M. BAUMER.

TELEPHONE SYSTEM.

APPLICATION FILED NOV. 24, 1908.

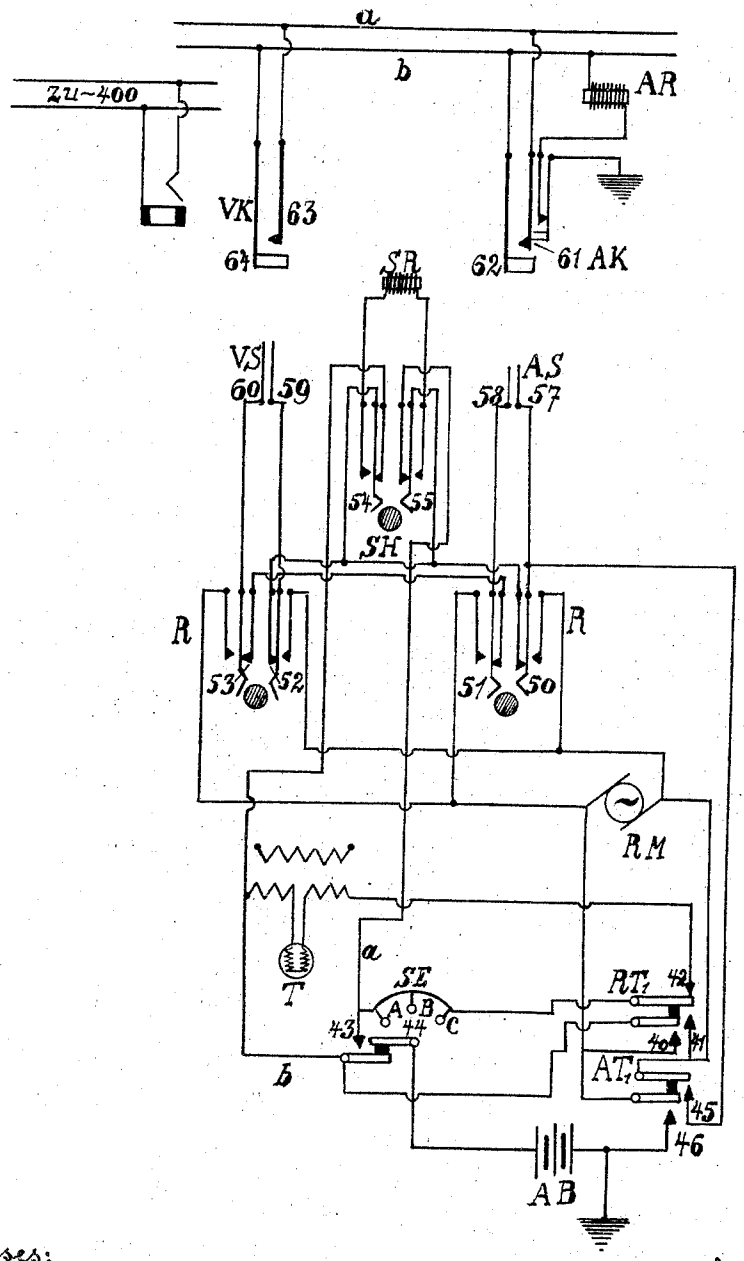
928,171.

Patented July 13, 1909.

3 SHEETS—SHEET 1.

Exchange

Fig. 1.



Witnesses:

Kenneth Romanes

E. Beckers-Scheinert

Inventor:

Moriz Baumer

by Hans E. Schiessing

his Attorneys.

M. BAUMER.

TELEPHONE SYSTEM.

APPLICATION FILED NOV. 24, 1908.

928,171. Patented July 13, 1909.

3 SHEETS—SHEET 2.

Fig. 3.

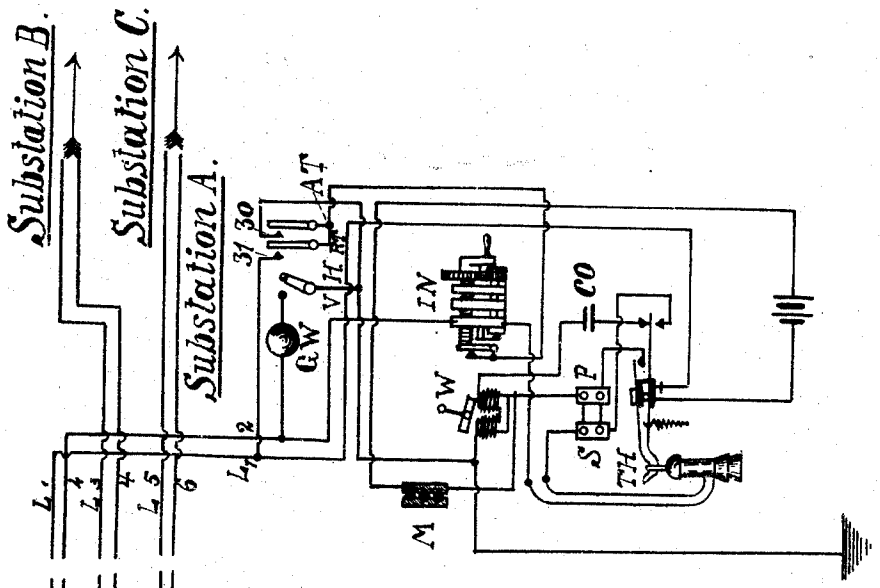


Fig. 2. Z U.

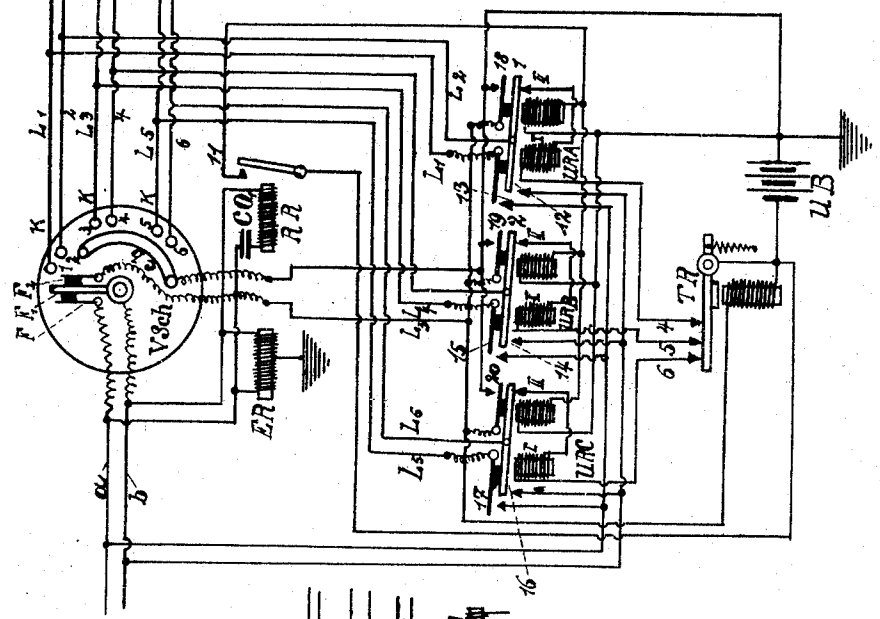
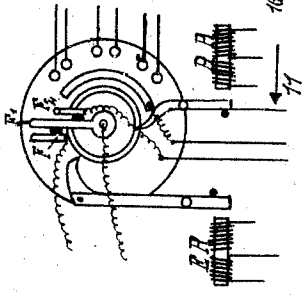


Fig. 6



Witnesses:
Kenneth Romanis
E. Backers-Scheiner.

Inventor:
Moritz Baumer
by Paul E. Schilling
his Attorney.

M. BAUMER.

TELEPHONE SYSTEM.

APPLICATION FILED NOV. 24, 1908.

928,171. Patented July 13, 1909.

3 SHEETS—SHEET 3.

Subscribers' Apparatuses.

No 2000.

Fig. 4.

Substation B.

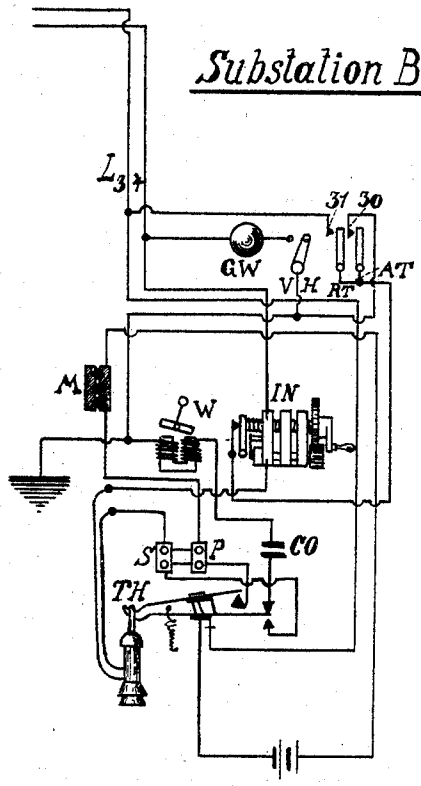
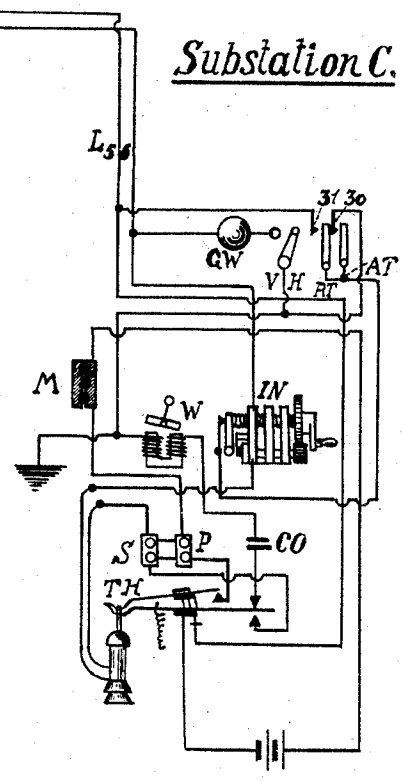


Fig. 5.

Substation C.



Witnesses:
Kenneth Romanes
E. Beckers-Schreiner

Inventor:
Moriz Baumer
by Paul E. Schilling
his Attorney

UNITED STATES PATENT OFFICE.

MORIZ BAUMER, OF NUREMBERG, GERMANY.

TELEPHONE SYSTEM.

No. 928,171. Specification of Letters Patent. Patented July 13, 1909.

Application filed November 24, 1908. Serial No. 464,329.

To all whom it may concern:

Be it known that I, MORIZ BAUMER, a subject of the King of Bavaria, residing at Nuremberg, German Empire, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to switching apparatus for an automatic branch exchange switching system, in which there is no relay carrying a permanent current connecting the substations with the main line, but in which, for the purpose of starting the automatic intermediate switching station from a substation, tip relays, each having two coils, are employed. The one coil, for the purpose of bringing the armature into the working position, is connected on the one hand over the armature to the corresponding branch line of the substation calling up for the time being, and on the other hand over back-contacts and the armature of a separating relay, used for all the tip-relays in common and grounded over a battery. The second coil of each tip-relay, for the purpose of returning its armature to the position of rest, is connected to the working contact of a step-back relay, excited by the clearing current, whose armature is connected to the non-grounded pole of the battery at the automatic intermediate switching station.

In the accompanying drawing, Figure 1 is a diagram of the existing exchange connections, Fig. 2 is the automatic intermediate switching apparatus, and Figs. 3, 4 and 5 are diagrams showing already existing subscribers' apparatuses. Fig. 6 is a detail view illustrating the relay-actuated pawl and ratchet mechanism for the springs of the intermediate switch.

At the exchange (Fig. 1), SE is a transmitter with call key AT_1 and step-back key RT_1. At the subscribers' apparatuses, (Figs. 3, 4 and 5), CO are condensers, GW record alarms, AT call keys and RT step-back keys.

The operation is as follows:—

1. Assume that from a telephone call 400, not shown in the drawing and lying outside the group, it is desired to communicate with the substation 2000 C. The subscriber 400 calls up the exchange in the ordinary manner, whereupon the call-indicator at the latter drops. The official inserts the inquiry plug AS (Fig. 1) into the inquiry jack, puts the speaking switch SH into the listening position and makes the inquiry. The subscriber 400 requests connection with the substation 2000 C connected in the common line *a b*, whereupon the official inserts the connecting plug VS into the jack VK, by which means the connection with the common line *a b* and automatic intermediate switch ZU (Fig. 2) is made. In order to get the connection with the substation 2000 C, the official now sets the transmitter SE (Fig. 1) to the group position C, but leaves the speaking switch SH in the listening position. A contact 43 is thus closed and the line *a* connected with the line *b*. The transmitter SE (which may for instance be spring actuated) returns automatically from the position C to the position of rest and closes three contacts in succession 44 C, B, A. At each of these contacts there results the following circuit: earth, battery AB, transmitter SE, contact 44 C (or B or A), line *a*, and simultaneously contact 43, line *b*, over contacts 54, 55 of the speaking switch SH, contacts R 52, 53, connecting plugs VS 59, 60 and multiple jacks VK 63, 64, through the common line *a b*, the two coils of the adjustment relay ER, intermediate switch ZU (Fig. 2), and earth, back to the exchange battery AB. Owing to the three rushes of current the three springs F, F_1, F_2 at the intermediate switch are advanced three steps, by actuation of the pawl-armature of the relay ER (Fig. 6). The springs F and F_1 now rest on the contact studs K_5, K_6 of the distributing disk VS*ch* and the lines *a b* are connected with the lines L_5, L_6 leading to the substation C. The spring F_2 rests at this moment on a segment *c b* of the distributing disk VS*ch* and the following circuit is closed: switching battery UB, coil of separating relay TR, spring F_2, segment *c b*, switching battery UB. The armature in the separating relay TR is thus attracted, three contacts 4, 5, 6 are broken and the three relays URA, URB, URC are cut off from the battery UB. The substation C now lies in the line *a b* over the two springs F, F_1, contacts K_5, K_6 and lines L_5, L_6. The official in order to call up the substation C now depresses the call key AT_1 (Fig. 1) at the transmitter SE and then turns the speaking switch SH back again. In this manner the following circuit is closed: alternator RM, call key AT_1, contact 45, call key contacts R 50, 52, connecting plug VS 59, jack VK 63, common line *a*, spring F (Fig. 2), contact button K_5, subscriber line L_5, re-

ceiver hook TH (Fig. 5), condenser CO, alternate current alarm coil W, earth, back to the exchange (Fig. 1), contact 46, call key AT_1, and alternator RM. The alarm W (Fig. 5) at the substation 2000 C rings. The subscriber unhooks his receiver and conversation can commence. On the call being given a branch circuit current flows to earth through the line *a* and the one coil of the adjusting relay, but remains ineffective, since the relay ER does not respond through the half coil. When the conversation is ended, the subscriber 2000 C hangs up his receiver and depresses the step-back key RT (Fig. 5), simultaneously turning the crank of the magneto IN, whereupon the following circuit is completed: subscriber's magneto IN (Fig. 5), subscriber's line L_6, contact stud K_6 (Fig. 2), spring F_1, common line *b*, jack VK 64 (Fig. 1), connecting plug VS 60, call key R 53, operating switch SH 54, clearing relay SR, speaking switch SH 55, call key R 52, connecting plug VS 59, connecting jack VK 63, line *a*, spring F (Fig. 2), contact stud K_5, subscriber line L_5, contact 31 of the step-back key RT (Fig. 5), magneto IN. The ring off indicator at the exchange drops, and the following branch circuit is also closed: intermediate switch ZU (Fig. 2), line *b*, step-back relay RR, condenser CO_1, line *a*. The pawl-armature in the step-back relay RR (Fig. 6) is attracted, whereby the springs F, F_1, F_2 and also the armature of the separating relay TR, return into the position of rest. The contacts 4, 5, 6 are again made and the relays URA, URB, URC are again connected with the earth through the intermediate switch battery UB. By attraction of the step-back armature RR a contact 11 is closed and a current flows from the positive pole of the battery UB, contact 11, all the parallel-connected coils II of the relays URA, URB, URC, back to the minus pole of the battery UB. The armatures of the relays UR are attracted, but as they have not hitherto operated they are already in their position of rest. The official now pulls the plugs VS and AS out of the jacks, whereupon the position of rest is again assumed.

2. Suppose, on the other hand, the subscriber at 2000 C wishes to call up the subscriber at 400, lying outside this group and not shown in the drawing. Assume that the common line *a b* is unoccupied. The subscriber 2000 C turns the record switch VH (Fig. 5) to the left, connecting the alarm GW with the substation wire L_6, whereby the following circuit is made: battery UB (Fig. 2), armature of the separating relay TR, contact 6, coil I of the relay URC, contact 3 of the armature thereof, substation line L_6, alarm GW (Fig. 5), record switch VH, earth, back to battery UB (Fig. 2). The alarm GW rings to show that the line *a b* to the exchange is unoccupied. In the relay URC no effect is produced, owing to the high resistance of the coil I and to the alarm being cut in. The subscriber now turns the record switch VH (Fig. 5) to the right again, depresses the call key AT and turns the crank of the magneto IN, so that the following circiut is closed: magneto IN (Fig. 5), line L_6, armature of the relay URC (Fig. 2), contact 3, coil I, contact 6, armature of separating relay TR, through battery UB to earth, earth (Fig. 5), contact 30, call key AT and magneto IN. The armature of the relay URC (Fig. 2) will now, despite its high resistance, owing to alarm OW being cut out, on the first rush of current be tipped to the left, whereby two contacts 16, 17 will be made and the contact 3 broken, so that the current flows from the magneto IN (Fig. 5) through the line L_6, armature of the relay URC (Fig. 2), contact 16, common line *b* to the call indicator AR (Fig. 1). In this manner the subscriber 2000 C has connected himself with the common line *b* and the call has been given at the exchange. The interruption at the contact 3 of the current flowing through the coil I is of no consequence, since the double armature always remains in the position given it for the time being. Owing to tipping of the double armature of the relay URC (Fig. 2) a contact 20 will also be made, so that the following curcuit is closed: battery UB, coil of the separating relay TR, contact 20, battery UB. The armature of the separating relay TR is attracted and the contacts 4, 5, 6 are broken, and also the extension of the lines L_2 L_4 used for adjusting the substations A and B over the coils I of their relays URA, URB. It is thus rendered impossible for these subscribers to connect themselves again with the common line *a b*, or to disturb the existing connection. After the call indicator at the exchange has dropped, the official inserts the inquiry plug AS (Fig. 1) into the jack AK, turns the speaking switch SH and inquires. The subscriber has meanwhile taken off his receiver from the hook and has requested connection with No. 400. The official gives the connection with No. 400 in the usual manner and the conversation can commence from the subscriber 400, main line *a*, intermediate switch ZU, contact 17, substation line L, substation 2000 C, receiver hook TH, induction coil S, receiver, magneto IN, common line *b*, over the exchange to apparatus of subscriber 400. On conclusion of the conversation the subscribers hang their receivers on the hooks again and ring off. The return of the intermediate switch ZU to the position of rest and the clearing signal at the exchange can be given by the ringing off either of the subscriber 400 or subscriber 2000 C. The subscriber 2000 C for this purpose depresses the step-back

key RT (Fig. 5), turns the crank of the magneto IN and thus completes the following circuit: magneto IN, line L_6, armature of the relay URC (Fig. 2), contact 16, common line *b*, jack AK (Fig. 1), inquiry plug AS 58, call key R 51, speaking switch SH 54, coil of ring off indicator SR, speaking switch SH 55, call key R 50, inquiry plug AS 57, jack AK 61, common line *a*, contact 17 (Fig. 2), insulated spring of the armature of the relay URC, substation line L_5, contact 31 (Fig. 5), step-back key RT, magneto IN; in this manner the clearing out indicator at the exchange is caused to drop. A substation current flows through the common line *a* to the condenser CO_1 (Fig. 2), coil of the step-back relay RR and line *b*. In this way the armature of the step-back relay is attracted and the contact 11 closed, whereby the following circuit is completed: battery UB, armature of step-back relay RR, contact 11, coils II of all the relays URA, URB, URC and back to battery UB. The armatures of these relays are attracted toward the right; at the armatures URA, URB no effect is produced, since they lie in the right hand position already. On the other hand, the armature of the relay URC, which was attracted to the left, will now be tipped over to the right. The contacts 16, 17 are broken and the common line *a b* is separated from the substation line L_5, L_6. Furthermore, the contact 20 is broken and the separating relay TR thus rendered currentless, whereby its armature returns to the position of rest and the contacts 4, 5, 6 are again made. The contact 3 will likewise be made again by tipping of the armature of the relay URC, so that the substation lines L_2, L_4, L_6 with the coils I of their relays URA, URB, URC are again earthed by the battery UB. The subscribers of the substations A B C can thus connect themselves with the common line *a b* again. Had the subscriber 400 first rung off, he would as hitherto usual, have sent an alternating current into the line, whereby the ring-off indicator at the exchange would drop. From this alternating current, which would also have passed through the common line *a b*, a substation current would have flowed from the line *a* to the condenser CO_1 and the coil of the step-back relay RR to the line *b*, which would have produced the same effects as the magneto current which the subscriber 2000 C has sent through the line as above described.

3. Assume now that the subscriber at the substation 2000 A wishes to speak with the subscriber 2000 C, the common line *a b* however being occupied. The subscriber 2000 A turns the record switch VH (Fig. 3) to the left and the alarm GW does not ring: the line is therefore occupied. The circuit which is intended to ring the alarm GW has not been completed owing to the separating relay TR having attracted its armature. The subscriber 2000 A turns the record switch VH to the left and waits. After the foreign conversation has been concluded the armature of the separating relay TR (Fig. 2) drops into the position of rest again. The circuit of the alarm GW is closed and the latter rings. The subscriber 2000 A is thus informed that the line is unoccupied, he now turns the record switch VH (Fig. 3) back again and thus breaks at VH the following circuit: battery UB (Fig. 2), armature of separating relay TR, contact 4, coil I of the relay URA, contact 1, armature of the relay URA, substation line L_2, alarm GW (Fig. 3), record switch VH, earth, earth (Fig. 2), back to battery UB, whereby the alarm ceases to ring. The subscriber at 2000 A now depresses the call key AT (Fig. 3) and turns the crank of the magneto IN, this magneto current flows as follows: magneto IN, line L_2, armature of relay URA (Fig. 2), contact 1, coil I of the same relay, contact 4, armature of separating relay TR, through battery UB to earth, earth (Fig. 3), contact 30, call key AT, back to magneto IN. The armature of the relay URA (Fig. 2) is tipped to the left, contact 1 is broken and contact 12 closed. The current now flows from the magneto IN (Fig. 3), line L_2, armature of relay URA over contact 12, common line *b*, coil of call indicator AR (Fig. 1) to earth, earth (Fig. 3), contact 30, call key AT, back to magneto IN. In this manner the call indicator drops at the exchange. By tipping of the armature of the relay URA (Fig. 2), besides the contact 12 there are two other contacts 13, 18 closed. By contact 13 the substation line L_1 is connected to the common line *a*, so that the substation 2000 A is connected through the lines L_1, L_2, armature and spring of relay URA and contacts 12, 13, with the common line *a b*.

By closing the contact 18 the following circuit is made: battery UB, coil of separating relay TR, contact 18, battery UB. The armature of the separating relay is attracted, the contacts 4, 5, 6 broken and thus the substation line branch L_4, L_6 separated from earth, as already above described in detail. When the call indicator AR at the exchange has dropped, the official inserts the inquiry plug AS (Fig. 1) into the jack AK, turns the speaking switch SH and makes the inquiry. The subscriber 2000 A has meanwhile removed his receiver and asks for call 2000 C. The official now leaves the speaking switch SH in the listening position, and sets the transmitter SE to C, contact 43 is closed and the line *a* thus connected with line *b*. The transmitter SE, being spring actuated, returns automatically from the position C to its position of rest: it thus closes three contacts in succession, viz. 44 C, B, A; at each

of which the following current flows: exchange battery AB (Fig. 1), transmitter SE, contact 44 C (or B, or A), line *a*, contact 43, line *b*, that is to say, simultaneously through both lines *a* and *b*, over the contacts 54, 55 of the speaking switch SH, inquiry plug AS 57, 58 and inquiry jack AK 61, 62 and through the common line *a b* to the two coils of the adjusting relay ER (Fig. 2), to earth, earth (Fig. 1), battery AB. By means of these three rushes of current the springs F, F_1, F_2 (Figs. 2 and 6) are advanced three steps, the springs F, F_1 now resting on the contact studs K_5, K_6 with which the substation lines L_5, L_6 are connected. The spring F_2, which rests on the segment *c b*, could not close the circuit: battery UB, coil of separating relay TR, spring F_2, segment *c b*, battery UB, because it has already been closed on connection being made with substation 2000 A. The substation C is thus connected with the common line *a b* by the substation lines L_5, L_6, contact studs K_5, K_6 and springs F F_1, that is, over the distributing disk VS*ch*, while the substation A is connected with the common line *a b* over the relay URA. The official now depresses the call key AT_1 (Fig. 1) and thus calls up the substation 2000 C. The circuit completed is as follows: alternator RM (Fig. 1), call key AT_1, contact 45, inquiry plug AS 57, inquiry jack AK 61, common line *a*, spring F (Fig. 2), contact stud K_5, substation line L_5, receiver hook TH (Fig. 5), condenser CO, alternating current alarm W, earth, earth (Fig. 1), contact 46, call key AT_1, alternator RM. The alarm W of the substation 2000 C rings, the subscriber goes to the apparatus, unhooks the receiver and the conversation can commence. When the conversation is concluded the subscribers 2000 A and 2000 C hang up their receivers again on the hooks and ring off. Assume that the subscriber 2000 A is the first: He depresses his step-back key RT (Fig. 3), turning the crank of his magneto IN simultaneously. In this manner the following circuit is closed: magneto IN (Fig. 3), substation line L_2, armature of the relay URA (Fig. 2), contact 12, common line *b*, inquiry jack AK 62 (Fig. 1), inquiry plug AS 58, call key R 51, speaking switch SH 54, (which has meanwhile been reversed) coil of the ring off indicator SR, speaking switch SH 55, call key 50, inquiry plug AS 57, jack AK 61, common line *a*, contact 13 (Fig. 2), insulated spring of the armature of the relay URA, substation line L_1, contact 31 (Fig. 3), step-back key RT, magneto IN. The ring off indicator SR thus drops. The following branch circuit is also closed: common line *a*, condenser CO_1 (Fig. 2), coil of the step-back relay RR, common line *b*. The armature at the step-back relay RR is attracted, the springs F, F_1, F_2 (Figs. 2 and 6) return in consequence to their position of rest and the contact 11 is closed, whereby the following circuit is completed: battery UB, armature of the step-back relay RR, contact 11, all the coils II of the relay URA, URB, URC, battery UB. The armatures of the relays URA, URB, URC are drawn to the right; at URB, URC there will be no result, since the armatures of these relays are already in the right hand position; the armature of the relay URA, on the other hand, which has been lying toward the left, is now tipped toward the right, the contacts 12, 13 are interrupted and thus the substation lines L_1, L_2 of the common lines *a b* separated; the contact 18 will likewise be broken, so that no current will pass through the separating relay TR. The armature of the latter will return to its normal position and the substation lines L_2, L_4 L_6 will, with the coils I of their relays be again connected to earth. Had it been the subscriber 2000 C who first rang off, the return to the step-back position would have been effected in the same manner, except that in this case the magneto current instead of flowing through the contacts 12, 13 of the relay URA would have passed over the contacts K_5, K_6 and springs F, F_1 of the switch ZU, to the common line *a b*. If, whether accidentally or with intention, the step-back position has not been brought about by either subscriber, the ring off indicator at the exchange does not drop. The official will then inquire after some time, and if no reply is received she must bring about the step-back position herself, before drawing out the plug. Similarly the official can interrupt the conversation if a long-distance line is required for a subscriber of the common line *a b*.

For the purpose of effecting the step-back position, or the interruption, the official must leave the speaking switch SH turned to listening and depress the step-back key RT_1 (Fig. 1) at the transmitter. In this manner the following circuit is completed: alternator RM, contact 41, upper spring of the step-back key RT_1, transmitter SE, line *a*, speaking switch SH 55, call key R 50, inquiry plug AS 57, jack AK 61, common line *a*, condenser CO_1 (Fig. 2), coil of the step-back relay RR, common line *b*, jack AK 62 (Fig. 1), inquiry plug AS 58, call key R 51, speaking switch SH 54, line *b*, lower spring of the step-back key RT_1, contact 40, alternator RM. In this manner the armature of the step-back relay RR (Fig. 2) is attracted and the step-back position produced in the same way as already above described. On depression of the step-back key RT_1 (Fig. 1), the contact 42 and thus the line to the receiver T of the official will now be broken, so that there is no rush of current to the receiver.

Having thus described my invention, I declare that what I claim is—

1. In a telephone switch apparatus for an automatic branch exchange switch system, a rotary switch instrument and an adjusting relay operating with current impulses from the exchange for the purpose of connecting the subscribers' apparatuses; tip-relays, one corresponding to each subscriber's apparatus and having two coils, the one end of the first coil, to enable the subscriber to bring the armature of said relay into the working position, being connected with the tip-relay armature, said armature being connected with the subscriber's line; a separating-relay whose armature is furnished with back-contacts, one corresponding to each subscriber-station and connected with the other end of said coil; an earthed battery in circuit with last-named relay and its armature; a clearing out circuit; and a step-back relay operated by the clearing-current, whose armature is furnished with a working-contact, which to enable the subscriber to return the tip-relay to its position of rest, is connected with the one end of the second said tip-relay coil, whose other end is grounded, while the armature of said step-back relay is connected with the non-grounded pole of said battery, substantially as described.

2. In a telephone switch apparatus for an automatic branch exchange switch system, a rotary switch instrument and an adjusting relay operating with current impulses from the exchange for the purpose of connecting the subscribers' apparatuses; tip-relays, one corresponding to each subscriber's apparatus and having two coils, the one end of the first coil, to enable the subscriber to bring the armature of said relay into the working position, being connected with the tip-relay armature, said armature being connected with the subscriber's line; a separating-relay whose armature is furnished with back-contacts, one corresponding to each subscriber-station and connected with the other end of said coil; an earthed battery in circuit with last-named relay and its armature; a clearing out circuit; and a step-back relay operated by the clearing current, whose armature is furnished with a working-contact, which to enable the subscriber to return the tip-relay to its position of rest, is connected with the one end of the second said tip-relay coil, whose other end is grounded, while the armature of said step-back relay is connected with the non-grounded pole of said battery; a contact-piece carried by, but insulated from, each tip-relay armature and connected to the earthed-battery through the separating-relay coil; and a back-contact for each tip-relay armature, connected with the ground side of said battery; and means for grounding the line at the subscribers' stations; whereby on the exchange being called up by a subscriber the corresponding tip-relay armature is brought into its working position and its insulated contact-piece caused to make connection with said back-contact, and, by thus completing the circuit through said separating-relay, break connection between the separating-relay armature and its back-contacts and thus disconnect the lines of the other subscribers and the first said coils of the tip-relays corresponding to these lines from said battery, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

MORIZ BAUMER.

Witnesses:
OTTO HAEFNER,
PAUL DOLLHOPE.