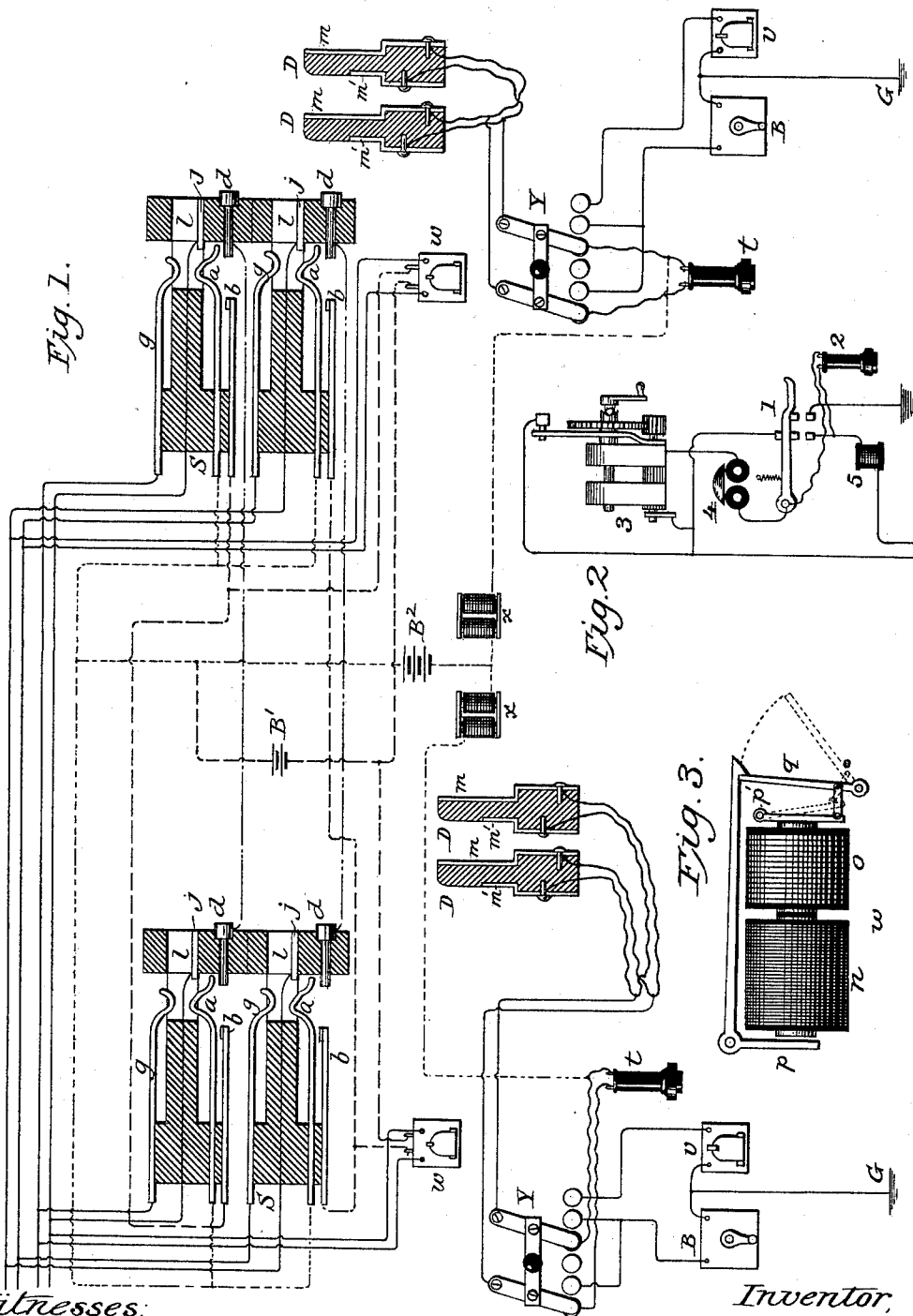


(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,425.

Patented Oct. 26, 1897.



Witnesses:

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UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF SAME PLACE.

MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,425, dated October 26, 1897.

Application filed March 9, 1895. Serial No. 541,161. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, a citizen of the United States, residing in the city of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Multiple Switchboards for Telephone-Exchanges, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates especially to a metallic-circuit telephone-exchange system.

It consists in a system of calling, switching, testing, and clearing-out signals which I shall describe and claim in detail.

In the accompanying drawings, Figure 1 illustrates the central-office apparatus, and Fig. 2 the subscriber's-station apparatus, of my invention. Fig. 3 shows the line-annunciator which is used in the system, with its main-line and local magnets, and self-restoring and retaining mechanism which is employed in my invention.

In Fig. 1, A and A' are two multiple switchboards, to each of which all the lines of the exchange are connected. As many boards or sections may be used as are necessary for the exchange in which the system is used. Each switchboard or section has a switch for each line of the exchange. The line-switches are marked S S. Each switch has two contact-pieces (marked *g j*) with which, respectively, the two contact-pieces of the loop-switch plugs shown in Fig. 1 and marked D D' are connected when a plug is placed into the switch for switching. These contact-pieces *g j* are connected with the main-line circuit, as will hereinafter be described, and may therefore be called the "main-line contacts" of the switch. Each switch has also three other contact-pieces (marked *a, b, and d*) which are insulated from said other contact-pieces and are normally out of contact with each other; but when a switch-plug is inserted into a switch it presses the contact-piece *a* into contact with *b* and *d*. When the plug is withdrawn, the contact of *a* with *b* and *d* is automatically broken. The contacts *a, b, and d* are connected to the local system for disconnecting the annunciators and for testing, as will be

described, and may be called the "local contacts" of the switches. The last-mentioned contact-piece *d* is at or extends to or near the front of the switch, so that an operator's test contact-piece may be readily connected to it for testing.

l l are the switch-holes adapted to receive the plugs, and *r r* are the rubber pieces on which the metal parts are mounted.

The loop-switch plugs shown in Fig. 1 and adapted to be inserted into the line-switches are of the shape substantially as shown, and each plug has two contact-pieces, (marked *m m'*.) When a plug is placed into a switch, its contact *m* forms connection with the contact *g* of the switch, and its contact *m'* forms connection with the contact *j* of the switch, while the rubber insulation of the plug presses the piece *a* of the switch into contact with the pieces *b* and *d*.

The switches and plugs may be of the shape and construction substantially as shown. They may, however, be greatly changed in shape and construction and yet have substantially the same switch parts, operating in substantially the same manner or forming substantially the same connections, as heretofore described.

W W are the line-annunciators, of which there is one for each line. These annunciators are distributed among the several boards or sections of the exchange and each is placed at the section where its subscribers' calls are to be answered. The line-annunciators, as shown in Fig. 3, have each a main-line electromagnet (marked *n*) and a local electromagnet, (marked *o*.) The armature *p* of the main-line electromagnet *n* is pivoted, as shown, and has a lever extending to the front of the annunciator, with a catch which normally holds the shutter or drop *q*. When the electromagnet *n* is energized by calling-current passing through its helix, it attracts and moves its armature *p*, and thereby releases the catch from the shutter or drop *q*, pivoted at the bottom, which latter will then fall and indicate a call, unless prevented from doing so by the retaining mechanism, which will now be described.

The armature *p'* of the local electromagnet

5 *o* is in the rear of the shutter *q*, is pivoted at its top, and extends normally close to the face of the core of its electromagnet. The lower end of the armature is connected by a link with the shutter, just above the fulcrum of the latter. When the shutter *q* is released from the catch of the armature *p* and the local magnet *o* is not energized by being in closed circuit with a battery, the shutter will fall to the position shown by dotted lines, carrying the armature *p'* out with it, as is also shown by the dotted lines. This position of the shutter indicates a call. When, however, the electromagnet *o* is energized by being placed in closed circuit with a battery or other constant source of electricity, its armature *p'* is attracted to the position shown by the solid lines and is retained in that position as long as the electromagnet is thus energized. When the armature *p'* is thus attracted to this position by means of the link connection shown, it carries the shutter *q* to its normal position, where it is engaged by the catch of the lever of armature *p*, and it, moreover, holds or retains the shutter in this normal position so long as the electromagnet *o* may thus be energized, whether or not during this time the electromagnet *n* may be energized by calling-currents passing through it. If the circuit of *o* is closed while *q* is in its normal position, the armature *p'* will be held in its normal position, preventing *q* from falling to indicate a call. Thus the shutter *q* is restored to its normal position when the magnet *o* is energized and is retained in its normal position and prevented from indicating a call as long as the magnet is thus energized. Each operator has as many pairs of loop-switch plugs *D D* as she may need in order to properly attend to the lines which are allotted to her.

40 *Y Y* are switches, one for each pair of plugs. Each switch *Y* has two switch-levers and two pairs of contact-bolts, on which, respectively, the two levers may be alternately placed. It has also another or fifth contact-bolt on which one of the levers may be placed. The switch-levers are adapted to occupy three positions, at the will of the operator, in one of which they are in contact with one pair of said bolts, in another of which they are in contact with the other pair of bolts, and in the third position of which one of them is in contact with said fifth bolt.

55 *t t* are the operators' telephones, of which there is one for each operator.

x x are retardation-coils, one for each telephone.

60 *B B* are calling-generators, of which there may be one for each operator, or one generator may answer for several or all of the operators.

V V are clearing-out annunciators, of which there is one for each pair of plugs.

65 *B²* is a test-battery connected into the local test-circuit, as will be hereinafter described.

B' is the annunciator-battery, connected

into the local annunciator-circuit, as will hereinafter be described.

The two contact-pieces *m m* of a pair of plugs are connected together by a flexible conductor, and the two contact-pieces *m' m'* are connected together by another flexible conductor. The two flexible conductors of a pair of plugs are connected to the two levers of the switch *Y* of the pair of plugs. The flexible conductors are long enough so that a switch-plug may be placed in any switch of the section at which it is located. The bolts of one pair of contact-bolts of each switch *Y* are connected together through the operator's telephone. The bolts of the other pair are connected together by a circuit connection, from the center of which is a connection to one side of the calling-generator *B*. The other side of the generator is connected with ground. The last or fifth contact-bolt of each switch *Y* is connected to one side of the clearing-out annunciator *v* of the pair of plugs, and the other side of the annunciator *v* is connected to ground. One side or branch of each metallic-circuit line is connected to one of the main-line contacts—say *g*—of each switch of the line and the other side or branch is connected to the other main-line contact—say *j*—of each switch of the line. The two sides or branches of each line are bridged or connected together at the central office through the main-line magnet of the annunciator *W* of the line.

The local connections of the systems are substantially as follows: All of the contacts *a a* of all the switches of the exchange are connected together to a common circuit connection, and thence through battery *B²* to the circuit connection which connects the retardation-coils to the operator's telephone. One side of the battery *B'* is connected to this circuit connection before it passes to the battery *B²*. All of the contacts *b b* of all of the switches of any given line are connected together and are also connected through the local magnets of the annunciators of the line to the other side of the battery *B'* than that side which is connected to the contacts *a a* of the switches. The contacts *d d* of each line are connected together.

The circuit connections, both main-line and local, are shown substantially as above described. For convenience of illustration the main-line circuit and connections are represented by solid lines and the local circuits and connections are represented by broken lines.

The side of each operator's telephone which is connected to contacts *m' m'* of a pair of plugs, when the switch *Y* of that pair of plugs is in position for the telephone to be in circuit with them, is connected with the retardation-coil *x* of the telephone, and thence to battery *B²*, as shown and as above described.

In the subscriber's-station apparatus shown

in Fig. 2, 1 is the telephone-switch; 2, the subscriber's telephone; 3, the subscriber's calling-generator; 4, his signal-receiving bell, and 5 a resistance-coil of the resistance, which will hereinafter be described.

The calling-generator has the usual automatic device by which its armature is automatically short-circuited while it is not being operated. It should preferably be an alternate-current generator.

The switch 1 has a lever and three insulated contact-pieces, with two of which the lever is in contact when the telephone is on the switch and with the third of which the lever is in contact when the telephone is off the switch. One of the first-mentioned contacts is connected with the ground. Both sides of the line are connected to the switch-lever. In one side are the calling-generator and the signal-receiving bell and in the other side are the subscriber's telephone and the resistance-coil 5. The circuits to the switch-contacts are substantially as shown and such that when the telephone is on the switch the telephone is short-circuited, and when the telephone is off from the switch the calling-generator and signal-receiving bell are short-circuited.

The resistance of one side of the line from the switch-lever to the connection with one side of the line-annunciator should normally (or when the subscriber's telephone is not off from the switch) be substantially the same as the resistance of the other side of the line from the switch-lever to the other side of the line-annunciator. This may be obtained by making the resistance of the coil 5 of the right amount to produce this equality of resistance. Of course the lines themselves may be constructed so as to obtain this equality of resistance. All the annunciators should be constructed so as to offer high retardation to alternating currents of high frequency, such as telephone-currents.

The operation of the system is as follows: When a subscriber operates his calling-generator, he sends a signal over his metallic circuit, which operates his line-annunciator. The operator who receives the indication then places one of her switch-plugs D into the switch of the line, the levers of the switch Y, to which the plug belongs, being in the position in which the two sides of her telephone are connected to the two levers of the switch. Her telephone is then in complete or closed metallic circuit with the line and she will receive verbally the order of the subscriber. This complete circuit exists because the two contacts of the plugs (which are connected to the two levers of the switch Y) are by their contact with the two contacts *g j* of the switch connected to the two sides, respectively, of the line. This operation of placing the switch-plug in the switch of the line closes the local circuit in which is the local magnet of the annunciator. The local magnet is thus energized by the battery B' attracting its arma-

ture and restoring and retaining the shutter *q* in its normal position, as heretofore described. When the operator finds out what line is wanted, she tests that line, as will hereinafter be indicated, and if she finds that it is not in use she places the mate of the plug first used in the switch of the line wanted. This also closes the local-magnet circuit of the annunciator of this line and holds or retains its shutter in its normal position as long as the local circuit is thus closed, or while the plug is in the switch. The operator then moves the levers of the switch Y so that they are in contact with the other pair of bolts, (which are grounded through the generator B.) Current from her generator will then pass from ground at the central office through the two sides or branches of the metallic circuit of the line wanted in split or derived circuit to the ground at the subscriber's station. As the two branches of the line are of the same resistance as much current will pass through one branch as the other. The current which passes through the signal-receiving bell of the subscriber wanted will be sufficient to ring his bell. The operator then moves the switch-levers of the switch Y so that one of the levers is on the said fifth contact-bolt connected to ground through the clearing-out annunciator of the pair of plugs. The two lines are thus connected together into a complete metallic circuit for conversation, and one side of the circuit is grounded through the clearing-out annunciator. When the lines are thus connected, their combined circuit is bridged or cross-connected through the annunciators of both lines. As these annunciators offer high retardation to telephone and other alternating currents, substantially none of the telephone-current generated during the conversation will pass through them.

When the call is sent by the operator, the subscribers' line-annunciators will not be operated, because the resistances from the generator to each side of the line-annunciator are the same, as are also the resistances from each side of the annunciator through the two sides or branches of the line to the subscriber's ground, and thus none of the calling-current will therefore pass through the line-annunciator. Should for any reason this equality of resistances be destroyed, so that part of the operator's calling-current will pass through the line-annunciators, the operation of the retaining mechanism, as hereinafter described, will prevent their being operated.

The clearing-out system is as follows: Each subscriber's apparatus is connected into his circuit so that his calling-generator is in the circuit between his ground and the ground connection through a clearing-out annunciator when the line is switched for conversation. The clearing-out signal is sent after the subscriber has placed his telephone on his switch. The current generated will therefore divide into four parts, passing through four branch or derived circuits. One of these cir-

cuits is from the subscriber's ground through
 his generator and one branch of the line to
 the clearing-out annunciator and thence to
 ground. Two other circuits through which
 5 part of the current passes are through his
 metallic-circuit line at the central office and
 thence in split circuit through the two line-
 annunciators. The fourth circuit is by way
 of the subscriber's station of the other line.
 10 If when the clearing-out signal is sent the
 telephone of the other subscriber is not yet
 placed on its switch, the circuit is through
 the metallic-circuit line of the other sub-
 scriber. If, however, both subscribers have
 15 their telephones on their switches, it is also
 from the ground at one station through one
 side of the combined circuit to ground at the
 other station. The line-annunciators of the
 two lines will not then be operated, although
 20 part of the current generated for the clearing-
 out signal passes through them, because their
 shutters are then retained or held in their
 normal position by their local magnets and
 mechanism, as heretofore described. The
 25 clearing-out annunciator not having retain-
 ing mechanism, but being of ordinary con-
 struction, will respond to the clearing-out
 current passing through it. The operator
 will then remove the plugs from the switches
 30 of the lines. The local annunciator-circuits of
 the lines being thus automatically opened,
 each annunciator will thus be free to respond
 to any calling-current sent through it.

The operation by which the line-annunci-
 35 tors are automatically restored if they indi-
 cate a call and are locked or prevented from
 being operated by a calling-current whenever
 the line is switched at the central office is
 briefly this: Whenever a plug is placed in the
 40 switch of a line, it automatically closes the
 local contacts *a b* of the switch, as heretofore
 described. This brings the battery *B'* and
 the local magnets *o o* of the line-annunciators
 of the line into a closed local circuit, which
 45 operates, as heretofore described, to restore
 the shutter if it indicates a call and to pre-
 vent the annunciators from responding or
 indicating when calling-currents pass through
 them. The closed local circuit may be traced
 50 thus: from the contact *b* of the switch, to
 and through the battery *B'*, and thence
 through the helix of the electromagnetic de-
 vice to the contact *a* of the switch. When
 the plug is removed, the contact between *a*
 55 and *b* is broken and the local circuit is there-
 fore open, thus demagnetizing the local mag-
 nets of the annunciators and removing the
 locking mechanism, so that the annunciators
 may respond to calling-currents.

60 The test system is as follows: When an op-
 erator desires to test any line to determine
 whether or not it is switched at the central
 office, she places the contact *m* of one of her
 switch-plugs on the contact-piece *d* of the
 65 switch of the line, the switch *Y* being then in
 position so that her telephone bridges across
 the two cord-circuits of the plug. If the line

is then switched for use, a closed circuit is
 established which contains the battery *B*² and
 the operator's telephone, and the operator 70
 will hear a click in her telephone and know
 that the line is already in use. This closed
 circuit may be traced as follows: through the
 retardation-coil and telephone of the operator
 to the contact *m* of the plug used in testing, 75
 thence to the contact *d*, to which the plug is
 applied, and thence to the contact *d* of the
 switch at which the line is switched, thence
 to contact *a* of that switch, which is then in
 contact with *d*, and thence through the com- 80
 mon connection of the contacts *a a* of the
 switches of the exchange and the battery *B*²
 to the retardation-coil. If the line is not
 switched at any board, no closed circuit will
 be established on testing, because no contact 85
d of the line is in contact with its spring *a*.
 The operator will therefore hear no click in
 her telephone and will thereby know that the
 line is not in use and will place a plug in its
 switch. It is evident that the subscriber's sig- 90
 nal-receiving bell might also be placed in the
 ground connection at his station. In that case
 all the calling-current which the operator
 sends over his line would pass through his
 bell. For the purpose heretofore indicated 95
 the resistances of the two branches of the line
 should in this case also be made substantially
 alike. Certain features of my invention are
 also applicable to systems in which the line-
 annunciators are prevented from being oper- 100
 ated when either the operator calls or a clear-
 ing-out signal is sent by other instrumental-
 ities than those heretofore indicated. My in-
 vention in these respects is broad enough to
 include these variations. 105

Other forms of locking or retaining annun-
 ciators than the one shown and described
 herein, or other forms of annunciators which
 both restore the shutter and lock or retain it
 when the line is switched, may be used for 110
 the line-annunciators.

I claim as my invention—

1. In a telephone-exchange system, metal-
 lic-circuit lines, multiple switchboards,
 switches, one switch for each line on each 115
 board, each switch having two contact pieces
 or terminals to which respectively the two
 sides or branches of its line are connected,
 and means at each board to connect together
 any two lines into a metallic circuit for con- 120
 versation by connecting together their re-
 spective contact pieces or terminals at that
 board, in combination with line-annunciators,
 one of each line located at a switchboard and
 permanently bridged across between the two 125
 sides or branches of its line, a clearing-out
 annunciator grounded on one side and con-
 nected on its other side to one side of a met-
 allic circuit established by connecting any
 two lines together for conversation; a calling- 130
 generator at each subscriber's station in the
 closed metallic circuit of its line whenever it
 is operated to send any signal, (either primary
 or clearing-out;) means for grounding each

closed metallic circuit at the subscriber's station while the subscriber sends a clearing-out signal with the ground connection on such side of the generator that the generator and the clearing-out annunciator are in a closed ground-circuit which comprises that side or branch of the line to which the clearing-out annunciator is directly connected, and electromagnetic apparatus for each annunciator, each in its normally open circuit with battery, said circuit being automatically closed by the switching of the line for conversation, and said electromagnetic apparatus of the annunciator of the line, then or when the line is thus switched, operating to prevent the annunciator from being operated to indicate the passage of calling-current.

2. In a telephone-exchange system, metallic-circuit lines, a switchboard, switches, one switch for each line on said board, each switch having two contact pieces or terminals to which respectively the two sides or branches of its line are connected, and means to connect together any two lines into a metallic circuit for conversation by connecting together their respective contact pieces or terminals, in combination with line-annunciators, one for each line, permanently bridged across between the two sides or branches of its line, a clearing-out annunciator grounded on one side and connected on its other side to one side of a metallic circuit established by connecting any two lines together for conversation, a calling-generator at each subscriber's station in the closed metallic circuit of its line, whenever it is operated to send any signal, (whether primary or clearing-out;) means at each subscriber's station for grounding his closed metallic circuit while he sends a clearing-out signal, with the ground connection on such side of the generator that the generator and the clearing-out annunciator are in a closed ground-circuit which comprises that side or branch of the line to which the clearing-out annunciator is directly connected, and electromagnetic apparatus for each annunciator, each in its normally open circuit with battery, said circuit being automatically closed by the switching of the line for conversation, and said electromagnetic apparatus of the annunciator of the line, then or when the line is thus switched, operating to prevent the annunciator from being operated to indicate the passage of calling-current.

3. In a telephone-exchange system, two metallic-circuit lines temporarily connected together at the central office into a metallic circuit for conversation, and the annunciator of each line, then or when the lines are thus connected, in a bridge at the central office between the two sides, in combination with electromagnetic apparatus for each line, including an auxiliary electromagnet in a normally open circuit with battery, but whenever the line is thus switched for conversation, said normally open circuit being closed to actuate

said electromagnetic apparatus of the annunciators to prevent them from being operated to indicate the passage of calling-current, a clearing-out annunciator in a circuit connection from said metallic circuit to ground, a calling-generator at each subscriber's station in the closed metallic circuit of the line whenever operated to send a call, and a ground connection to each line at each subscriber's station, when his generator is operated to send a clearing-out signal, with the calling-generator and the clearing-out annunciator between said ground connection and the ground of the annunciator at the central office.

4. An electric annunciator containing a main-line electromagnet and an armature therefor, with a lever and a catch, a pivoted shutter normally inclined to fall by gravity and held by the catch, but released from said catch when said electromagnet is energized by electric current, an auxiliary electromagnet and an armature therefor, and a link connection between said shutter and said armature, said shutter on falling when released from said catch while said auxiliary electromagnet is not energized carrying the armature of the auxiliary electromagnet away from its core and said auxiliary magnet when energized by the passage of electric current attracting its armature and through said link connection carrying said shutter to its normal position and retaining it there.

5. An electric annunciator containing a main-line electromagnet, and an armature therefor, with a lever and a catch, a shutter pivoted at its lower end, normally inclined to fall by gravity, and held by the catch, but released from said catch when said electromagnet is energized by electric current, an auxiliary electromagnet and an armature therefor pivoted at its upper end, extending in proximity to the core of the electromagnet and connected at its lower end by a link connection to said shutter, near to and above the pivot of said shutter, said shutter on falling when released from said catch while said auxiliary electromagnet is not energized carrying the armature of the auxiliary electromagnet away from its core and said auxiliary magnet when energized by the passage of electric current attracting its armature and through said link connection carrying said shutter to its normal position and retaining it there.

6. An electric annunciator containing a main-line electromagnet and an armature therefor, with a lever and a catch, a shutter pivoted at its lower end, normally inclined to fall by gravity, and held by the catch, but released from said catch when said electromagnet is energized by electric current, an auxiliary electromagnet and an armature therefor pivoted at its upper end, extending in proximity to the core of the electromagnet and connected at its lower end by a flexible connection to said shutter, near to and above

the pivot of said shutter, said shutter on falling when released from said catch while said auxiliary electromagnet is not energized carrying the armature of the auxiliary electromagnet away from its core and said auxiliary magnet when energized by the passage of electric current attracting its armature and through said flexible connection carrying

said shutter to its normal position and retaining it there. 10

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:

C. M. BROOKE,
B. W. MILLER.