

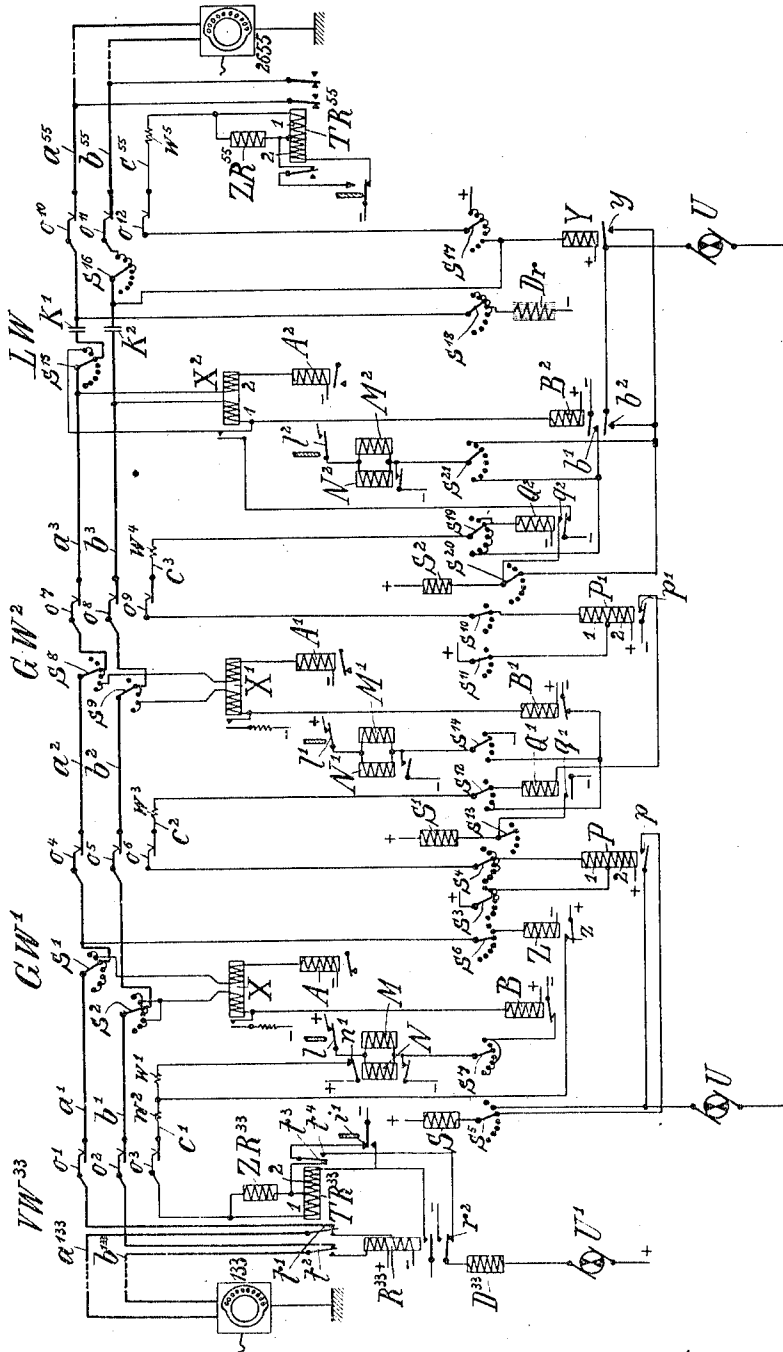
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APPARATUS FOR METERING CONVERSATIONS IN AUTOMATIC TELEPHONE EXCHANGES.

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1,020,976.

Patented Mar. 26, 1912.



WITNESSES
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APPARATUS FOR METERING CONVERSATIONS IN AUTOMATIC TELEPHONE-EXCHANGES.

1,020,976.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, GEORG GRABE, a subject of the German Emperor, and residing at Nikolassee, near Berlin, Germany, have
5 invented certain new and useful Improvements in Apparatus for Metering Conversations in Automatic Telephone-Exchanges, of which the following is a specification.

This invention relates to apparatus for
10 metering conversations in automatic telephone exchanges, in which the metering takes place after the termination of the conversation. In contradistinction to former arrangements, in which the selectors and
15 connectors utilized for a connection are released simultaneously with the metering of the conversation, according to my invention the release of the connectors and selectors is retarded or takes place only after metering
20 has been effected. To this end, at the termination of the conversation after the line relay located at the connector has become currentless or has operated, a connection is brought about which causes the first selector
25 first to meter at the calling subscriber's line by means of an additional change over, and then by means of a subsequent reversal to bring about the releases of the selectors and the connector occupied for the connection.
30

According to my invention the testing and releasing lines are closed backward up to the first selector in succession by way of the coils of the auxiliary relay as soon as the line
35 relay of one of the speaking subscribers located at the connector has become currentless and without a releasing relay being actuated or a relay which serves at the first selector for influencing the meter of the calling station by way of another branch of the
40 connecting line closed in the meantime at the connector, whereupon the connector is released by interrupting the testing line to the second selector at the first selector and
45 by interrupting the testing lines in turn by means of the auxiliary relays. This is brought about, according to my invention, by the side or controlling switch of the connector being placed one step beyond the
50 through position after the line relay of the calling or called subscriber located at the connector has become currentless. In this position the testing line leading from the connector to the last selector is closed by
55 way of the winding of an auxiliary relay

which interpolates the electromagnet of the side or controlling switch in a holding circuit, the testing relay of the last selector closes the testing line to the preceding selector in the row by way of the coil of a like
60 auxiliary relay, and so on until the testing relay of the first selector connects in circuit the controlling switch electromagnet by way of an interrupter. Then the controlling switch at the first selector will be brought
65 one step forward and arrives into a position, in which a relay at the first selector for starting the movement of the meter of the subscribers' lines is energized by way of a branch line closed at the connector. Owing
70 to the controlling switch at the first selector being automatically fed forward a second time, the testing line to the second selector is now interrupted and the stepwise interruption of the testing lines and the further
75 movement of the controlling switch of the connectors for interpolating the circuits of the releasing magnets are brought about by means of the auxiliary relays.

In order after metering has taken place,
80 and the releasing circuits at the controlling switches have been interpolated, to prevent the connector being advanced when the telephone is hung up at the calling station only, and to prevent the first selector in the row
85 being advanced when the telephone is hung up only at the called station, according to my invention the calling subscriber's line relay which is located at the connector and when currentless brings about the interpolation
90 of the releasing circuit is connected by the controlling switch into a holding circuit, while the line relay at the first selector is connected to the calling line.

One illustrative embodiment of my invention is represented diagrammatically by way
95 of example in the accompanying drawing.

Referring to the drawing, 133 designates a calling station which is connected with a called station 2655 by way of the pre-selector VW³², two selectors GW¹ and GW²
100 and the connector LW. In the drawing the selectors and connector are shown in the position during the conversation, only those parts of the connection and apparatus being shown, for the sake of clearness, which are requisite for understanding the connection of the releasing and metering circuits at the known pre-selectors and Strowger
105 selectors.

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The coil 1 of the testing and disconnecting relay TR³³ at the pre-selector VW³³ is interpolated for the duration of the connection in a holding circuit by way of the testing line *c*¹ of the selector GW¹ and holds the branches *a*¹³³, *b*¹³³ connected with the branches *a*¹, *b*¹ by way of the contacts *t*¹, *t*² and the contact arms *o*¹, *o*² of the selector GW¹. The meter ZR³³ is connected in shunt with the coil 1 of the relay TR³³ and the current flowing from the + pole of the exchange battery by way of the contact *n*¹ of the releasing magnet N, series resistances *w*¹, *w*², testing line *c*¹, contact arm *o*³, coil 1 of relay TR³³ and coil of meter ZR³³, contact *t*³, contact *i*¹ of the pulling switch does not suffice, on the one hand, for energizing the meter magnet and produces, on the other hand, a fall of voltage at the testing line *c*¹ which makes this appear occupied, as another subscriber's relay TR testing with its high resistance coil 2 on this line cannot obtain sufficient current to excite it. At the selector GW¹ the levers *s* of the controlling switch are in the fifth, *i. e.* the through position, in which the branches *a*¹, *b*¹ are connected with the branches *a*², *b*² of the selector GW² by way of the levers *s*¹, *s*² of the controlling switch and the selector arms *o*⁴, *o*⁵, while the line relays A, B, X are disconnected from the branch line. The low resistance coil 1 of the testing relay P of the selector GW¹ is here connected by way of the switch levers *s*³, *s*⁴ and the selector arm *o*⁶ to the test line *c*², which is connected with the coil of an auxiliary relay Q¹ at the selector GW² by way of a series resistance *w*³ and the switch lever *s*¹² of the controlling switch of the second selector GW². The relays P and Q¹ are currentless, however, as the circuit is broken in the through position at the armature of the testing relay P¹.

At the selector GW² the controlling switch levers are in the fourth position, which is likewise the through position, and the branch lines *a*², *b*² are connected with the branch lines *a*³, *b*³ leading to the connector LW by way of the switches *s*⁸, *s*⁹ of the controlling switch and the selector arms *o*⁷, *o*⁸, while the line relays A¹, B¹, X¹ of this selector are disconnected. The low resistance coil 1 of the testing relay P¹ is connected by way of the switches *s*¹¹, *s*¹⁰ and the selector arm *o*⁹ with the test line *c*³ which, however, is interrupted at the switch *s*¹⁹ of the controlling switch of connector LW. At the connector LW the controlling switch is in the sixth or through position, and the branch lines *a*³, *b*³ are connected by way of the switches *s*¹⁵, *s*¹⁶, the condensers *k*¹, *k*² and the selector arms *o*¹⁰, *o*¹¹ with the branch lines *a*⁵⁵, *b*⁵⁵ which lead to the subscriber's station 2655.

The line relays A², B², X² are connected in front of the condensers *k*¹, *k*² located in

the branches of the telephone line in bridge connection with the branch lines *a*³, *b*³, and the choking coil Dr and the supervisory relay Y are connected behind the condensers in bridge connection with the branch lines *a*⁵⁵, *b*⁵⁵. The coils 1, 2 of the relay TR⁵⁵ of the called subscriber 2655 are energized for the duration of the connection by way of the switch *s*¹⁷, connector arm *o*¹², line *c*⁵⁵ and series resistance *w*⁵ and hold the line relay of the subscriber disconnected from the branch lines *a*⁵⁵, *b*⁵⁵; simultaneously, line *c*⁵⁵ is subjected to a testing voltage which prevents the connection of a second connector to the line of the subscriber 2655.

The microphone current for the subscriber flows from the + pole of the battery by way of relay B², coil 1 of the differential relay X², branch line *b*³, selector arm *o*⁸, switch lever *s*⁹, branch line *b*², selector arm *o*⁵, switch lever *s*², branch line *b*¹, pre-selector arm *o*², contact *t*², branch line *b*¹³³, station 133, branch line *a*¹³³, contact *t*¹, pre-selector arm *o*¹, branch line *a*¹, switch lever *s*¹, selector arm *o*⁴, branch line *a*², switch lever *s*⁸, selector arm *o*⁷, branch line *a*³, coil 2 of the relay X², relay A² and back to the battery. The feeding current for the subscriber 2655 flows from the + pole of the battery by way of relay Y, switch lever *s*¹⁶, connector arm *o*¹¹, branch line *b*⁵⁵, station 2655, branch line *a*⁵⁵, connector arm *o*¹⁰, switch lever *s*¹⁸, choking coil Dr and back to the battery. Consequently, the relays A², B², Y are energized during the conversation, but not the differential relay X² because the two coils 1, 2 oppose one another.

As soon as the calling or the called subscriber hangs up his telephone, owing to the relay B² or Y, respectively, becoming currentless the electromagnet S² of the controlling switch is connected by way of switch lever *s*²⁰ in position 6, contact *b*² of the relay B² or contact *y* of the relay Y, in a circuit leading from the battery by way of the interrupter U. In this manner the controlling switch is brought from the sixth into the seventh position. In this position the branch line *a*³ is disconnected at the switch *s*¹⁵ from the branch line *a*⁵⁵ and connected by way of the coil of the relay B² with the + pole of the battery, so that a current now flows from the + pole of the battery by way of relay B², switch lever *s*¹⁶, coil 2 of the differential relay X² and relay A² to the - pole of the battery, while the test line *c*³ is connected at the switch *s*¹⁹ with the coil of the relay Q². Another current arises, which flows from the + pole of the battery by way of switch lever *s*¹¹, coil 1 of the relay P¹, switch lever *s*¹⁰, selector arm *o*⁹, test line *c*³, resistance *w*⁴, switch lever *s*¹⁹, relay Q² to the - pole of the battery which energizes the relays Q² and P¹, there being at the test line *c*³ a fall of voltage which pre-

vents the excitation of a relay P^1 of another second selector testing in known manner with the high resistance coil 2. The relay Q^2 interpolates the electromagnet S^2 at the contact q^2 in a holding circuit, while by closing the contact p^1 the relay P^1 causes a current to flow from the + pole of the battery by way of the switch lever s^3 , coil 1 of relay P , switch lever s^4 , selector arm o^6 , test line c^2 , resistance w^3 , switch lever s^{12} , relay Q^1 , contact p^1 to the - pole of the battery. The relay Q^1 interpolates at its contact q^1 the electromagnet S^1 of the controlling switch at the selector GW^2 in a holding circuit, while the relay P connects the electromagnet S of the first selector at the contact p to the battery by way of the interrupter U . After the circuit has been closed and subsequently opened at the interrupter U the controlling switch at the first selector is moved on from the fifth into the sixth position. In this position the relay Z connected with the - pole is connected by way of the switch s^8 to the branch line a^2 , while the branch lines a^1 , b^1 are connected again with the line relays A , B , X by way of the switches s^1 and s^2 . A current flows from the + pole of the battery by way of the coil of the relay B^2 at the connector LW , switch lever s^{15} in position 7, branch line a^3 , selector arm o^7 , switch lever s^8 , branch line a^2 , selector arm o^4 , switch lever s^8 , relay Z to the - pole of the battery. The current flowing to the - pole of the battery from the branch line a^3 by way of the coils of the relays X^2 , A^2 is only small on account of the high resistance of these relay coils in comparison with that of the coil of the relay Z . By attracting its armature the relay Z short circuits the series resistance w^1 , so that a heavy current flows from the + pole of the battery by way of the contact z , resistance w^2 , test line c^1 , pre-selector arm o^3 , the coils of the meter ZR^{33} and relay TR^{33} connected in parallel, contacts t^3 , i^1 to the - pole of the battery, so that the meter of subscriber 133 is fed forward. Further, in the sixth position of the controlling switch the electromagnet S is connected directly with the interrupter U and when the circuit at the interrupter is next closed and opened the controlling switch is brought by the electromagnet S from the sixth into the seventh position. In this position the releasing electromagnets M and N of the first selector GW^1 and the controlling switch of the latter are connected at the switch s^7 with the rest contact of the relay B and they are interpolated as soon as no current flows over the subscriber's line.

Further, in the seventh position of the controlling switch the test line c^2 is interrupted at the switch s^4 and the relay Q^1 which has consequently become currentless

interrupts the current in the electromagnet S^1 , whereby the controlling switch of the second selector GW^2 is moved from the fourth into the fifth position, in which the releasing electromagnets M^1 and N^1 are interpolated at the switch s^{14} and the line c^3 is interrupted at the switch s^{16} .

The relay Q^2 which has become currentless owing to the interruption of the line c^3 interrupts the current in the electromagnet S^2 , whereupon the controlling switch of the connector passes from the seventh into the eighth position, in which the releasing electromagnets M^2 , N^2 of the connector LW and the controlling switch of the latter are interpolated at the switch s^{21} . As the relay B^2 is interpolated in a holding circuit leading from the + pole of the battery by way of the relay B^2 , switch lever s^{15} , coil 2 of the differential relay X^2 and relay A^2 to the - pole of the battery and holds the contact b^2 open, when the controlling switch is in the seventh and eighth positions, the circuit of the releasing electromagnets M^2 , N^2 can only be closed at the connector LW when the called subscriber 2655 has hung up his receiver and the relay Y , which has thereby become currentless, has closed the contact y .

When their armatures are attracted the releasing electromagnets N , N^1 , N^2 are connected together with the electromagnets M , M^1 , M^2 into holding circuits which are only disconnected when the selectors open the pressing contacts l , l^1 , l^2 , after reaching their rest position. The releasing magnet N of the first selector GW^1 also brings about the interruption of the line c^1 at the contact n^1 , whereby the relay TR^{33} also becomes currentless and, owing to its armature falling, connects the rotatory electromagnet D^{33} of the pre-selector VW^{33} to the battery by way of the interrupter U^1 , contact n^2 of the line relay R^{33} , contact t^4 , contact i^1 , whereby the pre-selector is rotated step by step until it arrives into its rest position, in which the contact i^1 is opened and electromagnet D^{33} is cut out of circuit.

I claim:—

1. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, selectors and connectors for connecting a calling with a called station and testing branches for connecting the selectors with each other, releasing relays at the selectors and connectors, a meter for each subscriber's station, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at a selector for making a circuit for the meter of the calling sub-

scriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station, means for imparting the switching movements of said armatures to the switching devices at the selectors, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made.

2. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for each subscriber, selectors and connectors for connecting a calling with a called station and testing branches for connecting the selectors with each other, a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite for operating the selectors, releasing relays at the selectors and connectors a meter for each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at a selector for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station, means for imparting the switching movements of said armatures to the switching devices at the selectors, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made.

3. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for each subscriber, selectors and connectors for connecting a calling with a called station and testing branches for connecting the selectors with each other, a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite for operating the selectors, releasing relays at the selectors and connectors, a meter for each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at a selector for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station, means comprising switch arms at the controlling

switches of the selectors for imparting the switching movements of said armatures to the switching devices at the selectors, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made.

4. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for each subscriber, selectors and connectors for connecting a calling with a called station and testing branches for connecting the selectors with each other, a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite for operating the selectors, releasing relays at the selectors and connectors, a meter for each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at the first selector in the row for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station, means comprising switch arms at the controlling switches of the selectors for imparting the switching movements of said armatures to the switching devices at the selectors, means at each connector and at each first selector in the row for moving the controlling switches another step in succession after the termination of a conversation, means at the remaining selectors for locking their controlling switches until metering has taken place, means at the selectors and at each connector for releasing the latter locked controlling switches after the meter circuits have been made, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made.

5. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for each subscriber, selectors and connectors for connecting a calling with a called station, testing lines and testing relays for connecting the selectors with one another, with the connector and with the subscribers' stations, a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite for operating the selectors, releasing relays at the selectors and connectors, a meter for

each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at the first selector in the row for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station, means comprising switch arms at the controlling switches of the selectors for imparting the switching movements of said armatures to the switching devices at the selectors, an auxiliary relay at each connector and at each selector, with the exception of the first selector in a row, in series with the testing line and the testing relay of the previous selector, switching means controlling the testing lines, testing relays and auxiliary relays for moving the controlling switches another step in succession after the termination of a conversation, means at the remaining selectors for locking their controlling switches until metering has taken place, means at the selectors and at each connector for releasing the latter locked controlling switches after the meter circuits have been made, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made.

6. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for each subscriber, selectors and connectors for connecting a calling with a called station, testing lines and testing relays for connecting the selectors with one another, with the connectors and with the subscribers' stations, a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite for operating the selectors, releasing relays at the selectors and connectors, a meter for each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at the first selector in the row for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station, means comprising switch arms at the controlling switches of the selectors for imparting the switching movements of said armatures to the switching devices at the selectors, an auxiliary relay at each connector and at each selector, with the exception of the first selector in a row, in series

with the testing line and the testing relay of the previous selector, switching means controlling the testing lines, testing relays and auxiliary relays for moving the controlling switches another step in succession after the termination of a conversation, the auxiliary relays being used for locking the connectors and the selectors with the exception of the first selector in a row until metering has taken place, means at the selectors and at each connector for releasing the latter locked controlling switches after the meter circuits have been made, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made.

7. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for each subscriber, selectors and connectors for connecting a calling with a called station, testing lines and testing relays for connecting the selectors with one another, with the connectors and with the subscribers' stations, a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite for operating the selectors, releasing relays at the selectors and connectors, a meter for each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at the first selector in the row for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station, means comprising switch arms at the controlling switches of the selectors for imparting the switching movements of said armatures to the switching devices at the selectors, an auxiliary relay at each connector and at each selector, with the exception of the first selector in a row, in series with the testing line and the testing relay of the previous selector, switching means controlling the testing lines, testing relays and auxiliary relays for moving the controlling switches another step in succession after the termination of a conversation, means for connecting the auxiliary relay of a connector in a holding circuit after the first step of the appertaining controlling switch beyond the through position, means for connecting the auxiliary relay of the first selector in a row with the subscribers' lines after the first step of the appertaining controlling switch, means for locking the controlling switches of the selectors except-

ing the first in the row until the metering has occurred, means at the selectors and at each connector for releasing said locked controlling switches after the meter circuits
5 have been made, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made.

8. In an automatic telephone system, the
10 combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for
15 each subscriber, selectors and connectors for connecting a calling with a called station, testing lines and testing relays for connecting the selectors with one another, with the connectors and with the subscribers' stations,
20 a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite for operating the selectors, releasing relays at the selectors and connectors, a meter
25 for each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at the connector controlling the calling and called lines, switching devices at the first selector in the
30 row for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone is replaced at a subscriber's station,
35 means comprising switch arms at the controlling switches of the selectors for imparting the switching movements of said armatures to the switching devices at the selectors, an auxiliary relay at each connector and at each selector, with the exception
40 of the first selector in a row, in series with the testing line and the testing relay of the previous selector, switching means controlling the testing lines, testing relays
45 and auxiliary relays for moving the controlling switches another step in succession after the termination of a conversation, means at the remaining selectors for locking their controlling switches until metering has
50 taken place, means at the selectors and at

each connector for releasing the latter locked controlling switches after the meter circuits have been made, means for moving the controlling switch of the first selector in a row
55 another step for starting the progressive release of the selectors and the appertaining connector, and means at the switching devices for closing the circuits for the releasing relays of the selectors and connectors after the meter circuits have been made. 60

9. In an automatic telephone system, the combination, with subscribers' stations, a telephone and switching means in each subscriber's station, an exchange, lines for connecting the subscribers' stations with the exchange, a calling device in the exchange for
65 each subscriber, selectors and connectors for connecting a calling with a called station, a controlling switch at each selector and connector for bringing about the stepwise change over of the selector circuits requisite
70 for operating the selectors, releasing relays at the selectors and connectors, a meter for each subscriber, and means for connecting and for starting the meter through the testing branch, of relays at each connector having
75 one pole connected to the same branch of the subscriber's line, condensers interpolated in the subscribers' lines between the relays for dividing the latter into two
80 groups, switching devices at a selector for making a circuit for the meter of the calling subscriber at the end of a conversation, switch armatures at said relays at the connector which are moved when the telephone
85 is replaced at a subscriber's station, means for imparting the switching movements of said armatures to the switching devices at the selectors, and means at the switching devices for closing the circuits for the releasing
90 relays of the selectors and connectors after the meter circuits have been made.

In testimony whereof I have signed my name to this specification in the presence of two witnesses.

GEORG GRABE.

Witnesses:

WOLDEMAR HAUPT,
HENRY HASPER.