terminating in the  
100 usual connecting apparatus of a telephone-switchboard, together with the incoming terminal of a trunk-line or other link-conductor

designed to make connection from another line, whether in the same or in a different exchange, to the line shown in the drawing.

The apparatus at the substation comprises the usual telephones  $a$  and  $a'$ , a polarized call-bell  $a^2$ , a condenser  $a^3$ , permanently in circuit with the bell, and a telephone-switch  $a^4$  for closing the normally-open circuit through the telephones when the switch is relieved from the weight of the receiving telephone. From these appliances line conductors 1 and 2 extend to the terminal contacts of spring-jacks  $b$  in a telephone-switchboard, from which they are normally prolonged through the switch-contacts of a cut-off relay  $c$  to the poles of a battery  $e$ , common to the different lines of the exchange, the magnet-winding of a relay  $d$  being interposed in the conductor 2, controlling a secondary line-signal  $f$ , associated with one of the spring-jacks.

The trunk-line comprises conductors 3 and 4, which are brought into electrical connection with the line-contacts of the terminal plug  $g$  of the trunk-line in the switchboard. The trunk-line conductors 3 and 4 may lead to any suitable apparatus at a different exchange or in the same switchboard, whereby connection may be made between the trunk-line and the line of a calling subscriber. The windings of a repeating coil  $h$  are interposed in the trunk-line, near the incoming end thereof, in the usual way, two of the four windings being serially connected in each conductor of the trunk-circuit, and a source  $i$  of current is connected in a bridge 5 of the trunk-circuit between the points of junction of the serially-connected windings. This source of current is for the purpose of operating the signals belonging to the trunk-line and of supplying current for the excitement of the transmitting telephone at a substation with which the trunk-line is connected. The usual supervisory relay  $k$  is also included in an extension of conductor 3 of the trunk-line controlling a supervisory signal  $k'$ , which is associated with the terminal plug  $g$  in the switchboard. The means by which the signal is controlled by the relay must be described in connection with the call-sending mechanism.

The mechanism which forms the subject of this invention consists in two electromagnetic switches  $l$  and  $m$ , with their circuits. The appliance  $l$  consists of a magnet  $l'$  and two switch-springs  $l^2$   $l^3$ , each with a normal and an alternate resting-anvil, the anvils of the different springs being denoted by the letters  $l^4$   $l^5$  and  $l^6$   $l^7$ , respectively. The magnet  $l'$  should be of comparatively-high resistance, one hundred ohms being suitable. The other appliance  $m$  comprises an electromagnet  $m'$ , provided with switch-springs  $m^2$  and  $m^3$ , each having normal and alternate contacts  $m^4$   $m^5$  and  $m^6$   $m^7$ , respectively. The magnet  $m'$  has two windings  $m^8$  and  $m^9$ . The former of these should be of comparatively-low resistance, thirteen ohms being a

proper amount, while the latter should have a resistance as high as fifty ohms. The switch-springs  $l^2$  and  $l^3$  form the terminals of wires 6 and 7, which lead to the sleeve and tip contacts, respectively, of the terminal plug  $g$  of the trunk-line. These conductors are thus in effect extensions of the trunk-line 3 4 when the line is in use. The normal resting-contact  $l^6$  of spring  $l^3$  is connected by wire 8 with the switch-spring  $m^2$ . The resting-contact  $l^4$  of spring  $l^2$  is connected directly with conductor 3 of the trunk-line. The alternate contact  $l^7$  of spring  $l^3$  is connected by a wire 9 to earth. The corresponding contact  $l^5$  of the spring  $l^2$  leads to one pole of a grounded generator  $n$  of calling current of usual form. The resting-contact  $m^4$  of lever  $m^2$  constitutes the terminal of a wire 10, leading to the operator's telephone and grounded therethrough. The alternate contact  $m^5$  of the same spring forms the terminal of line conductor 4 of the trunk-line. Switch-spring  $m^3$  is connected with the terminal of a battery  $o$ . This battery may have an electromotive force of twenty volts. The normal resting-contact of the same spring forms the terminal of a wire 11, leading to the magnet-winding of magnet  $l'$ . The alternate contact  $m^7$  of the same spring is connected by wire 12 with one extremity of winding  $m^8$  of relay  $m$ , whose other terminal is led by wire 13 to lamp  $k'$ , the other terminal of this lamp being connected, through wire 14, with a third contact-piece  $g^3$ , this contact-piece being adapted to register in the usual way with a contact-ring in the spring-jack  $b$ , which forms the terminal of a portion 15 of a local circuit, including the magnet-winding of the cut-off relay  $c$  of a line into which the plug is inserted. The free terminal of magnet  $l'$  is connected with this wire 14. Also one switch-contact of the supervisory relay  $k$  is connected by wire 17 with conductor 14. The other contact-piece of the same relay is united by wire 16 with winding  $m^9$  of magnet  $m'$ .

The supervisory signal  $k'$  may be a ten-volt lamp. The resistance of magnet  $c$  may be eighty-five ohms.

While all the apparatus is in its inert condition the conductor 3 of the trunk-line is in electrical connection with the sleeve of the connecting-plug by way of conductor 6. The connection of the tip of the plug with the conductor 4 of the trunk-line is severed, however, the circuit being closed by way of conductors 7, 8, and 10 to the operator's telephone.

Assume that the incoming trunk operator listening at this telephone receives an order to connect the trunk-line 3 4 with a subscriber's line terminating in the switchboard. Her first act is to raise the plug  $g$  and test the line called for by applying the tip of the plug to the test-ring  $b^3$  of a spring-jack of the line. In correspondence with ordinary practice the existence of a connection with any spring-jack of a subscriber's line will have altered the electrical condition of these test-rings by

applying a source of current to the rings to raise them to a difference of potential from earth. Hence at each application of the testing-plug to the test-ring current will flow from the ring through conductors 7, 8, and 10. Each pulsation of current will produce a click in the operator's telephone. In case no connection exists with the line tested no such sounds will be heard. It will be noted that inasmuch as no connection exists between conductor 7 and the remaining portion of wire 4 of the trunk-line no disturbance can arise in the operator's telephone on account of foreign electromotive forces in the trunk-line. Having found the line free, the operator inserts plug *g* into the spring-jack tested. This act brings the conductors 6 and 7 into connection with line-wires 2 and 1 of the telephone-line. At the same time it permits current to flow from battery *o* through wires 11, 14, and 15. This current excites the cut-off relay *c* of the line with which connection has been made, causing this appliance to sever the normal ground connections of the line, while at the same time it electrifies the test-rings *b*<sup>3</sup> to make the line test "busy" to subsequent attempts to connect with it. Magnet *l'* also becomes excited, whereby the wire 7 is broken from wire 8 and closed to wire 9 and wire 6 is severed from wire 3 of the trunk-line and is connected with the calling generator *n*, the springs *l*<sup>2</sup> and *l*<sup>3</sup> having been raised from their resting-anvils and thrust against their alternate anvils. Calling current from the source *n* then flows out over the circuit 6 2 1 7 9, which rings the bell *a*<sup>2</sup> at the substation of the line. When in response to the call the user of the telephone removes the receiving-telephone from its switch and permits the switch to close the line-circuit through the telephones, the current in the circuit becomes greatly increased, the resistance of the condenser and the bell having been cut out. Thus the supervisory relay *k* becomes excited and, attracting its armature, closes the circuit 16 17, including the winding *m*<sup>9</sup> of magnet *m'*. This magnet being thus excited withdraws its switch-springs *m*<sup>2</sup> *m*<sup>3</sup> from their normal contact-anvils and thrusts them against their alternate anvils *m*<sup>5</sup> and *m*<sup>7</sup>, respectively, whereby the circuits are altered as follows: The connection of wire 11 with battery *o* is broken, the magnet *l'* is deprived of current, the springs *l*<sup>2</sup> *l*<sup>3</sup> are permitted to fall against their normal resting-anvils *l*<sup>4</sup> *l*<sup>6</sup>, respectively, and thus the conductor 3 of the trunk-line is extended by way of wire 6 to the sleeve-conductor of the terminal plug *g*. Connection is established between wires 8 and 4 at the point of contact of spring *m*<sup>2</sup> and anvil *m*<sup>5</sup>, so that conductor 7, terminating in the tip of plug *g*, is made a continuation of conductor 4 of the trunk-circuit. Wire 10 is disconnected from wire 8, and thus becomes wholly severed from the talking circuits of the trunk-line, the operator's telephone being thus finally disconnected from the circuit. A local circuit is

formed from battery *o* through wires 12, 13, 14, and 15, which includes the signal-lamp *k'*, together with winding *m*<sup>8</sup> of magnet *m'*, and inasmuch as this circuit is independent of the action of supervisory relay *k* the magnet *m'* will remain continuously excited while connection exists between wires 14 and 15. A shunt exists, however, about the lamp *k'* in wires 17 and 16, whereby the extinct condition of this lamp is maintained while the relay *k* is excited. Thus after making the test of the line the operator's insertion of the plug into the spring-jack tested disconnects her telephone from the trunk-line and applies the source of calling current to the line of the station to be signaled. The response of the called party effects the disconnection of the calling current and brings about the operative connection of the trunk-line with the terminal plug, whereby the subscriber's line is brought into circuit with the line connected with the distant end of the trunk-line. The supervisory signal remains inert while the source of calling current is applied to the line, but is brought under the control of the called party after his response to the call, after which it serves to indicate his signal for disconnection.

In many cases the display of signal *k'* to indicate that the telephone at the called station has been replaced on its switch may be followed by the disconnection of the trunk-line from the subscriber's line. In such case the users of the telephones must of course be instructed that the replacement of the telephone on its switch will constitute a call for disconnection. If, however, it is desired to control the disconnection both by the signal from the called party and by a clearing-out signal from the operator who initiates the connection at the distant terminal of the trunk-line, any suitable clearing-out signals may be associated with the trunk-line in the usual way without interfering with the mechanism of the present invention.

The invention is defined in the following claims:

1. The combination with telephone-lines having call-bells at their substations and switches for changing the resistance of the lines, and a terminal plug of a trunk-circuit for making connection with a line, of an electromagnet controlling a break in the trunk-circuit, said break being closed when the electromagnet is inert, a switch-spring actuated by the magnet adapted to connect a contact-piece of the terminal plug with a source of calling current, a second electromagnet responsive to current in the line produced by the operation of the switch at the station thereof, a local circuit and means for closing the same in the act of making connection with the line by means of said plug, the magnet-winding of said first-mentioned magnet being included in said local circuit, and switch-contacts of said second-mentioned electromagnet controlling the continuity of the local circuit;

whereby said first-mentioned magnet applies calling current to a telephone-line with which connection is made, but is deprived of current and closes the break in the plug-circuit when the telephone at the called station is taken for use, as described.

2. The combination with telephone-lines, call-bells connected therewith, and switches at the stations thereof operated in the use of the telephones for diminishing the resistance in the line-circuit, of a trunk-line and the terminal plug thereof for making connection with any line, a calling appliance consisting of a magnet and a switch-spring actuated thereby normally closing a break in the trunk-circuit, and adapted, when actuated, to open the said break and connect a source of calling current with the terminal plug, a second electromagnet controlled by current through the subscriber's line when increased by the diminution of the line resistance, a local circuit including the magnet of said calling appliance closed in registering contact-pieces of the plug and the spring-jack of a line, and switch-contacts of said second-mentioned electromagnet normally completing said local circuit but adapted to break it when the magnet is excited, a local circuit for said second-mentioned electromagnet, and switch-contacts actuated by the electromagnet to close the local circuit thereof; whereby the trunk-line is interrupted and calling current is applied to a line when connection is made therewith, but the source of calling current is disconnected in the use of the telephone at the substation and remains disconnected thereafter during the use of the line, as described.

3. The combination with telephone-lines, each provided with a call-bell at its station and with a switch and means controlled thereby for changing the resistance of the line in the use of the telephone, with spring-jacks for making connection with the line, of a trunk-line and a terminal plug thereof, a magnetically-controlled calling switch and a magnetically-controlled telephone-switch, switch-contacts of the telephone-switch forming a normal break of the trunk-circuit and connecting the testing-contact of the terminal plug with the operator's telephone or testing appliance, switch-contacts of the calling appliance normally completing the conductor leading to said testing-contact but adapted, when the magnet is excited, to break such normal connection and apply one pole of a source of calling current to said contact; a local circuit including the electromagnet of said calling appliance and registering contacts of the plug and spring-jack adapted to complete the said local circuit, auxiliary switch-contacts of the telephone-switch adapted to break the circuit through the magnet of said calling appliance when the magnet of the telephone-switch is excited; means for exciting the magnet of the telephone-switch in response to increase of current in the line-circuit with which the plug is connected, a local

circuit including a winding of the magnet of the telephone-switch, together with switch-contacts of the said switch closed when the magnet is excited, and means for breaking the said local circuit when the plug is withdrawn from the spring-jack, substantially as described.

4. The combination with a telephone-line having a high-resistance call-bell at its station and a switch for cutting out the call-bell in the use of the telephone, a spring-jack for the line, and a local-circuit conductor terminating in a contact-piece thereof, a trunk-line, a terminal plug therefor, and a relay in the trunk-circuit adapted to respond to current in the line when the said bell is cut out; of a magnetically-controlled calling switch having switch-contacts normally completing breaks in the different line conductors of the trunk-circuit, but adapted, when excited, to apply the poles of a source of calling current to the conductors leading to said terminal plug, a local circuit including the magnet of said calling switch, said local circuit terminating in a switch-contact of the plug adapted to make connection with the local circuit of a telephone-line to excite the magnet; a magnetically-controlled telephone-switch having a switch-spring normally forming a break in the conductor of the trunk-circuit leading to the test-contact of the terminal plug, and connecting the said test-contact with a telephone or other testing appliance, but adapted to close said break and disconnect the said telephone appliance, a branch of the local circuit closed between the plug and spring-jack including the magnet of said telephone-switch, said branch being controlled by the supervisory relay; other switch-contacts of said telephone-switch normally completing the circuit through the magnet of said calling switch but adapted to break the same when the magnet is excited; a local circuit including a winding of the magnet of said telephone-switch, said circuit being a branch of the local circuit closed between the plug and spring-jack, and switch-contacts controlled by the same magnet to complete the said circuit when the magnet is excited, substantially as described.

5. The combination with telephone-lines, each having a call-bell at its station and a switch for reducing the resistance of the line in the use of the telephone, a spring-jack for the line, a trunk-line and a terminal plug thereof for making connection with the spring-jack, a supervisory relay in the trunk-line and a supervisory signal associated with the terminal plug; of a magnetically-controlled calling switch having switch-contacts normally closing the different line conductors of the trunk-line, but adapted to break the said conductors and to connect the poles of a source of calling current with the line conductors to the terminal plug, a local circuit, contact-pieces of the plug and spring-jack adapted to complete the said local circuit, and a branch of the circuit including the magnet of said

calling switch, a telephone-switch, switch-contacts thereof forming a normal break in the conductor of the trunk-circuit leading to the testing-contact of said plug, and connecting the said testing-contact with an operator's telephone or other testing appliance, said switch-contacts being adapted to sever the connection with the telephone and complete the connection with the trunk-circuit when the controlling-magnet is excited, a second branch of the said local circuit including the controlling-magnet of said telephone-switch, said second branch being controlled by the switch-contacts of the supervisory relay; other switch-contacts of the telephone-switch normally closing the branch of the local circuit through the magnet of the calling switch, but adapted to break the said circuit when the magnet of the telephone-switch is excited; a third branch of the local circuit including the supervisory signal, together with a winding of the magnet of the telephone-switch, controlled by switch-contacts of the telephone-switch closed when the magnet is excited, said winding being of comparatively-low resistance, substantially as described.

6. The combination with trunk-lines and terminal plugs thereof for use in multiple switchboards, of an electromagnetic appliance

having a controlling-magnet in a local circuit closed in registering contacts of the plug and spring-jack, switch-contacts of the said appliance normally breaking the connection of the test-contact of said plug with the remainder of the trunk-circuit and connecting it with the operator's telephone for testing, substantially as described.

7. The combination with a trunk-line and a terminal plug therefor adapted for connection with multiple spring-jacks of the telephone-line, of calling and switching mechanism for controlling-magnets in a local circuit closed in registering contacts of the plug and spring-jack, said mechanism being adapted when inert to disconnect the testing-contact of the plug from the remainder of the trunk-line and to connect it with a terminal of the operator's telephone, and when excited to disconnect the operator's telephone and connect a source of calling current with the terminal plug, substantially as described.

In witness whereof I hereunto subscribe my name this 31st day of January, A. D. 1898.

CHARLES E. SCRIBNER.

Witnesses:

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GENEVA STEVENS.