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TELEPHONE SYSTEM

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Fig. 1

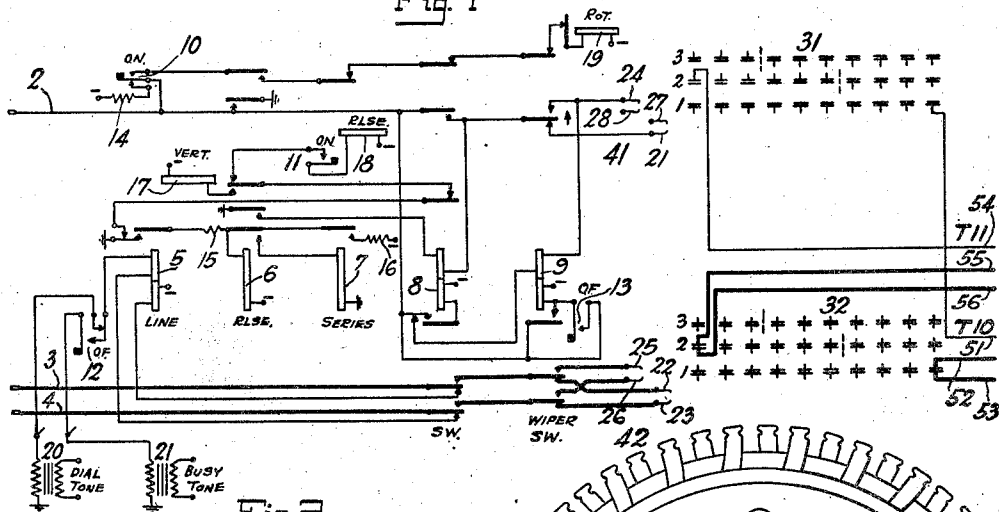


Fig. 2

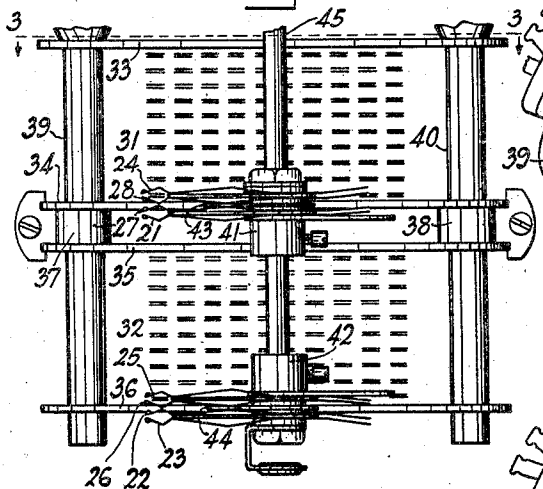


Fig. 3

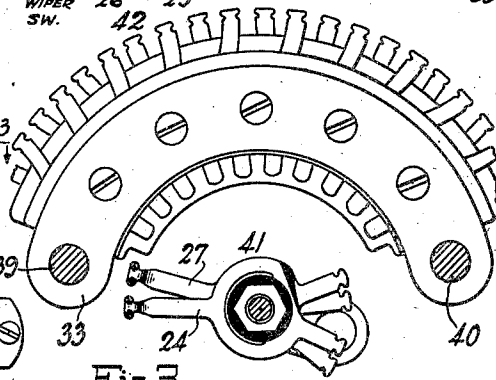


Fig. 4

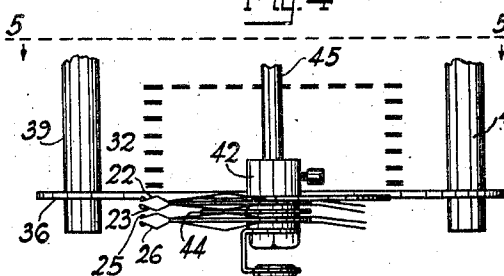
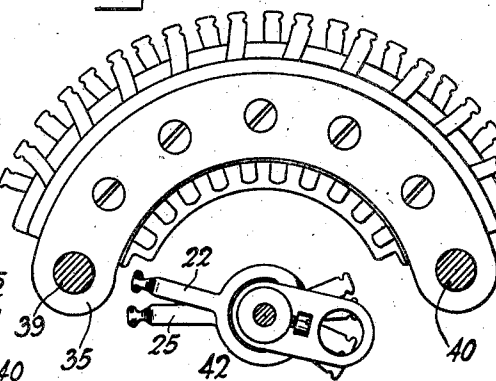


Fig. 5



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TELEPHONE SYSTEM

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14 Claims. (Cl. 179-18)

The present invention relates to telephone systems in general, but is concerned more particularly with automatic telephone systems employing the well known Strowger vertical and rotary switching mechanism; and the main object is the production of new and improved circuit arrangements for enabling the sets of contacts in the bank of a selector to be variously apportioned amongst the trunk groups accessible to such selector.

General description

As is well known, the ordinary Strowger switch has one hundred sets of bank contacts arranged in ten horizontal rows or levels. When this switch is used as a trunk selector, each level of contacts is ordinarily indexed by a different digit and has a separate group of trunks connected thereto. The selector switches are ordinarily mounted side by side in groups or "shelves", with a permanent multiple between the contact banks of all the switches in a shelf, and with arrangements for multiplying the banks of a number of shelves together and for connecting the bank multiple with outgoing trunks; as is explained in the McElyea Patent No. 1,633,118, granted June 21, 1927. The number of shelves multiplied together as regards a given level depends upon the relative amount of traffic carried by the level in question.

In multi-office telephone systems, the various groups of trunks accessible to an office selector often vary greatly in size amongst themselves. Although, by using suitable grading, a trunk group can be formed which is in effect a unitary group, but contains many more trunks than there are contact sets allotted to the group in the bank of any one selector, it is desirable, nevertheless, from the standpoint of securing the greatest possible efficiency in each individual installation, to be able to increase and decrease the number of contact sets allotted to a contact group to an extent dictated by the relative size and cost-per-trunk of the trunk groups concerned, so that more than ten contact sets of a selector may be allotted to a given trunk group when desired and without reducing the number of separate trunk groups. To this end, the circuit arrangement has been modified in order to enable the size of a contact group in the bank of the selector to be expanded or contracted at will by including any desired portion of the contacts in an adjacent level in the same trunk group with the contacts in any given level. With this novel arrangement, any level may be divided into two parts, each part being indexed by a separate

digit and belonging to a different trunk group; one part is indexed by the digit normally assigned to an adjacent level while the other is indexed by the digit normally assigned to the level in question.

In order to enable the improved selector to search over all contact sets assigned to a trunk group when such contact set lies partly in one level and partly in another level, the selector, in addition to having the regular private wiper and companion pair of line wipers is provided with an additional private wiper and companion pair of line wipers, so that two complete wiper sets are provided. The additional wiper set is preferably located on the shaft either the space of one level above the regular wiper set or the space of one level below the regular wiper set, as will be pointed out more particularly hereinafter. Then, when a trunk line group has contact sets assigned thereto in two adjacent levels, one wiper set searches in one of the two levels at the same time the other wiper set is searching in the other of the two levels, and either wiper set may find an idle trunk line reached through an idle contact set and cause the hunting operation of the selector to stop and the idle trunk line to be seized.

It will be understood, of course, that arrangements somewhat after the fashion of the arrangements ordinarily provided for switches having duplicate wiper sets are provided for the selector herein disclosed to prevent seizure of both trunk lines in case both wiper sets encounter idle trunk lines simultaneously.

A feature of the invention is that each contact set includes two test (or private) contacts, a 200-contact test bank being provided for this purpose, with the contacts arranged in pairs in the manner of the regular line-bank contacts, and that the regular test wiper of the switch always tests over one contact only of a pair while the added test wiper always tests over the other contact of the same pair; the arrangement is such that the regular test wiper tests the lower contact of each pair while the test wiper of the alternate set tests the upper test contact of each test-contact pair. With this arrangement, a contact set in any level may be assigned to the trunk group of the corresponding level by merely connecting the test conductor thereof to the lower test contact of the associated pair, and it may be assigned to the next adjacent level by merely connecting it to the upper test contact of the pair instead of to the lower.

With the arrangement above described, when

a test wiper is being rotated over a level of contacts, the lower test contacts of the level are tested in case the test wiper in question is the alternate test wiper, whereby connection with a trunk line is prevented unless the wipers are rotated into association with the contact set assigned to such trunk line responsive to the digit assigned to the trunk line group containing the trunk line in question, as will be more particularly explained hereafter.

It will be understood, of course, that selectors which have two or more wiper sets, together with suitable switching arrangements for causing the connection to be automatically extended by way of whatever wiper set finds an idle trunk, are well known. Such prior selectors, however, employ separate bank-contact sections for each wiper set, and the number of contact sets in the bank of a selector assigned to a trunk group is increased above ten only by duplicating the original bank arrangement for each added set of wipers. With the improved selector herein disclosed, the number of bank sections is not increased, but a more flexible use is made of the existing sets of bank contacts so that those trunk groups which require more than ten sets of contacts may be accommodated at the expense of other trunk groups not requiring as many contact sets.

An additional feature of the present invention is that the circuit arrangements of the selector have been improved and simplified by providing a simple and reliable control circuit for the slow-acting release and series relays, which circuit is of the so-called slugless type and which is maintained entirely separate from the circuit of the operating magnet of the selector, whereby it is applicable to selectors having operating magnets of different characteristics without necessitating a change in the resistance or other characteristics of the slow-relay, control-circuits.

Description of drawing

Referring now to the drawing, comprising a single sheet, they show a sufficient amount of apparatus in a telephone system embodying the features of the invention to enable the invention to be understood. More in particular, the drawing shows the circuit diagram of a selector constructed according to the invention, together with various views of the bank and wiper arrangement of the selector, so that the way in which the novel wiper assembly cooperates with the contact bank will be readily understood.

Fig. 1 shows the circuit diagram of the selector, together with its regular wiper set comprising wipers 21—23 and the alternate wiper set comprising wipers 24—26, and the first and second levels of the two bank sections 31 and 32.

Fig. 2 is a front view of the bank of the selector (with the contacts diagrammatically indicated), showing the wiper shaft and attached wipers, with an additional wiper set located one step above the normal wiper set.

Fig. 3 is a view taken along the line 3—3 of Fig. 2 in the direction indicated by the arrows, and it shows the normal relation of the wiper sets to the contact bank, with the alternate set of wipers off-set one step radially from the regular wiper set in order to avoid interference between the ends of the wiper arms when they enter the contact bank.

Fig. 4 is a view similar to Fig. 2 showing the lower part of the bank shown in Fig. 2, together with the bottom part of the shaft, and it discloses a modified arrangement wherein the

alternate set of wipers is placed below the regular wiper set instead of above the regular wiper set as in Fig. 2.

Fig. 5 is a view taken along the line 5—5 of Fig. 4 in the direction indicated by the arrows, and it indicates that the alternate wiper set is off-set radially the space of one rotary step.

As indicated in Fig. 1, the selector illustrated is provided with line relay 5, release relay 6, series relay 7, switching relay 8, and wiper-switching relay 9. In addition, the selector is provided with the usual vertical, rotary, and release magnets, 17, 19, and 18; and it has the off-normal spring contacts 10 and 11 as well as the over-flow contacts 12 and 13, which latter contacts are preferably operated only when the selector takes its twelfth rotary step, by which time all contacts in the path of the wipers will have been searched over. The dial-tone and busy-tone transformers 20 and 21 are provided common to the selector shown and other similar selectors for the usual and well understood purposes.

The selector, as illustrated, is of the so-called battery searching type in that it hunts for a trunk line having a battery connection on the test lead thereof.

It will be noted that, when relay 8 operates, the incoming conductors 2 to 4 of the selector are extended to wipers 21—23 in case the wiper switching relay 9 is in normal condition, and are extended to wipers 24—26 in case wiper-switching relay 9 is in operated condition. The wiper 27 is paired with the wiper 21 merely for the mechanical purpose of maintaining a tension on the wiper 21, as can be seen best in Fig. 2, while the wiper 28 is paired with the wiper 24 for a similar purpose. It is to be noted that there is no electrical connection made to either of the wipers 27 and 28 from the selector.

The dial-tone source is associated with the selector under the assumption that the selector is a first selector, to which connection is extended automatically responsive to the removal of the receiver and in the well-known manner. It will be understood, of course, that the dial-tone connection is replaced by a ground connection if the selector is used as a subsequent selector in the trunking system.

Referring now to Fig. 2, wherein the switch bank and the bottom section of the shaft, together with the attached wipers, are shown detached from the selector, it may be pointed out that the selector is mechanically of the general type illustrated in Fig. 62, page 62 of Automatic Telephony, second edition, written by Smith and Campbell, and published by the McGraw-Hill Book Company Inc., 1921. Other views of switches employing similar bank arrangements and wiper assemblies are shown in Figs. 50, 55, 56, 57, 59, 65, and 66 of the Smith and Campbell book. The two regular wiper assemblies, including wipers 21 to 23 and 27, Fig. 2, are positioned one step below the first level of the contact bank in the usual manner, while the additional set, including wipers 24 to 26 and 28, is positioned one level higher so that it normally stands opposite the first level of bank contacts, whereby it is raised opposite the second level of bank contacts when the digit 1 is dialled, and is raised one step above the tenth level of bank contacts when the digit 0 is dialled; the extra set of wipers is always brought opposite the next level higher than the level dialled and

with which connection is made by the regular set of wipers.

In Fig. 3, it may be seen that the alternate wiper set is set one step behind the regular wiper set, radially, so as to avoid the ends of the wipers being forced into engagement with one another when the wipers enter the contact bank.

The contact grouping

The grouping of the bank contact will now be explained. Referring to Fig. 1, it is assumed that the trunk group to which the digit 1 is assigned is a group of rather expensive inter-office trunks, while the trunk groups to which the digits 2 and 3, respectively, are assigned are either small trunk groups or else are relatively inexpensive groups not requiring the efficient trunk-use demanded by the first group. A total of thirty contact sets, comprising the first three levels of the selector bank (all three of the illustrated levels) have been assigned to the three trunk groups above mentioned. As indicated by the following table, all contact sets in the first level, together with the first six contact sets in the second level, have been assigned to group 1; the last four contact sets in the second level together with the first three contact sets in the third level have been assigned to group 2; and the last seven contact sets in the third level have been assigned to the third group:

Trunk groups	Contact set numbers	Number of contact sets
1.....	11 to 10, 21 to 26	16
2.....	27 to 20, 31 to 33	7
3.....	34 to 30	7
		30

In explanation of the information given in the second column of the above table, it may be pointed out that contact set number 11 refers to the first contact set in the first level, that the succeeding contact sets in the first row are designated 12, 13, 14, etc. to the ninth set, which is numbered 19, and that the tenth set is numbered 10. The numbering of the contact sets in the higher levels follows the same plan.

It will be understood, of course, that the above indicated apportionment of contact sets amongst the three trunk groups is given by way of example only and that the relative sizes of the assigned contact sets may be varied at will. It will be understood, moreover, that the size of the third contact set may be increased, if desired, by assigning contact sets of the fourth level to the same trunk group, following the plan used in connection with the first and second trunk groups.

Detailed description

The invention having been described generally, a detailed description of the operation of the apparatus shown will now be given. For this purpose it will be assumed that the selector is seized in the usual course of setting up a telephone connection.

Seizure of the selector

When the selector is seized (by way of conductors 2, 3, and 4), which seizure is made by way of a lineswitch, for example, because there is no ground potential on conductor 2, and conductor 2 is supplied with "battery" potential (negative potential) by way of resistance ele-

ment 14, line relay 5 operates over conductors 3 and 4 and through contacts of switching relay 8. Upon operating, relay 5 closes a circuit for release relay 6 by way of resistance element 15. Relay 6 thereupon operates and closes a locking circuit for itself in series with relay 7, but relay 7 does not operate as long as it is shunted by resistance element 15. Relay 6 also prepares a test circuit for the upper winding of switching relay 8 by placing ground potential on the left-hand terminal thereof; it opens a point in the circuit of release magnet 18 and prepares a circuit for vertical magnet 17; and, at its upper armature, it places ground potential on the incoming release trunk conductor 2 so as to provide a holding circuit for the preceding switch (not shown).

By the above described operation of relay 6, the selector is prepared to operate responsive to the first digit of a desired number.

Dial tone

In order to inform the calling subscriber that a first selector has been seized and that he may now begin to dial the digits of the desired number, ground potential is normally applied to the upper terminal of the upper winding of line relay 5 through the secondary winding of the dial-tone transformer 20, whereby a characteristic dial-tone current is transmitted back over the calling line to the calling substation.

Directively setting the selector

When the first digit is dialled, the circuit of line relay 5 of the selector is interrupted at the calling device on the calling line a number of times depending upon the value of the digit. Each time its circuit is interrupted, line relay 5 deenergizes and closes a circuit for vertical magnet 17 by way of contacts of the unoperated switching relay 8 and contacts of the operated release relay 6. By the operation of vertical magnet 17, the wipers of the selector are raised step-by-step until they come to rest opposite the desired levels of contacts.

Responsive to the first restoration of line relay 5, relay 7 operates in series with release relay 6 because the shunt circuit including resistance element 15 is removed from around series relay 7. Upon operating, relay 7 connects resistance element 16 in shunt of release relay 6, thereby setting up a circuit condition which will enable relay 6 to release in spite of its connection in series with relay 7 in case the receiver is replaced at the calling substation.

Each time line relay 5 reoperates, it replaces the shunt circuit around series relay 7 through the resistance element 15, which shunt circuit is of such low resistance that relay 7 is unable to remain operated more than momentarily with this shunt applied. It may be pointed out here that the resistance element 16 preferably has a resistance low with respect to the resistance of relay 6, and that resistance element 15 has a resistance low with respect to the resistance of element 16, and that by varying the resistances of elements 15 and 16 with respect to each other and to the resistances of relays 6 and 7 the holding effects of relays 6 and 7 may be increased or decreased as desired; raising the resistance at 15 increases the holding effect of relay 7, and raising the resistance at 16 increases the holding effect of relay 6. By using this principle, different weights or gauges of contact assemblies may be provided for.

As a further result of the operation of relay 7,

a point in the circuit of rotary magnet 19 is opened at the upper contacts of the relay, whereby the premature operation of rotary magnet 19 responsive to off-normal spring 10 shifting to its alternate position upon the first vertical step of the switch is prevented.

Trunk hunting

At the end of the vertical movement of the switch, line relay 5 comes to rest in an energized condition, following which series relay 7 shortly restores responsive to the resistance element 15 being shunted around its winding. When relay 7 restores, the circuit of rotary magnet 19 is completed, which circuit includes off-normal spring 10 in its alternate position, and an armature of relay 6. By the buzzer-like operation of the self-interrupting rotary magnet 19, the wipers of the selector are rotated step-by-step over the selected contacts in search of an idle trunk line. It may be assumed that the digit 1 has been dialled, in which case the wipers 21—23 have been raised opposite the first level of bank contacts, while the alternate set of wipers, 24—26, has been raised opposite the second level of bank contacts. With the grouping as hereinbefore given, and as indicated in Fig. 1, both wiper sets pass over trunk lines of the first-level group while trunk-hunting until the alternate wiper set has advanced beyond the sixth group of contacts in the second level, following which only the lower wiper set, comprising wipers 21—23, is searching over first-level trunks, while test wiper 24 of the alternate set is passing over the disconnected upper test contact of the last four contact groups in the second level.

Because of the angular displacement of the two wiper sets, the normally connected wiper set (which has been raised opposite the first level of bank contacts, under the previous assumption) engages the first set of bank contacts while the alternate wiper set is still one step short of engagement with the bank contacts in the second level. As a result, the first set of bank contacts in the first level is always tested first, and relay 8 is operated by way of test wiper 21 to seize this set of bank contacts if the trunk line connected thereto is idle. If this contact set tests busy, however, the rotary movement continues and the alternate wiper set engages the first contact set in the second level at the same time that the normally connected wiper set engages the second contact set in the first level.

For the purpose of the following description, it will be assumed that the trunk lines connected to the contact sets now engaged by the two wiper sets both are idle, in which case a test circuit is closed for the upper winding of switching relay 8 by way of test wiper 21 and the lower test contact in the second set in the first level, while a test circuit is closed at the same time for the upper winding of wiper-switching relay 9 by way of wiper 24 and the upper test contact of the first group in the second level, the test circuit of relay 9 being completed by way of release trunk conductor 54 of trunk T11 of the first-level group.

Responsive to the closure of their test circuits, relays 8 and 9 both operate. Relay 8 closes a locking circuit for itself at its inner lower armature, and relay 9 does likewise. Responsive to the closures of the locking circuits, the relays both operate fully without further aid from their test circuits. Relay 9, in addition to opening a point in the circuit of rotary magnet 19 at its upper armature, disconnects the normally connected wipers 21—23 and substitutes the alternate wipers

24—26. Relay 8, in addition to opening a point in the circuit of rotary magnet 19 at its upper armature and a point in the circuit of vertical magnet 17 and release magnet 18 at its inner-upper armature, applies ground potential directly at its middle upper armature to test wiper 24 by way of the operated inner-upper armature of relay 9; opens the test circuit of the upper winding of relay 9 at the normally closed contacts controlled by its inner-lower armature so as to prevent a subsequent operation of relay 9 in case this relay has not operated by the time relay 8 operates; and at its lower armatures it disconnects the incoming conductors 3 and 4 from the windings of line relay 5 and extends them by way of the corresponding operated armatures of relay 9 to the alternate line wipers 25 and 26, which line wipers are now in engagement with the line contacts in the first contact set of the second level, to which contacts the talking conductors 55 and 56 of the trunk T11 are connected.

The line and release relays (not shown) to which the trunk T11 extends now operate and bring about the grounding of conductor 54 so as to extend the ground potential back through wiper 24 and contacts of the operated relays 9 and 8 so as to hold relays 9 and 8 operated and to maintain the preceding portion of the connection established after the release relay 6 has fallen back. Responsive to line relay 5 being disconnected, this relay falls back and again removes the shunt from around series relay 7, whereupon relay 7 operates and shunts resistance 16 around relay 6, responsive to which relay 6 shortly restores and opens the circuit of relay 7, permitting relay 7 to restore also.

Releasing the selector

When the selector is to be released, ground potential is removed from release-trunk conductor 54 of the trunk T11, whereupon relays 8 and 9 both restore. When relay 8 restores, it completes a circuit at its inner-upper armature for release magnet 18 by way of contacts of the restored release relay 6 and off-normal contacts 11. By the operation of release magnet 18, the selector is restored to its normal position, whereupon the circuit of the release magnet is opened at off-normal contacts 11. At off-normal contacts 10, battery potential is reconnected to release-trunk conductor 2 by way of resistance element 14 to indicate that the incoming trunk comprising conductors 2—4 is again in condition to be selected.

Additional description of trunk selection

It may be pointed out at this time that relays 9 and 8 operate successively rather than simultaneously in the event that the contact set engaged by the alternate wiper group is idle and the contact set engaged by the normally connected group is engaged. Under this condition, no test circuit is completed for the upper winding of relay 8 by way of test wiper 21, because of the lack of an idle-indicating battery potential on the contact engaged by wiper about the wiper switching operation hereinbefore described, whereupon the circuit of relay 8 is switched from wiper 21 to wiper 24, and relay 8 then operates over wiper 24 and completes the seizure of the idle trunk engaged by wipers 24—26.

Still another case needs to be considered: the normally connected set of wipers, wipers 21—23, may encounter an idle contact set at a time when

the contact set encountered by wipers 24—26 does not test idle. This may occur at a time when the wipers 24 to 26 are in engagement with a bank contact assigned to the group of the called level (for example one of the first six contact sets in the second level when the first level is called), or it may occur when the wipers have been rotated until the alternate wiper set has passed beyond the contact sets assigned to the group of the called level. For example, assume that the wipers 21—23 have been rotated to the last set of bank contacts in the first level. In this case, wipers 24—26 are in engagement with the ninth set of contacts in the second level. In this case relay 9 cannot operate, as there is no connection to the contact on which wiper 24 is standing. When relay 8 operates under this condition, it extends the connection by way of wipers 21—23 to conductors 51—53 of the trunk T10, whereupon the holding circuit for the selector and the preceding switch is established over conductor 51 of the trunk T10, and release relay 6 of the selector falls back as hereinbefore explained.

All trunks busy in the selected group

When all of the trunks in the selected group are busy, the group assigned to the first level of the selector for example, the wipers of the selector are rotated step-by-step until both sets of wipers have passed off the contact bank, which occurs upon the twelfth rotary step of the switch. This amount of rotation is necessary in order to insure that the alternate wiper set tests each contact in the level over which it is passing, as the alternate wiper set is angularly displaced one step behind the normally connected wiper set.

When the twelfth rotary step is taken, overflow contacts 13 are operated to close an operating circuit for the lower winding of wiper-switching relay 9, whereupon relay 9 operates to open the circuit of rotary magnet 19 at its upper contact to prevent further rotary movement. At the same time, overflow contacts 12 substitute busy-tone current from the transformer 21 for the dial-tone current from the transformer 20, thereby sending a busy signal back to the calling line.

When the calling subscriber responds to the busy signal by replacing his receiver, the deenergization of relay 6 results in the transmission of a momentary impulse to operating magnet 17 and in a momentary operation of relay 7, but relay 6 falls back after a short interval and opens the circuit of relay 7 and the circuit of magnet 17, at the same time closing the usual circuit for release magnet 18 to cause the selector to be released. At the same time, ground potential is removed from conductor 2 by relay 6, so as to bring about the deenergization or relay 9.

Modified grouping arrangement

If desired, the first-level group of trunks (the group to which the digit 1 is assigned) may be expanded so as to take over all of the contact sets of the second level of the bank instead of only the first six as disclosed. When this is done, it is merely necessary to disconnect the release trunk conductor of the last four contact sets in the second level from the lower contacts and connect them to the corresponding upper contacts in the manner of the first six groups of test contacts in the second level, whereupon the last four trunks in the second level are included in the first level group, in addition to the first six

contacts in the second level. It is to be understood, of course, that this does not cancel the second-level group, as this group may utilize as many contact sets as desired in the third level, the test conductor of each second-level trunk line in such case being connected to the upper test contact so that it will be searched over and connected with by the alternate wiper sets, if idle.

It may be pointed out that the normally connected wiper set cannot connect with any trunk line group in the second level, for example, which is assigned for the first-level group when the digit 2 is dialled, as the test contacts of the trunk lines so assigned are disconnected in the row then wiped over by test contact 21 of the normally connected wiper set.

The modified wiper setting

From the foregoing description it will be understood that a trunk group indexed by any digit from 1 to 9 may include trunk lines connected to the contact sets in the next higher level and wiped over by the alternate wiper set when the digit indexing the trunk group is dialled. But, the trunk group to which the digit 0 is assigned cannot have more than ten trunks therein with the arrangement disclosed in Figs. 1 to 3, unless an additional level of bank contacts is provided above the tenth level, because the alternate wiper set is raised above the tenth level of bank contacts when the digit 0 is dialled. The modified wiper setting of Figs. 4 and 5 may be used instead of the wiper setting indicated in Figs. 1 to 3 in case it is particularly desired to have more than ten contact sets in a selector bank assigned to the trunk line group indexed by the digit 0. As indicated in Figs. 4 and 5, the alternate wiper set, including line wipers 25 and 26, is positioned the space of one level of bank contacts below the normally connected wiper set including wipers 21—23. With this modified setting of the wipers, the alternate wiper set does not engage a given level of bank contacts until the digit indexing the next higher level is dialled. For example, when the digit 1 is dialled, the alternate wiper set rotates around one step below the first level, and does not engage any bank contacts (unless an extra row of contacts is provided below the level normally used as the first level). When the digit 0 is dialled, the normally connected set of wipers rotates over the tenth level, and the alternate wiper set is at the same time rotated over the ninth level, whereby as many of the ninth level contact sets as desired may be assigned to the 0 level group.

It will be understood, of course, that the assignment for any level with the modified arrangement is such that additional contacts assigned to the group indexed by a given digit are located in the next lower level instead of the next higher level as in the embodiment of Figs. 1 to 3.

A special feature of the selector when constructed in accordance with Figs. 4 and 5 is that the first level of bank contacts may be completely utilized in giving access to trunks in the second-level group when the digit 1 is not assigned. In explanation of this statement, it may be pointed out that it is common practice to leave the digit 1 unassigned as the first digit in subscribers' numbers because of the prevalence of so-called preliminary impulses caused by the careless removal of the receiver, and the like. Sometimes the first level of bank contacts of a first selector is left disconnected, in which case

the first selector merely releases in case the digit 1 is inadvertently dialled as the first digit or in case a preliminary impulse equivalent to the digit 1 is generated as the receiver is being removed.

5 If trunk lines are connected to the contacts of the first level of the selector herein disclosed and constructed in accordance with Figs. 4 and 5, and the release-trunk conductors of these trunk lines are connected to the upper test contact in each case, the first level tests open to the normally connected wiper set when it rotates over the first level responsive to the digit 1 being dialled, in which case the wipers advance to the overflow condition, causing a busy-tone signal to be sent back to the calling subscriber. However, when the digit 2 is dialled the alternate wiper set rotates over the first level of bank contacts (while the normally connected wiper set is rotating over the second level), and the entire first level of bank contacts may be utilized for trunk lines of the second-level group.

If desired, the trunking flexibility of this latter situation may be secured when the full ten trunking digits are utilized by providing eleven bank levels, in which case the wiper sets are adjusted on the shaft so that each encounters a bank level responsive to the dialling of each of the ten assigned digits.

It is evident that considerable modification may be made of the trunking arrangement herein disclosed. For example, the two wiper sets of the selector may be set more than one level apart in order to meet conditions which may arise from time to time. If this is desired, the alternate wiper set may be provided in different assemblies from the assemblies of the normally connected wiper set and located lower on the shaft than the regular wiper set, in which case the angular displacement of the two wiper sets is unnecessary, as there is no danger of interference between them when they are more than one level apart.

It is apparent that all levels of a standard bank may be utilized when less than ten and more than four trunk groups are needed, as the trunking digits may be so assigned with respect to the wiper setting that one wiper set searches over an unassigned level while the other wiper set is searching over an assigned level.

What is claimed is:

50 1. In combination, a selector having bank contact sets arranged in groups, each group normally corresponding to a separate digit designation, the contacts in one of said groups being divided between two trunk groups bearing different digit designations, means for bringing said selector into association with said contact group as a result of control being exercised over the selector in accordance with either of said digit designations, means thereupon effective for starting said selector searching over the contact sets in said groups successively, said selector having two test wipers arranged to cooperate differently with the test contacts of said contact groups, and means including said two test wipers and automatically effective dependent upon the digit in accordance with which the selector receives its control for preventing the selector from making connection with any trunk line of one group and for permitting the selector to make connection with any idle trunk line in the other group.

75 2. In combination, an automatic switch having a bank of contacts divided into groups, said switch having two sets of wipers, operating means effective to operate said selector to bring one of said wiper sets into association with a group of said

contacts by a movement of one extent, said means being effective to operate said selector to bring the other set of wipers into association with the same contact group by movement of a different extent, means for causing said selector to advance either set of wipers over the contacts in said group, each contact set in said group comprising two test contacts, a test wiper in the first wiper group arranged to cooperate with the first test contact of any of said contact groups, and a test wiper in the second wiper group arranged to cooperate with the second test contact in any one of said contact groups.

3. In combination, a selector having a bank of contacts divided into groups, each group including a row of line contacts and two rows of test contacts, means for bringing said selector into association with a group of contacts as a result of either of two imparted movements, means for advancing said selector over the contacts in the group successively, means effective when one movement has been imparted to the selector for causing the selector to make successive electrical connection with the contacts in one of said rows of test contacts, and means effective responsive to the other movement having been imparted to the selector for causing the test contacts in the other of said rows instead of the first.

4. In combination, an automatic two-motion switch having a single contact bank divided into groups and having two sets of contact wipers, and means for variously positioning said selector so as to cause either of said wiper sets to come into operative relationship with any one of a plurality of groups of said bank contacts.

5. In combination, an automatic switch having a bank of contacts arranged in parallel coextensive rows, said switch having two sets of contact wipers and means for bringing either wiper set into engagement with any one of a plurality of said rows and for operating it over such row, the second set of wipers being so positioned relative to the first that the second wiper set engages the adjacent contact row when the first wiper set is caused to engage a contact row to which it is directed, and means for securing said two wiper sets at a suitable angle with each other so as to prevent their making electrical contact with each other as they are being advanced over adjacent contact rows.

6. In combination, an automatic switch having contact sets arranged in rows, said switch having two sets of wipers, means responsive to a control of one value being exercised over said automatic switch for causing it to associate one set of wipers with a contact row, means responsive to a control of a different value being exercised over said switch for causing it to associate the other wiper set with the same contact row, and means effective in either case to cause the associated set of wipers to be driven over the said contact row.

7. In combination, an automatic switch having wipers, a bank of contacts accessible to said wipers and divided into groups, means in said switch responsive to an external control being exercised thereover for advancing said wipers into association with said contact groups successively, means effective after said selector has been operated to position the wipers with a desired group of contacts for operating the selector to rotate said wipers over the contact group, trunk lines extending from the contacts of said group, and means controlled by the busy or idle condition of the trunk lines connected to the contacts of said bank for causing said selector to extend a connection

to a trunk line reached by way of the said desired group of contacts or by way of a trunk line reached through the immediately preceding group of contacts.

5 8. A circuit arrangement for controlling the release and series relays of an automatic switch wherein the two relays are operated in series with each other, two resistance elements, means controlled by the line relay of the automatic switch
10 for connecting one of said resistance elements in shunt of the series relay, and means controlled by the series relay for connecting the other of said resistance elements in shunt of the release relay.

15 9. In a control circuit for use in an automatic switch, including a release relay and a series relay connected in a series circuit, a line relay having contacts for shunting the series relay, and a resistance element included in said shunt circuit for preventing said series relay from being completely
20 short circuited, whereby a residual holding current is caused to flow through said series relay when the shunt circuit is established.

25 10. In an automatic switch, a bank of contacts in which the contacts are arranged in pairs in a plurality of rows, a pair of wipers, one of said wipers having access to only one contact of any of said pairs of contacts and the other wiper having access to only the other contact of any of said contact pairs, and means for advancing said
30 wipers over two rows of contact pairs, respectively, at the same time.

35 11. In an automatic switch, a contact bank in which the contacts are arranged in pairs in a plurality of rows, a pair of wipers, and means for moving said wipers to a position so that one of them engages one contact of a pair in a given row, while the other wiper engages the non-corresponding contact of a pair located in another row.

12. In combination, an automatic switch having a bank of contacts including pairs of contacts arranged in rows, said switch having a pair of progressively movable contact makers, means for maintaining said contact makers in a fixed position relative to one another, means for selectively operating said contact makers to associate either
80 desired one of them with a given contact row and for advancing them so that the desired one passes over the selected row of contact pairs, said contact makers being so positioned and adjusted that one contact maker engages a given contact of any pair when it is being advanced over a row of contact pairs, while the other contact maker engages the other contact of the same pair when the said
85 other contact maker is being advanced over the same row of contact pairs.

13. In combination, a selector having two test circuits, two wipers included in said test circuits, respectively, a bank of test contacts in which the contacts are arranged in pairs in a plurality of rows, and means for moving said wipers so that
90 when one engages a contact of a pair the other engages the non-corresponding contact of a pair in another row.

14. In combination, a selector having two test circuits, two test wipers included in said test circuits, respectively, a bank of test contacts over which the test circuits may be completed, said
95 contacts being arranged in pairs, one wiper having access to only one contact of any of said pairs and the other wiper to only the other contact, and means for operating said selector to advance said wipers over two rows of contact pairs, respectively, at the same time, whereby said test circuits
100 are variously completed.

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