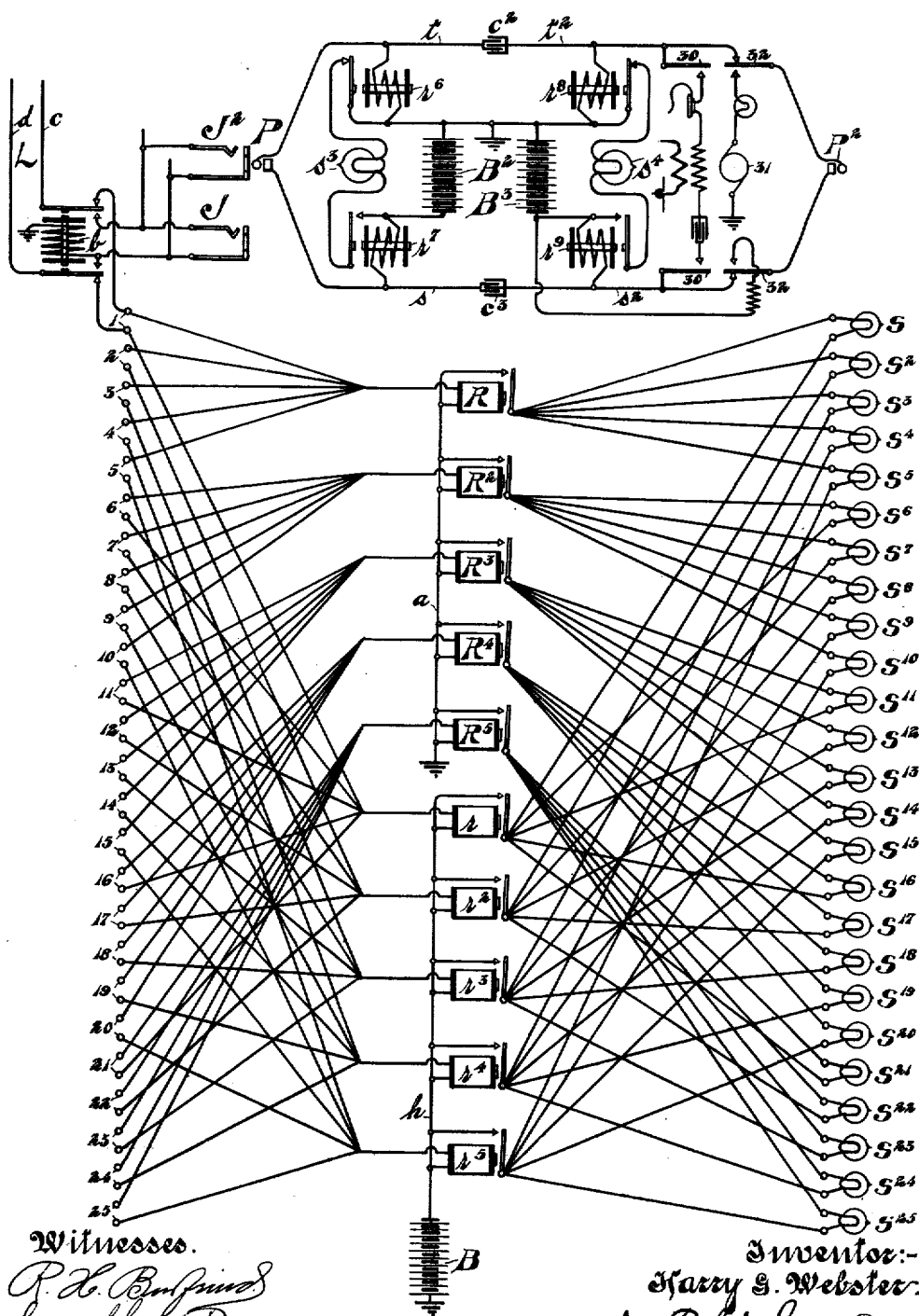


H. G. WEBSTER.
TELEPHONE SYSTEM.
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, 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 Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and particularly to means for reducing the number of relays required for the exchange.

Heretofore at least one relay was required for each subscriber's line, but in my system I arrange the relays in two sets, one set being actuated over the tip sides of the telephone line, while the other set is energized over the sleeve sides of the lines. Each lamp or other line signal requires the simultaneous actuation of one of the tip and one of the sleeve relays for its operation. In order to reduce the total number of relays I arrange to actuate them in different combinations, whereby with a certain number of relays in each set the possible number of operative combinations or lines that may be served at said relays is equal to the square of the number of relays in each set.

In the accompanying drawing which diagrammatically illustrates my invention, I have shown such an arrangement for twenty-five lines. It will be obvious, however, that the number may be varied and a greater or less number of lines served. The tip relays are indicated by the characters R , R^2 , R^3 , R^4 and R^5 which have each a terminal connected with the common wire a . The other terminals of said relays are connected with the tip binding posts of the subscribers' lines as indicated by the numerals 1 to 25 at the left-hand side of the page. These binding posts or terminals of the lines are for convenience shown in pairs and are designed to be connected as shown in connection with posts or terminals 1, with the normal contacts of a suitable cut-off relay b , which normal contacts are connected with the line conductors c and d , which lead to the subscriber's station or stations in the usual manner. The first five of these tip posts are connected with the first tip relay R , the second group with the second tip relay R^2 , the third group with relay R^3 , and so on throughout the series.

The sleeve relays are designated by the characters r , r^2 , r^3 , r^4 and r^5 which are connected with the common lead h extending to

the live pole of the battery B which is preferably common to the exchange or to a certain number of subscribers at the exchange. The opposite terminals of these sleeve relays are connected with the sleeve binding post of said pairs in the manner shown, that is the first post is connected with relay r , the second with relay r^2 , the third with relay r^3 , the fourth with relay r^4 and the fifth with relay r^5 . The sixth to the tenth sleeve binding posts are also connected with said five sleeve relays in the order before named and the connection is repeated for each successive group of said sleeve binding posts or terminals. With this arrangement, it will be seen that when the subscriber upon the line L for example closes the limbs of his line together in the usual way by taking up his receiver, a path for current from the battery B will be provided over the common conductor h , through the sleeve relay r and thence to the sleeve binding post 1, and over the sleeve line conductor d to the sub-station, returning over the tip conductor c , the tip binding post 1, through the tip relay R and thence by common conductor a to ground and the other pole of said source of current. The relays r and R will therefore respond to current over this path and will suitably close the circuit of the line signal as hereinafter explained. Likewise the closing together of the line conductors connected with any other of the pairs of terminals or posts will serve to actuate the corresponding combination of tip and sleeve relays.

The signals corresponding to the lines and controlled by said relays are shown at the right hand side of the page and are indicated by the characters S , S^2 , S^3 , etc., up to S^{25} . The first five of these lamps have a common terminal controlled by the first tip relay R and individual terminals separately controlled by the said sleeve relays. The second group of five are similarly controlled by the second tip relay R^2 and the said sleeve relays, and the same arrangement follows for the remaining groups and in connection with the other tip relays. With this arrangement, assuming the relays r and R to have been operated by the subscriber located upon line L it will be seen that the first lamp S of the series has its local circuit controlled through contacts of said relays and is then lighted from the battery B . Similarly any other

lamp may be lighted by the proper combination of tip and sleeve relays. It will therefore be seen that ten relays suffice for the 25 lines, whereas under the ordinary arrangement at least a single relay is required for each line. It may not be expedient to carry out this proportion or exact arrangement for any number of lines but the principle may be applied in many relations and systems to abridge or reduce the number of relays employed.

It will be obvious that the terminals 1, 2, 3, etc., may be connected in any desired way with the subscribers' lines, as by cut-out jack contacts or other styles of cut-off relays and may be used with various forms of operators' connective outfits. I have indicated generally one means by which the operation of establishing connections between the subscribers' lines may be carried out in a satisfactory manner. In this apparatus the jacks J , J^2 , etc., are shown connected with the forward contacts of the cut-off relay so as to be placed in connection with the external line circuit for conversation, at the time that the line signals and relays are disconnected from said external circuit. The cord circuit comprises the connective plugs P and P^2 , having their tip contacts joined by suitable strands t and t^2 and the interposed condenser c^2 , while the sleeve contacts are similarly connected together by strands s and s^2 and the condenser c^3 . The battery B^2 is connected across the answering end of the cord circuit and controls the supervisory relays r^6 and r^7 , the latter serving to close a local circuit of supervisory lamp s^3 , and the former to open the same when actuated. A battery B^3 is likewise connected across the calling end of the cord circuit and energizes supervisory relays r^8 and r^9 which control the local circuit of the supervisory signal s^4 . The operator's head telephone is adapted to be connected across the circuit by springs 30 of any suitable listening key, while a calling generator 31 is adapted to be connected with the cord circuit by the ringing springs 32. The battery B may be the same as the battery B^2 or B^3 .

The manner of using this apparatus is well understood. The insertion of the plug P in response to the signal S serves to actuate the cut-off relay b from the battery B^2 and thereby renders the line signal inoperative and places the line in condition for operation. Upon connecting her telephone set with the cord circuit and learning the order desired, the operator then tests the line wanted in the usual manner and upon finding the line idle inserts the plug and rings the wanted subscriber. The supervisory lamps s^3 and s^4 serve to apprise the operator at all times of the condition of the connected lines, being lighted when the receivers are upon their hooks and extinguished at other times.

In the operation of this system it is necessary that the operator be prompt in answering calls for the reason that if certain subscribers having each conductor of their lines associated with different relays, such as subscribers 1 and 7 for example, place their calls simultaneously, a plurality of signals, in excess of the lines, will be displayed upon the switchboard. It will be noted that this only occurs when four relays are simultaneously actuated, that is where each limb of the two simultaneously calling lines run to different relays. It cannot occur when only three relays are actuated, as would be the case for instance, if subscriber 1 and 16 should call in simultaneously. In small exchanges where simultaneous calls are infrequent, this feature is an advantage, because, as previously stated, the operator by being attentive to her board can prevent duplication, except when the calls are exactly simultaneous. In case of duplication, which may sometimes occur, it is only necessary for the operator to insert her plug in the jacks indicated by the signals to ascertain at once what subscribers are calling. If the supervisory lamp lights, the operator will know that that line is not calling, because the subscriber's telephone is upon its hook. If the line lamp is extinguished and the supervisory lamp does not light the operator will know that the calling line has been plugged into. If the proper line is first plugged into the other signals will be at once extinguished. A further advantage of this feature in small exchanges, where the operator is personally acquainted with the subscribers, is that the operator cannot show partiality in answering signals, but must reply to them in the order in which they appear upon the switchboard. For instance, if a signal appears, and immediately thereafter three more signals appear, the operator knows that the first signal appearing is a calling line, and upon plugging into that line jack the two signals of the last three that are not calling lines will be extinguished, so that by answering calls promptly in the order in which they appear, without showing partiality, she is enabled to tell at once the calling lines, without trying the last three. Such duplication would occur so infrequently in small exchanges that the improvement in service in prompt attention to calls, would more than counterbalance the annoyance to the operator, who in such exchanges is seldom rushed.

In large multiple switchboard exchanges where simultaneous calls would occur more frequently than in small exchanges, this increased probability is satisfactorily provided for by connecting all the signals at one operator's position, with one relay, such as R , and those at the next operator's position with another relay such as R^2 , thus having as many operators' positions as there are relays on one side of the combination. It is apparent that

by this arrangement, in case of four signals lighting when two subscribers call in simultaneously, instead of the four signals appearing before the same operator only two will appear at one position, and two at another position. As soon as an operator at one position answers the calling line the two signals at the other position will be extinguished. It will be seen therefore that in large exchanges, while the liability to duplication is in all probability not doubled over what it would be in a small exchange, the difficulty of eliminating a plurality of signals is reduced considerably more than one half by dividing the plurality of signals between different operators. As in small exchanges the operation of the supervisory lamp would notify the operator that the line was not calling, and the insertion of the plug in the jack of the calling line would extinguish the plurality of signals.

It will be understood that in practice a telephone line is connected with each of the sets of binding posts, 1, 2, 3, etc., and that I have shown only one such line to avoid confusion in the drawing.

Although I have shown lamps for the line signals it will be understood that any other form of signal may be employed. The fact that the invention is shown as used for a certain type of line, is not intended to so limit its application.

I claim:

1. In a telephone system, the combination with a plurality of telephone lines, of an individual signal for each line, and line relays to control said signals, said relays being less in number than the telephone lines, substantially as described.

2. In a telephone system, the combination with a plurality of telephone lines, electromagnetic signaling devices less in number than the telephone lines, and individual signals for the lines controlled by said devices, substantially as described.

3. In a telephone system, the combination with a plurality of telephone lines, of a line relay common to said lines and a line relay individual to each of said lines, and line signaling devices one for each line each controlled by said common and one of the individual relays, substantially as described.

4. In a telephone system, the combination with a plurality of telephone lines, of a plurality of line relays therefor but less in number than the said lines, and a line signaling device for each of said lines controlled by said relays, substantially as described.

5. In a telephone system, the combination with a plurality of telephone lines, of a plurality of line relays for each line, the total number of said relays being less in number than the telephone lines, signaling devices one for each line, and means for suitably controlling said signals by said relays, substantially as described.

6. In a telephone system, the combination with a plurality of telephone lines, of a signal for each line, a plurality of relays less in number than the telephone lines, and means to operate said relays in combinations and from over the telephone lines to operate the corresponding line signals, substantially as described.

7. In a telephone system, the combination with a plurality of telephone lines, of a plurality of line relays each connected with a plurality of said lines, a line signal for each line, and means controlled from the telephone line for operating said relays in pairs to suitably actuate said signals, substantially as described.

8. In a telephone system, the combination with a telephone line, of a plurality of line relays therefor, a line signal controlled by the joint action of said relays, said relays being also used for the operation of other signaling apparatus for other lines, substantially as described.

9. In a telephone system, the combination with a plurality of telephone lines, of a plurality of line relays, one connected with each side of each line, said relays being less in number than the telephone lines, and signals one for each line controlled by said relays, substantially as described.

10. In a telephone system, the combination with a plurality of telephone lines, of a plurality of line relays therefor, one for each side of the circuit of the telephone lines, said relays being less in number than the telephone lines, and signals one for each line suitably controlled by said relays, substantially as described.

11. In a telephone system, the combination with a telephone line, of two relays, one adapted to be actuated by current in one limb of the line and the other by current in the other limb, signaling apparatus controlled by the joint action of said relays, other signaling apparatus affected by said relays said relays also being associated with other telephone lines, substantially as described.

12. In a telephone system, the combination with a plurality of telephone lines, of a relay associated with each limb of each line, each relay being associated with one limb of a plurality of lines, a signal for each line, each signal being controlled by two of said relays, and each relay being a factor in the control of a plurality of said signals, substantially as described.

13. In a telephone system, the combination with a plurality of telephone lines, of a relay normally connected with one limb of said plurality of lines, other relays and the limbs of other telephone lines being normally connected with the limbs of said first telephone lines, substantially as described.

14. In a telephone system, the combination

tion with a plurality of telephone lines, of a line signal for each of said lines, a relay with its armature connected to one side of a plurality of said signals, and its coil connected to one limb of a plurality of said lines, a source of actuating current to one pole of which said signals are adapted to be connected by the actuation of said relay, other relays, the other side of said signals being connected to the armature of said other relays, said relays by their actuation being adapted to connect the second side of said signals with the other pole of said source, said latter relays having their coils connected to the second side of said plurality of lines, whereby the current in any line will actuate a relay of each group to connect the opposite terminals of the signal corresponding to said line with the opposite poles of said source, substantially as described.

15. In a telephone system, the combination with a plurality of telephone lines, of a cut-off relay for each of said lines, a cord circuit adapted to be connected to said lines for conversation, a source of energy line relays normally connected between said source and each limb of said plurality of lines, line signals for said lines adapted to be displayed by the simultaneous actuation of the relays associated with each limb of each of said lines, and contacts of said cut-off relay adapted to disconnect the line from said line relays dur-

ing the connection of said cord circuit therewith, substantially as described.

16. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith for conversation, line relays normally associated one with each limb of said telephone line, other telephone lines having limbs associated with said line relays a signal adapted to be displayed by the simultaneous actuation of said line relays, and means for disconnecting said line relays from the telephone line during connection of the cord circuit therewith without disconnecting them from the other telephone lines, substantially as described.

17. In a telephone system, the combination with a telephone line, of two relays, one adapted to be actuated by current in one limb of the line and the other by current in the other limb, a plurality of auxiliary circuits, one of which is completely controlled by said relays, and the others of which are partially controlled by said relays, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 10th day of December 1902.

HARRY G. WEBSTER.

Witnesses:

GAZELLE BEDER,
ROBERT LEWIS AMES.