

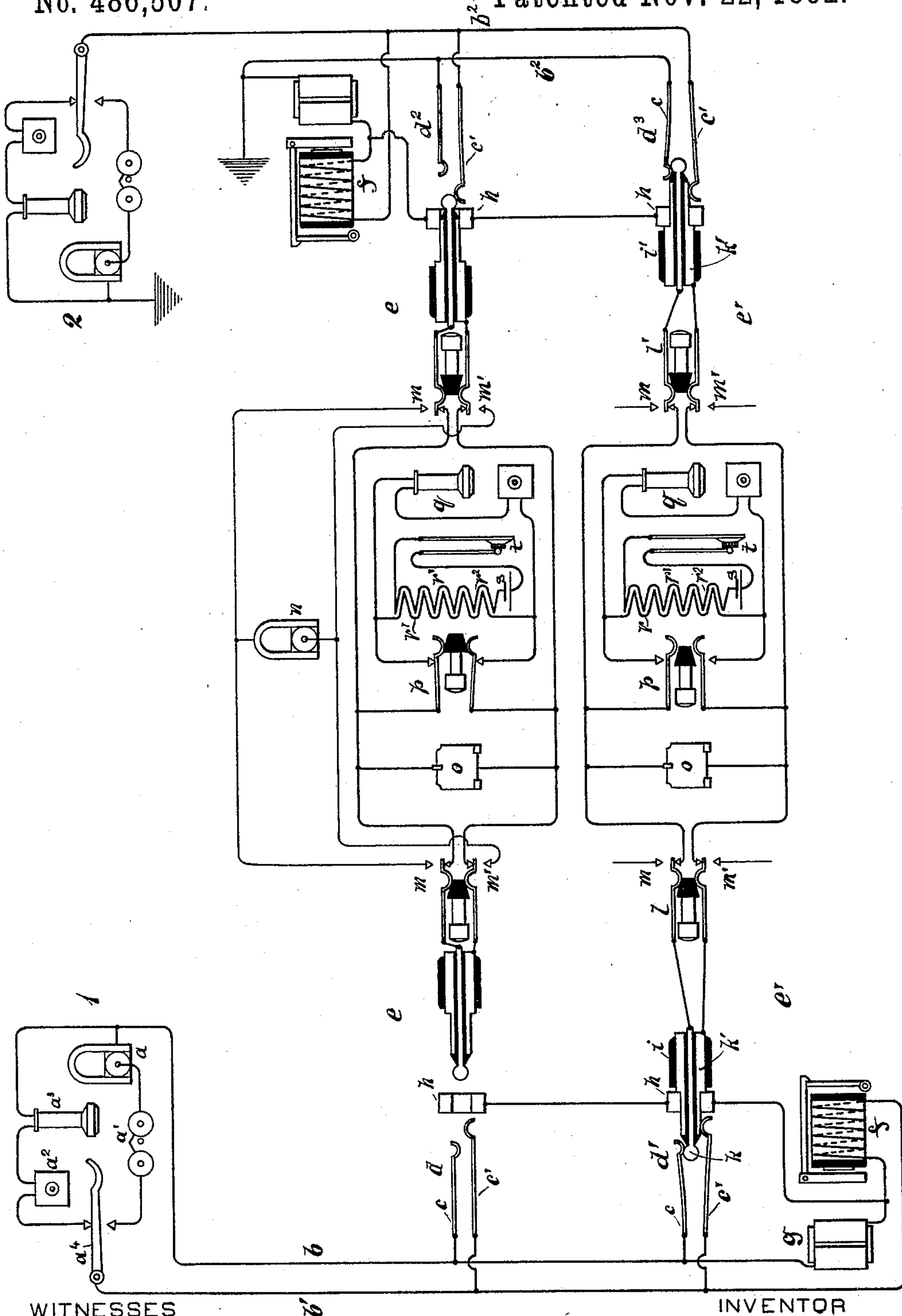
(No Model.)

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## TEST SYSTEM FOR MULTIPLE SWITCHBOARDS.

No. 486,507.

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# UNITED STATES PATENT OFFICE.

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## TEST SYSTEM FOR MULTIPLE SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 486,507, dated November 22, 1892.

Application filed February 11, 1892. Serial No. 421,174. (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 Test Systems for Multiple Switchboards, (Case No. 291,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to multiple-switchboard systems for telephone-exchanges. Its object is to provide means whereby it may be certainly determined at any board whether a line is already in use at some other board or not, said means being distinct and separate from the line-circuits.

My invention comprises contact-pieces upon the different jacks of the line, adapted to be crossed together by a suitable contact-piece upon the connecting-plug, corresponding contact-pieces upon the different jacks being connected together, and novel means for determining at any spring-jack when the said contact-pieces are short-circuited at some other jack. Said means consists of a testing-plug having two contact-pieces which are adapted to make contact with the said contact-pieces of the spring-jack, a telephone-receiver in a circuit between the two contact-pieces of the testing-plug, and a source of telephonic undulatory current in a parallel circuit with the telephone. This source of telephonic undulatory current will then normally create a continuous and preferably slight disturbance in the telephone-receiver; but the current will be wholly shunted from the telephone when the testing-plug is inserted into the spring-jack of a line already in use through the contact-pieces of the testing-plug, corresponding contact-pieces of the spring-jack tested, and the cross connection between the contact-pieces of the jack in which a connecting-plug is present.

My improved testing system is especially adapted for use in connection with a multiple-switchboard system in which contacts upon the spring-jacks are provided, adapted to be short-circuited to shunt or otherwise render inoperative the individual annunci-

ater of the line. In such a case the same contacts which perform the function of rendering the individual annunciator unresponsive when a connection is made to line will perform the additional function of indicating the idle or busy condition of the line when tested with the testing apparatus of my invention.

The testing-plug may be one of the regular connecting-plugs of an operator's telephone outfit. The source of telephonic current may be the secondary coil of an induction-coil whose primary is in circuit with a battery and a microphone lightly adjusted and kept in continuous slight vibration. The induced current in the secondary of the induction-coil then finds circuit through the telephone-receiver in parallel with it and produces a continuous rustling noise therein. Thus to an operator testing a line the cessation of the sound in her telephone indicates that the line is already in use at some other switchboard.

My invention is illustrated in the accompanying drawing, wherein I have shown it in connection with a multiple-switchboard system in which a retardation-coil is included with the individual annunciator in a branch circuit between the two sides of the telephone-line, the annunciator being short-circuited when a connection is made to a line.

In the drawing two telephone sub-stations 1 and 2 are shown connected each with two spring-jacks upon two sections of switchboard and with individual annunciator upon one of the boards. The two lines are shown in connection for communication through a cord-circuit of well-known type equipped with my testing apparatus. A second cord-circuit is shown, one of its connecting-plugs being placed in position for testing one of the lines. The apparatus at the sub-station 1 is of the ordinary character, consisting of a calling-generator  $a$  and a call-bell  $a'$  in a branch from one side of line  $b$ , a telephone-transmitter  $a^2$  and a receiver  $a^3$  in another branch from the same side of line, and a gravity-switch  $a^4$ , connected to the other side of line  $b'$ , adapted to connect either the calling apparatus or the telephone apparatus in the line-circuit, according to the position of the switch. The lines  $b$   $b'$  extend to an exchange, where they are connected to line-springs  $c$   $c'$ , re-



spectively, of the two spring-jacks  $d d'$  upon two sections of multiple switchboard  $e e'$ . An individual annunciator  $f$  of ordinary construction and a retardation-coil  $g$ , also of well-known character, are included in a loop joining the two sides of line  $b b'$ . The spring-jacks are provided with additional contact-pieces or test-rings  $h$ , which are connected together and by a conductor to a loop including the retardation-coil and the individual annunciator at a point midway between them. The connecting-plug  $i$  is of the ordinary two-part type, having tip  $k$ , making connection with the line-spring  $c$ , and sleeve  $k'$ , making contact with the line-spring  $c'$ , which is made longer for that purpose. The extra contact-piece  $h$  also makes contact with the sleeve  $k'$  of plug  $i$ , whereby longer line-spring  $c'$  and the piece  $h$  are crossed together when the plug is inserted into the spring-jack. The circuit connections are so disposed that the individual annunciator  $f$  is short-circuited when the line-spring  $c'$  and the piece  $h$  are thus crossed together. The apparatus and disposition of the circuits of sub-station 2 is similar to that of sub-station 1, the line  $b^2$  being continued through earth instead of a complete metallic conductor. Its individual annunciator is placed upon another switchboard  $e$ . Like contact-pieces of the two plugs of a pair are connected together by conductors in the usual way, calling-keys being included in these conductors, each adapted to disconnect both contact-pieces of one of the plugs from those of the other and to connect them to wires  $m m'$ , forming the terminals of a calling-generator  $n$ , whereby call-signals may be sent to any line. A clearing-out annunciator  $o$  is placed in a bridge connection between the different conductors joining the two plugs. A listening-key  $p$  is provided, adapted to connect the terminals of a telephone-set  $q$  to the different conductors or cord-strands in the usual manner when its plunger is depressed. The secondary  $r$  of the induction-coil  $r'$  is placed in a parallel circuit with the telephone-set  $q$ . The primary  $r^2$  of this induction-coil is included in circuit with a battery  $s$  and a microphone  $t$ , which is adjusted lightly and kept in continuous slight vibration.

I will now explain the operation of the system shown, giving special attention to the operation of testing by my invention to determine whether a line is already in use or not.

Suppose, for example, that subscriber at sub-station 1 wishes to communicate with subscriber at sub-station 2. He operates his calling-generator  $a$  and the switch  $a^4$  being down, sends a current over the lines  $b b'$ , which finds circuit at the central station through the retardation-coil  $g$  and the individual annunciator  $f$ . The annunciator  $f$  is thus operated, attracting the attention of the operator at the board  $e'$ , whereon it is situated, to the call. The operator then inserts one connecting-plug  $i$  of her pair into the jack  $d'$ .

A local short circuit is now closed about the individual annunciator  $f$ , which may be traced from one side of that annunciator by the branch of line  $b'$  to the line-spring  $c'$  of jack  $d'$ , thence to the sleeve  $k'$  of the plug  $i$ , thence to the extra contact-piece or test-ring  $h$  of the jack, thence returning to the annunciator  $f$ . Hence any subsequent calling-current sent over the lines  $b b'$  will be wholly shunted from the annunciator  $f$ , which will therefore be unresponsive. The telephonic current of lines  $b b'$  will not, however, be shunted through the coil  $g$  on account of its high self-induction. The operator having thus established a connection between her cord-circuit and the calling line, depresses the plunger of her listening-key  $p$ , as is shown in the upper cord-circuit at board  $e$ , thereby connecting her telephone set in a loop with the lines  $b b'$ . Having learned the connection desired, she proceeds to test the line called for. This she does by inserting the other connecting-plug  $i'$  of her pair a slight distance into the jack  $d^3$  of the line called for at her board until the tip of the plug makes contact with the longer line-spring of that jack, at the same time fixing her attention upon the faint rustling noise in her telephone. The plug  $i^3$  at her board  $e$  is shown in position for making such a test of the jack  $d^2$  of lines to station 2. If now the line tested be in use, as is actually the case in the drawings, the secondary  $r$  of induction-coil  $r'$  will be provided with a short circuit through one side of the listening-key  $p$ , one cord-strand to the tip of the testing-plug, thence to the line-spring  $c'$  of the jack  $d^2$ , thence to conductor  $b^3$  to the line-spring  $c'$  of jack  $d^3$  to the sleeve  $k'$  of the plug in that jack, thence to the test-ring  $h$ , returning to test-ring  $h$  of jack  $d^2$ , thence to the sleeve of plug  $i^3$  through the other side of listening-key  $p$  to the other terminal of coil  $r$ . The telephonic current from the induction-coil  $r'$  is thus wholly shunted from the telephone set  $q$ , producing complete silence therein, thus indicating to the operator testing that the line tested is already in use at some other switchboard. If the line tested were not in use, a circuit would still exist from the tip to the sleeve of the test-plug, but would contain the coil of the electro-magnet of the annunciator  $f$  of the line tested, which, being of high resistance and self-induction, would not form any appreciable shunt to the telephone set, and hence would not materially reduce the noise in the telephone. Thus a complete disappearance of noise in the telephone of the testing-operator is a certain indication that the line tested is already in use. It will be noted that this test is effected without disturbing the condition of the line tested and without at any time attaching a ground or common connection to either the line or the operator's outfit.

Assume that the operator at board  $e'$  finds lines to station 2 not in use. She then inserts the other plug  $i'$  of her pair into the jack  $d^5$ .



The two sub-stations are thus looped into a continuous circuit, which may be traced from station 1 over the lines  $b b'$  to the line-springs  $c c'$  of jack  $d'$ , thence to the corresponding contacts of plug  $i$ , thence through the ringing keys  $l l'$  to the similar contacts of the plug  $i'$ , thence to the corresponding contacts of the jack  $d^3$ , and over the lines  $b^2 b^3$  to sub-station 2. The operator's telephone  $q$  is in a bridge connection between the two sides of this circuit. The operator now depresses the plunger of ringing-key  $l'$ , thus connecting the two contact-pieces of the plug  $i'$  to the two poles  $m m'$  of the calling-generator  $n$ , thereby sending a calling-signal to the sub-station 2. Having assured herself that the subscribers at station 1 and 2 are in communication, she allows the plunger of listening-key  $p$  to rise, thus disconnecting her telephone set. When the communicating subscribers have completed their conversation, one of them—for example, subscriber at station 1—may send a clearing-out or disconnection signal. This current will find circuit to the line-springs  $c c'$  of jack  $d'$ , thence through the cord-circuit to the clearing-out annunciator  $o$ , which will thus be operated and will indicate the disconnection-signal to the attendant. An inconsiderable portion of the signaling-current will find circuit through the retardation-coil  $g$ ; but none can by any possibility operate the individual annunciator  $f$  of either of the connected lines.

Many other circuits for multiple switch-boards have been devised to which my invention is equally applicable. I do not deem it necessary to describe these systems further, since the application of my invention thereto may be readily made by any one skilled in the art. I do not limit myself to the employment of an induction-coil  $r$  as a source of undulatory current or to the vibrating microphone  $t$  to induce such current. Any other source of slight telephonic current or current of rapid pulsation or alternation may be employed in connection with the operator's telephone set in the manner I have described. Moreover, it is not essential that the operator's telephone be employed as a responsive device. Other appliances adapted to give an audible or visual response upon the cessation of current through them may be employed in place of the telephone set  $q$ , and a source of current suitable to the particular responsive device may be employed. Many modifications of my invention may thus be constructed without departing from the spirit thereof.

Having thus described my invention and the mode of operation thereof, I claim as new and desire to secure by Letters Patent—

1. In a testing system for multiple switch-

boards, the combination, with a device adapted to give a suitable response upon cessation of current through it, of a source of electricity in a parallel circuit therewith and contact-pieces constituting terminals of said parallel branch circuits, adapted to be applied to the contact-pieces of a spring-jack, whereby it may be determined whether the said contact-pieces of the spring-jack are short-circuited or not, substantially as described.

2. The combination, with a group of spring-jacks, each having two contact-pieces adapted to be crossed together by a connecting-plug placed therein, like contact-pieces of all the spring-jacks being connected together, of a testing-plug having two contact-pieces adapted to be applied to the two contact-pieces of a spring-jack, and a source of electric current and a responsive device adapted to give a response upon the cessation of current there-through in parallel circuits between the two contact-pieces of the plug, substantially as described.

3. The combination, with spring-jacks, each having two contact-pieces adapted to be crossed together when connection is made thereto, like contacts of the different spring-jacks being connected together, of a testing-plug having contacts adapted to be applied to the contact-pieces of a spring-jack and a source of telephonic undulatory current, and a telephone-receiver in parallel circuits, whose terminals are connected to the two contact-pieces of the testing-plug, respectively, substantially as described.

4. In combination with a telephone-line circuit extending from a sub-station to a central station and connected with spring-jacks at the central station, each having two line-springs and a test-ring, a connecting-plug adapted to be inserted into any spring-jack having two contact-pieces, one adapted to make contact with one of the line-springs and the other adapted to cross together the other line-spring and the test-ring of the jack, a testing-plug having two contact-pieces adapted to be applied to the test-ring and to that line-spring which is adapted to be crossed with the test-ring, respectively, and a source of telephonic undulatory current, and a telephone-receiver in parallel branches, whose terminals are connected to the two contact-pieces of the testing-plug, respectively, substantially as described.

In witness whereof I hereunto subscribe my name this 30th day of January, A. D. 1892.

CHARLES E. SCRIBNER.

Witnesses:

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GEORGE L. CRAGG.