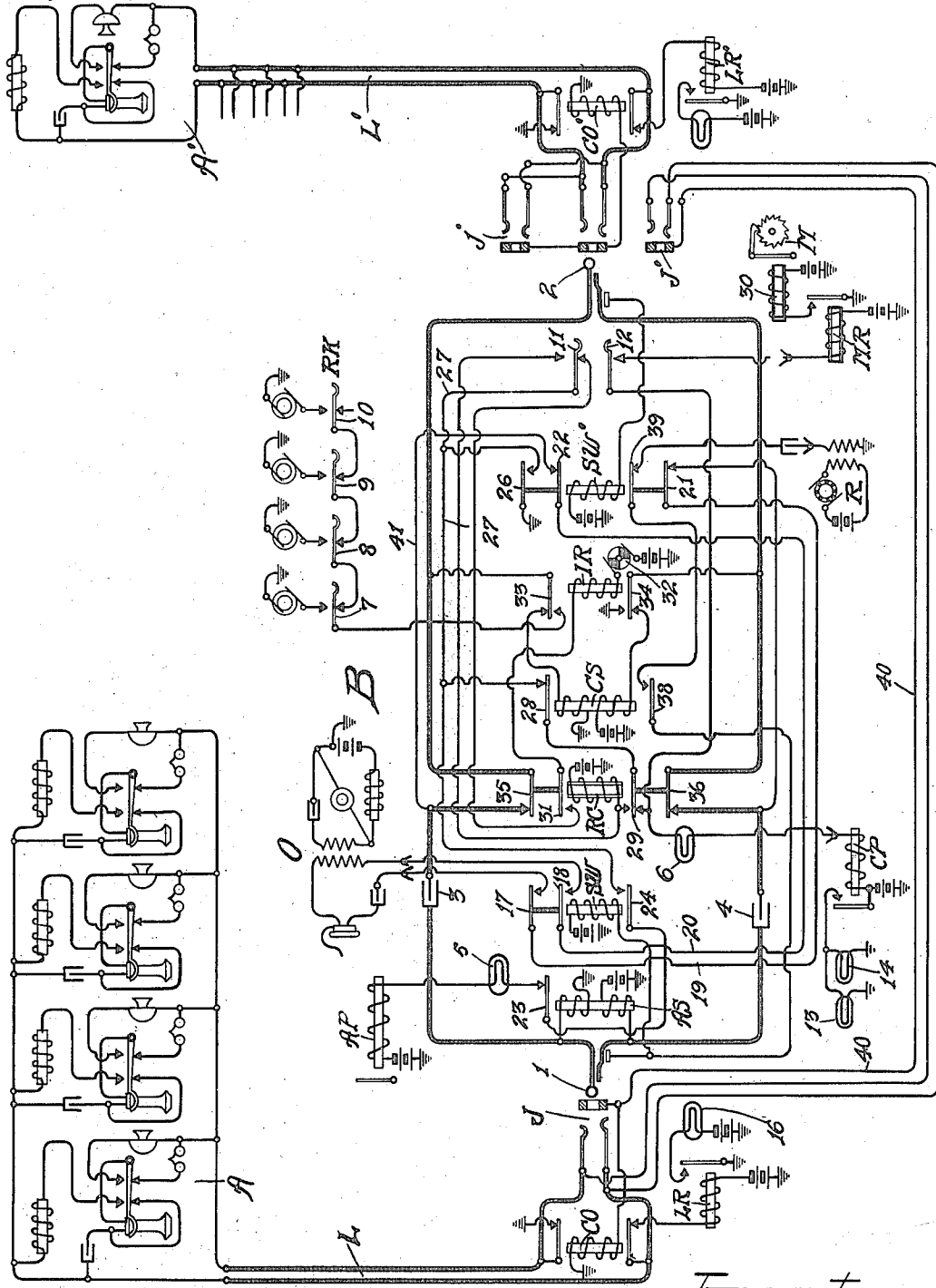


H. D. CURRIER.
TELEPHONE SYSTEM.
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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HIRAM D. CURRIER, a citizen of the United States of America, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates in general to telephone systems and is directed more particularly to certain features having to do with the control of supervisory, test and meter circuits, an object of my invention being to provide a simplified arrangement of control circuits of the above character in connection with an operator's link circuit.

One of the features of my invention is the provision of a simplified reverting busy control circuit wherein a supervisory relay associated with the calling end of the link circuit is adapted to control the application of such a reverting test.

Another feature of my invention is the provision of a calling supervisory control circuit wherein the calling supervisory signal is combined with a calling pilot and control circuit so as to produce a more useful supervision of the connection.

In systems wherein calling supervisory lamps are provided and wherein such lamps are lighted when connection is made with the called line and remain lighted until a response is secured, it is of no advantage to provide calling pilot signals in connection therewith because of the fact that during a greater portion of the time there is some unanswered call at each operator's position and therefore such a pilot signal would remain lighted the most of the time and serve no useful purpose. In systems wherein automatic ringing is provided I have found it unnecessary to arrange the calling supervisory signal so that it will light during the period of ringing because of the fact that the ringing disconnect is automatic. Therefore I have arranged the present embodiment of my invention so that the calling supervisory signal does not show during the ringing period but when a called subscriber replaces his receiver after finishing his conversation, the calling supervisory signal will light. I have also provided means whereby when a calling plug is inserted into a jack of a called line, the calling supervisory signal will light and remain lighted until the ringing key is

depressed. The period between inserting the plug in the called jack and the operation of the ringing key, and the period from the hanging up of the called receiver until the calling plug is withdrawn, are periods where an operator may lose considerable time in handling connections and therefore I have provided a common calling pilot signal associated with the calling supervisory signals of each operator's cord circuits whereby a chief operator or monitor is enabled to see by the operation of the calling pilot signal just how each operator is working during the said periods.

For a better understanding of my invention reference is to be had to the accompanying drawing in which two telephone lines L and L' are shown, each line being of the party line type and having a plurality of substations A or A' connected thereto. Said lines terminate at a central office switchboard in line circuits comprising jacks J and line signal control apparatus preferably a line relay LR, cut-off relay CO.

I have preferably embodied my invention in an operator's cord circuit B having answering and calling plugs 1 and 2 respectively, said plugs being united by the heavily marked tip and sleeve conductors having interposed condensers 3, 4. An answering supervisory relay AS is associated with the answering end of the cord circuit together with a switching relay SW which assists in the control of the answering supervisory signal 5, and also connects the operator's telephone O to the cord circuit. An answering pilot relay AP is also provided.

In connection with the calling end of the cord circuit, I provide supervisory control relays comprising a calling supervisory relay CS and a so-called switching relay SW', which relay SW' assists in the control of the calling supervisory signal 6 and disconnects the operator's telephone O from the cord circuit. Automatic ringing control apparatus is also provided including an interrupter relay IR which is adapted to periodically apply ringing current to the called line, and a second ringing control relay RC which acts to disconnect the interrupter relay responsive to the energization of the calling supervisory relay CS, when a response is secured from the called substation. A party line ringing key RK is provided being preferably of the four-party type and having

independently operable ringing contacts, 7, 8, 9 and 10 and a set of common contacts 11, 12. The ringing key is also preferably of the so-called indicating type in which when a ringing plunger is fully depressed to its ringing position, one of the ringing contacts is operated as are also the common contacts 11, 12. When the operator relieves the pressure upon the actuated ringing plunger it restores to its middle or indicating position restoring the common contacts 11, 12 to their normal position as illustrated, but maintaining the actuated ringing contacts in their alternate position.

When the operator inserts the calling plug 2 into a jack *j*, the calling supervisory signal 6 and its associated pilot signals 13, 14 are operated and remain so until the ringing key is actuated at which time the ringing control relay RC operates to efface signals 6, 13, 14. The actuation of the ringing key is also effective to cause the energization of the meter relay MR to register a single connection upon the meter M, and although the operator may repeatedly operate the ringing key, further registrations of the meter apparatus is prevented, until another connection by the cord circuit B is established, or such additional registration cannot occur without calling some party on the line connected with.

In connection with party line systems it is most essential that a so-called revertive busy test be provided so that an operator may know when a subscriber is calling for a substation on his own line. To this end I have provided an improved revertive busy control so arranged that when the operator places the tip of the calling plug 2 upon the sleeve of a busy jack, the calling supervisory relay CS will operate and connect the revertive busy tone R to a contact of the answering plug 1 whereby if the calling plug 2 is touching a jack multiply connected to the jack in which the answering plug 1 is inserted, a characteristic busy tone is transmitted to the operator's telephone.

Having described more in general the apparatus employed in the preferred embodiment of my invention, its operation will now be described. Assuming that a substation A on line L desires to call, the receiver thereat is removed whereby a circuit for the line relay LR is established over the calling line, causing the energization of said relay and the lighting of line lamp 16. The operator in response to this signal inserts an answering plug 1 into the answering jack J of the calling line whereby a series circuit including the winding of cut-off relay CO and switching relay SW is established through the third contacts of the connected plug and jack. Said relays CO and SW are therefore energized, the energization of CO causing the disconnection of the line relay and effacing the line lamp. Responsive to the energization of relay SW, its alternate contacts 17, 18 are closed connecting the operator's telephone O over conductors 19, 20, and normal contacts 21, 22 in bridge of the talking strands of the cord circuit. Also upon connection of jack J and plug 1, the answering supervisory relay AS is connected in bridge of the calling line L whereby current flows through the winding of said relay and over the calling line, causing the energization of AS.

The operator's telephone having been automatically connected with the link circuit, the operator ascertains the wants of the calling subscriber and finding that a connection is wanted with substation A¹ of the line L¹, the operator proceeds to test the called line in the usual manner, that is by touching the tip of the calling plug 2 to the third or test contact of the called line jack *j*. Finding the called line is idle she inserts plug 2 into a jack *j* thereof. A circuit including switching relay SW¹ and cut-off relay CO¹ is therefore established over the third contacts of the connected plug and jack 2, *j* respectively whereby said relays are energized. The energization of CO¹ removes the substation control of its line signal while upon energization of SW¹, its normal contacts 21, 22, are interrupted causing the disconnection of the operator's telephone from the link circuit.

It might be well to state at this time that when the called line is busy there is a battery connection to the third contact of its connected jacks so that when the tip of the plug 2 is placed against this third contact in testing, an energizing circuit through the upper winding of relay CS is established, but this is only incidental when a line different than the calling line is being tested, and has no effect upon the usual "click" test circuit here employed.

Referring again to the switching relay SW¹, also responsive to its energization its alternate contact 26 is closed whereby ground is connected to conductor 27, normal contact 28 of relay CS, supervisory signal 6 and the winding of the calling pilot relay CP to battery. Lamp 6 is therefore lighted and relay CP energized to light the pilot signals 13, 14, said signals 6, 13, and 14 remaining lighted until the associated ringing key is operated. It will be apparent that with this arrangement a chief operator or monitor by watching any operator's pilot signals 13 or 14 can tell how the operator is working. The operator's pilot 13 is of course positioned before the operator, and pilot 14 may be positioned before a chief operator or monitor.

The operator now depresses the plunger of the proper ringing key 7, 8, 9 or 10 to its

fully depressed position, thereby actuating the associated ringing contacts and the common contacts 11, 12. Responsive to the closing of alternate contact 12, a circuit for the meter relay MR is established from battery through the winding of MR, alternate contact 12, to grounded normal contact 29 whereby said relay MR is energized to cause a single operation of the meter M by its magnet 30. Responsive to the closing of alternate contact 11, which occurs after the closing of alternate contact 12, a circuit for the ringing control relay RC is established, traced from battery through the winding of RC, alternate contact 11 to the grounded conductor 27. Relay RC therefore interrupts its normal contact 29 effacing signals 6, 13, 14 and restoring the meter relay MR. Relay RC also establishes a locking circuit for itself through its alternate contact 29, normal contact 28 to grounded conductor 27 which circuit is maintained until the calling supervisory relay CS is energized by the response of the called subscriber. The operator of course releases the actuated ringing key plunger after maintaining it fully actuated for a short period, whereby the common contacts 11, 12 are again restored to normal, but the actuated ringing contact 7, 8, 9, or 10 is maintained closed in its alternate position. It will be apparent that although the operator may actuate the ringing plunger more than once, further operations of the meter relay MR are prevented due to the interruption of its circuit at normal contact 29 of RC.

Responsive to the closing of alternate contact 31 of RC, and upon the closing of normal contact 11 of the ringing key, a circuit for the interrupter relay IR is established traced from battery through interrupter 32, the winding of IR, alternate contact 31, normal contact 11, to grounded conductor 27. Relay IR is therefore periodically energized operating its contacts 33, 34 each closure of the alternate contacts 33, 34, connecting ringing current from the proper ringing generator in bridge of the called line to ring the call bell of substation A¹. Upon each closure of normal contacts 33, 34, of relay IR, the calling supervisory relay CS is connected in bridge of the called line but due to the condenser at substation A¹ no path for the flow of direct current over CS exists as long as the receiver remains upon the switch-hook. During the ringing period normal contacts 35, 36, of relay RC are interrupted so that the ringing current does not affect the calling line.

In response to the operation of the call bell at substation A¹, the subscriber thereat removes his receiver whereby a path for direct current is established over the called line L¹ and including the windings of calling supervisory relay CS. Said relay there-

fore energizes interrupting its normal contact 28 and thereby interrupting the locking circuit for the ringing control relay RC, causing its deenergization. Alternate contact 31 of RC is therefore interrupted, interrupting the circuit for relay IR and preventing any further application of ringing current. Lines L and L¹ are now connected for conversation.

After the subscribers have finished conversation they replace their receivers upon their respective switch-hooks whereby the circuits for supervisory relays AS and CS are interrupted causing the restoration of said relays. Responsive to the closing of normal contact 23 of AS, a circuit for the answering supervisory signal 5 is established through alternate contact 24 of SW to the grounded conductor 27. Responsive to the closing of normal contact 28 of CS, ground is again connected to normal contact 29 of RC whereby signals 6, 13, and 14 are again lighted, and remain lighted until the calling plug 2 is withdrawn from the jack, thus affording to the chief operator or monitor before whom lamp 14 is positioned, a check upon the period of disconnection.

Should the operator now attempt to cause another, or improper actuation of the meter relay MR by again actuating the ringing key RK before withdrawing plug 2, the result will be that ringing current will again be applied to the connected line as before described. It will be apparent from the above that it is impossible for the operator to register connections on the meter without calling some substation.

The operator observing the lighting of signals 5, 6 referred to, is aware that disconnection is desired and therefore withdraws plugs 1, 2 from the connected jacks. At the answering end of the cord circuit this results in the restoration of relays CO and SW, and at the calling end of the cord this results in the restoration of relays SW¹ and CO¹. Signal 5 is therefore effaced due to the interruption of alternate contact 24 of SW, and the signals 6, 13, 14 are effaced due to the interruption of alternate contact 26 of SW¹ and the removal of ground from conductor 27. The apparatus used in establishing the connection being again at normal is available for use in establishing other connections.

Now as to the operation of so-called reverting busy test, assuming that an answering plug 1 has been inserted into a jack J in response to a call over line L and whereby relays AS and SW have operated as before, and that the calling substation is to be connected with another substation on the same line. Therefore the operator, unaware that the calling and called substations are on the same line will place the tip of the associated calling plug 2 against the third

or test contact of a multiple jack J¹. This test contact of course is connected to battery through the test contact of J, third contact of plug 1 and the winding of SW. Therefore when the operator places plug 2 against the jacks J¹, a circuit is established for relay CS from battery at said test contact of J¹, the tip of plug 2, tip calling conductor, normal contact 33 and the upper winding of CS to ground. Relay CS therefore closes its alternate contact 38 connecting the characteristic reverting tone from apparatus R through normal contact 39, alternate contact 38, third contacts of plug 1 and jack J, conductor 40, test contact of jack J¹, tip of plug 2, calling tip conductor, normal contact 35, conductor 41, normal contact 22, alternate contact 18, receiver of operator's telephone O, alternate contact 17, conductor 19, normal contacts 21, 36, 34, and the lower winding of CS to battery and ground. The operator by this characteristic tone knows that the wanted substation is on the same line with the calling substation and therefore asks the calling subscriber to replace his receiver upon its switch-hook for a moment or two while the called substation is being rung.

The operator now inserts the calling plug 2 into a multiple jack J¹ whereby the switching relay SW¹ is operated in a manner as before described. The operator then depresses the proper ringing plunger whereby ringing current is applied to the called line in a manner as before described. The application of ringing current is continued until a path for direct current is established over the line L either by the removal of the receiver of the calling or called substations whereby both of the relays AS and CS are energized by current over the line L, the energization of CS causing the disconnection of ringing current in a manner as already described.

When the subscribers have finished their conversation and upon the replacing of both receivers upon their switch-hooks, relays AS and CS deenergize resulting in the operation of the signals for disconnection in a manner as before described followed by the withdrawal of the connecting plugs and the restoration of the apparatus to normal.

Having described my invention, what I now claim as new and desire to secure by United States Letters Patent, is:

1. A telephone system comprising a telephone line having multiple jacks, an operator's link circuit, an answering plug for said link circuit connected to one of said jacks, means for rendering the other jacks connected thereto busy, a double wound supervisory relay connected to the calling end of the link circuit, a signal controlled thereby, a characteristic test tone, an operator's

telephone, and means whereby when the calling terminal of said link circuit is placed against a multiple jack of said line said relay is energized to transmit said test tone to said operator's telephone.

2. A telephone system comprising a telephone line having multiple jacks, an operator's link circuit, means for connecting the answering end of said link circuit to one of said jacks whereby the other connected jacks are rendered busy, a calling supervisory relay adapted for energization over a called line connected to the calling end of the link circuit, a signal controlled thereby, a characteristic test tone, an operator's telephone, means whereby when the calling terminal of said link circuit is placed against a multiple jack of said line said relay is energized, and means responsive to such energization to connect said test tone in circuit with said operator's telephone.

3. A telephone system comprising telephone lines having multiple jacks, an operator's link circuit for interconnecting said lines, means for connecting the answering end of said link circuit to one of said jacks whereby the other connected jacks are rendered busy, a calling supervisory relay adapted for energization over a called line connected to the calling end of the link circuit, a signal controlled thereby, a characteristic test tone, an operator's telephone, means whereby when the calling terminal of said link circuit is placed against a multiple jack of the line connected to the answering end of the cord said relay is energized, means responsive to such energization to connect said test tone in circuit with said operator's telephone, and means whereby said test tone is not connected in circuit with said operator's telephone when the calling terminal of said link circuit is placed against a busy multiple jack of another one of said telephone lines.

4. A telephone system comprising telephone lines having multiple jacks, an operator's link circuit having tip and sleeve talking conductors for interconnecting said lines, means for connecting the answering end of said link circuit to a jack of a calling one of said lines whereby the other connected jacks are rendered busy, a calling supervisory relay adapted for energization over a called line connected to the tip conductor of the calling end of said link circuit, a signal controlled thereby, a characteristic test tone, an operator's telephone, means for rendering the jacks of said lines busy, means for energizing said relay when the calling tip terminal of said link circuit is placed against a busy multiple jack of any of said lines, means whereby when said tip terminal is placed against a jack of the connected calling line said relay is energized to connect said test tone in circuit with said oper-

ator's telephone, and means whereby when said relay is energized responsive to the placing of said tip terminal against a busy jack of another of said lines said test tone is not connected to said operator's telephone.

5. A telephone system comprising telephone lines, an operator's link circuit, a supervisory signal, means responsive to connection of said link circuit to a called one of said lines to operate said signal, a ringing key for applying ringing current to the called line, means responsive to the actuation of said key to efface said signal, and substation controlled means for re-operating said signal.

6. A telephone system comprising telephone lines, an operator's link circuit, a supervisory signal, means responsive to connection of said link circuit to a called one of said lines to operate said signal, a ringing key for applying ringing current to the called line, means responsive to the actuation of said key to efface said signal, and means responsive to the replacing of the receiver at the called substation after said call has been answered to again operate said signal.

7. A telephone system comprising telephone lines, an operator's link circuit, a supervisory signal, means responsive to connection of said link circuit to a called one of said lines to operate said signal, a ringing key for applying ringing current to the called line, means responsive to the actuation of said key to efface said signal, means responsive to the replacing of the receiver at the called substation after said call has been answered to again operate said signal, and means whereby when said link circuit is disconnected from the called line said signal is again effaced.

8. A telephone system comprising telephone lines, an operator's link circuit, a supervisory signal, means for connecting said link circuit to a called one of said lines, means for applying ringing current to the called line, circuit connections for said signal effective to operate same prior to the application of said ringing current, means effective when said ringing current is applied to efface said signal, and a relay for rendering said circuit connections effective to re-operate said signal.

9. A telephone system comprising telephone lines, an operator's link circuit, a supervisory signal, means for connecting said link circuit to a called one of said lines, means for applying ringing current to the called line, circuit connections for said signal effective to operate same prior to the application of said ringing current, means effective when said ringing current is applied to efface said signal, and means responsive to the replacing of the receiver at the called substation after said call has been answered to again operate said signal.

10. A telephone system comprising telephone lines, an operator's link circuit, means for connecting said link circuit to a called one of said lines, means for thereafter signaling a substation on said line, and a pilot or supervisory signal positioned before a distant operator whereby the periods of time between the connecting to and the signaling of a called substation and the receiving of a disconnect signal from and the actual disconnection from the called substation, are indicated.

11. A telephone system comprising telephone lines, an operator's link circuit, means for connecting said link circuit to a called one of said lines, means for signaling a substation on said line, a disconnect signal, and a pilot or supervisory signal positioned before a distant operator whereby the periods of time between the connecting to and the signaling of a called substation, and the operation of said disconnect signal and the disconnection of the associated plug from the line, are indicated.

12. A telephone system comprising telephone lines, an operator's link circuit, means for connecting said link circuit to a called one of said lines, means for thereafter applying ringing current to said line, a disconnect signal responsive to the replacing of the receiver at the called substation after said call has been answered, and a pilot or supervisory signal positioned before a distant operator whereby the period of time between the connecting to and the ringing of a called substation, and the period of time between the operation of the disconnect signal and the disconnection of the associated plug from the line, are indicated.

13. A telephone system comprising telephone lines, an operator's link circuit, a supervisory signal, means responsive to connection of said link circuit to a called one of said lines to operate said signal, a ringing key for applying ringing current to the called line, means responsive to the actuation of the said key to efface said signal, means for restoring said last means without again operating said signal, subscriber controlled means for reoperating said signal, and operator controlled means for again effacing said signal.

14. In a telephone system including a subscriber's telephone line, a plug-ended link circuit, a supervisory signal for said link circuit, ringing apparatus for signaling the substation upon said line, a relay for closing a circuit for said signal responsive to the connection of said link circuit to said subscriber's line, a relay for opening said circuit responsive to an operation of said ringing apparatus, subscriber controlled means for restoring said last relay, and a third relay for again closing said circuit.

15. A telephone system including a sub-

scriber's telephone line, an operator's link circuit for connection to said line, a supervisory signal, circuit connections rendered effective to operate said signal upon connection of said operator's link circuit to said line, ringing apparatus for applying ringing current to the said line, means responsive to the actuation of said ringing apparatus to efface said signal, substation controlled means for restoring said signal in its normal position and for again operating said signal, and operator controlled means for again effacing said signal.

15 16. A telephone system including a subscriber's telephone line, a link circuit provided with supervisory apparatus, ringing

apparatus, means for closing a circuit for said supervisory apparatus, means for opening said circuit, said first means being responsive to the connection of the link circuit to the subscriber's line and to the replacing of the subscriber's receiver, said second means being responsive to an operation of said ringing apparatus and to the disconnection of said link circuit from said line.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

HIRAM D. CURRIER.

Witnesses:

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