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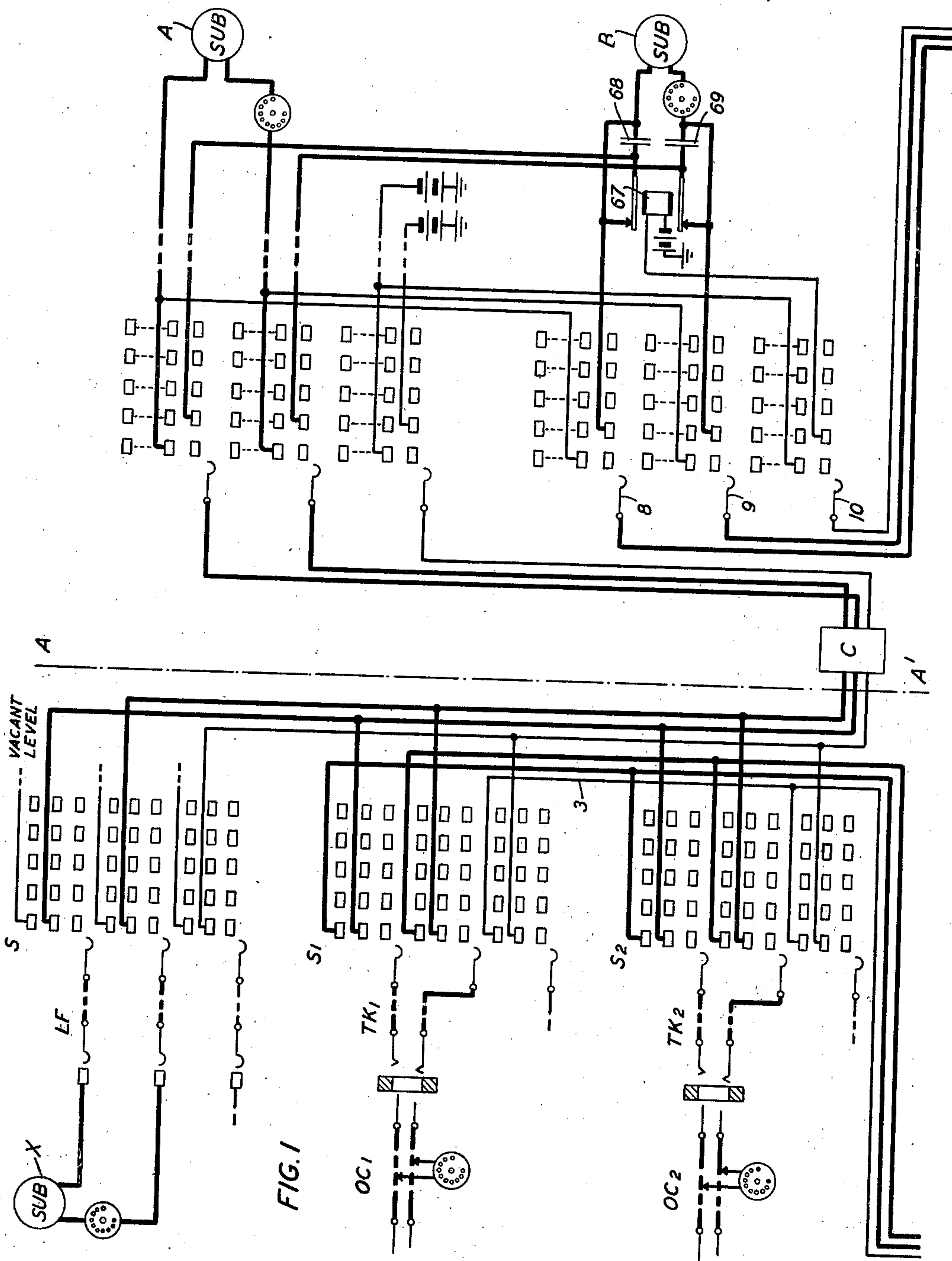
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2,244,596

AUTOMATIC TELEPHONE SYSTEM

Filed Dec. 2, 1939

2 Sheets-Sheet 1



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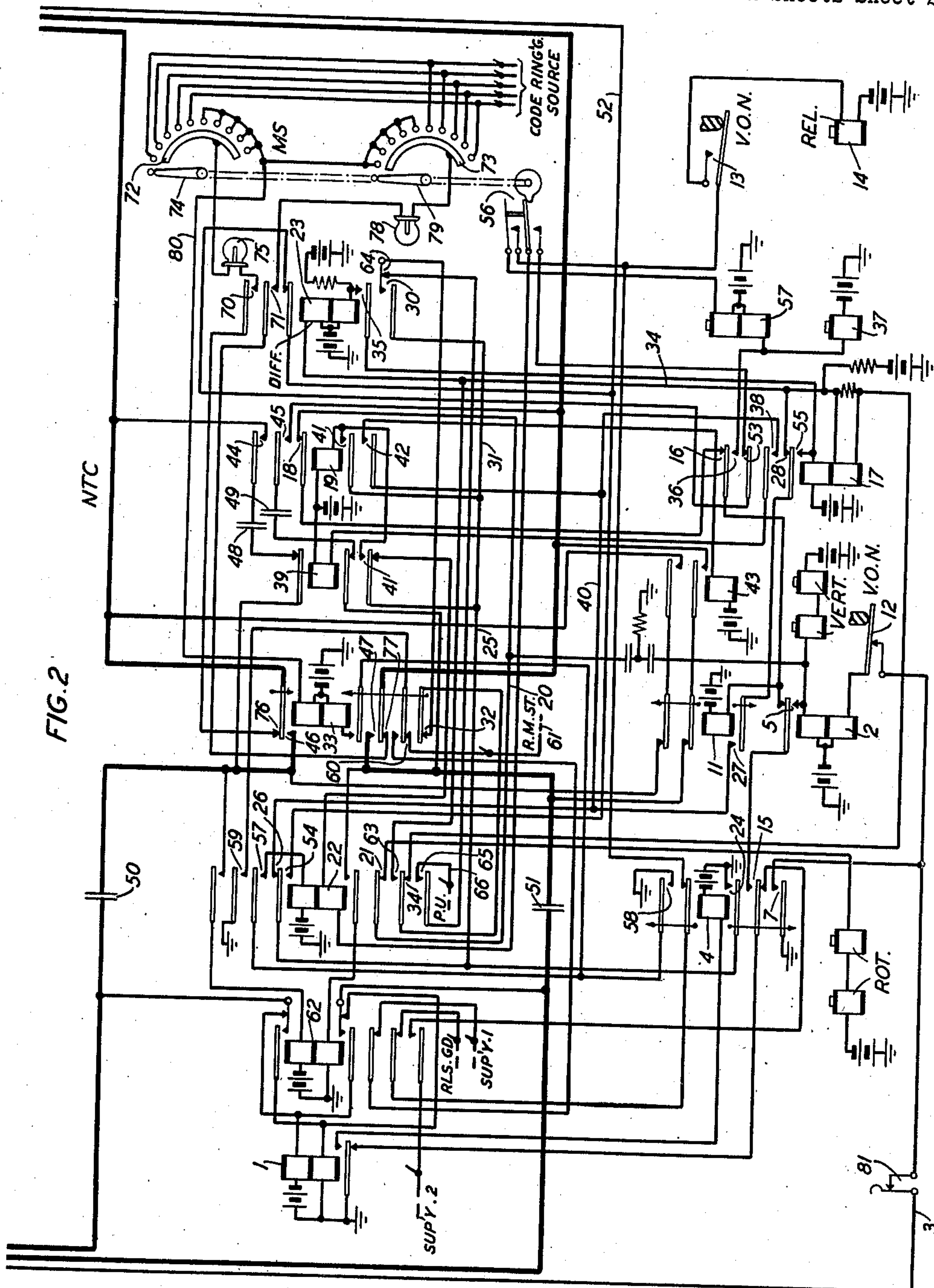


FIG. 2

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AUTOMATIC TELEPHONE SYSTEM

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This invention relates to automatic telephone systems and more particularly to systems of the type referred to as community dial systems, i. e., small automatic systems for small towns and villages. Such systems are usually unattended but are provided with trunking facilities to a distant larger office sometimes called a master. Due, however, to the general service requirements of such a system, simplicity and low cost are very important and therefore various features usually found in large systems have been eliminated in these smaller equipments as, for example, facilities for enabling a toll operator to rerung a subscriber over a previously established connection, which facilities are in some cases desirable, for example when a subscriber who makes a large number of toll calls desires to have several calls completed one after the other as fast as the operator can complete them, without the delay incident to building up a connection for every call and then perhaps, on occasion, finding the line busy. Obviously, the most efficient method for providing this service would be to hold the connection between the toll operator over the trunk to the subscriber's line and recall the subscriber by ringing on his line as soon as each call was ready. As previously mentioned, arrangements whereby a community office subscriber's line can be held and rerung repeatedly at the will of a toll operator are not ordinarily furnished in small systems of this type for the reason that the cost of the added equipment cannot in most cases be justified.

An object of the present invention is therefore to provide facilities of a relatively simple nature whereby an operator in a distant exchange can establish and hold a connection to a subscriber's line, in an exchange of the type described, and thereafter cause ringing current to be connected thereto as often as desired.

Further, it is desirable in systems of this nature that a distant operator be able, in case an attempt is made either by herself or any subscriber to complete a call to a community office subscriber and receives a line busy indication, to verify the fact that the line is actually in use by overriding the busy indication and establishing a connection to the desired line, either to merely verify the busy condition or in a more extreme case to converse with the parties talking and ask them to make way for an emergency call, such as a call for police or to report a fire.

Busy test verification facilities are now provided in large automatic exchanges and the

smaller community exchanges can be arranged to provide this service by employing suitable known equipment but the expense of such facilities frequently cannot be justified for small exchanges of the type in question.

It therefore is a further object of the invention to provide a simple and practicable arrangement for small exchanges whereby a busy called line can be seized by certain predetermined calling lines to establish a talking connection therewith and when the original busy condition is removed, to ring on said line.

A feature of the invention whereby both of the foregoing objects are attained resides in the employment of a special "no test" connector switch so wired and arranged that it may be controlled over certain lines or group of lines as, for example, trunks from an operator's position, to connect to any line available to the switch, regardless of the busy condition of said line, and when the line is idle, i. e., receiver on hook, to ring thereon.

A further feature resides in auxiliary circuit means associated with certain predetermined subscribers' lines available to said "no test" connector whereby when one of these lines is being held by an automatic switch on a regular connection and is subsequently seized by the "no test" connector, the first connected switch will be disconnected therefrom, except for a high impedance connection, which in practice may be a small condenser, during the period the line is engaged by the "no test" switch. When the line is rung by the "no test" switch only an audible ringing tone will be transmitted back through the first switch.

The invention will be understood from the following description when read in connection with the accompanying drawings, Figs. 1 and 2 of which, when placed together with Fig. 1 above Fig. 2, represent a so-called community dial exchange including calling and called local stations and trunks incoming thereto from a distant master office, which exchange is arranged to provide the facilities set forth in the foregoing objects and features of the invention.

The arrangement whereby the present sequence call service feature is obtained will now be described.

Referring to the drawings, X, A and B are local stations of the community dial exchange and OC1 and OC2 are cord circuits arranged for dialing and located in a distant master office which cord circuits have access to the community

office subscribers X, A, B, etc. over dial trunks TK1 and TK2.

The lines of local stations such as X are associated with line finders LF which in turn are associated with wipers of selector S and the trunks TK1 and TK2 terminate in wipers of selectors S1 and S2, respectively.

C represents a regular connector of conventional type which in the present instance is one arranged for ten party divided code ringing controlled by a final code digit transmitted following the transmission of the code impulse which rotates the wipers of the connector to the desired line, which connector appears in the banks of all the selectors S, S1 and S2. At this point it may be mentioned that the selector S, serving local subscribers such as X, has a vacant level, for example the upper or top level as shown in the drawings, in which level no connector trunks are terminated.

NTC represents a special or "no test" connector also arranged for the same type of ringing control as the regular connector C but modified to the extent that it is unresponsive to a busy condition encountered on the test terminal of a dialed subscriber's line and therefore its wipers stop on the terminals of any line to which they are advanced irrespective of the busy or idle condition thereof.

It will be noted that the connector C appears in the banks of all the selectors S, S1, and S2, but the connector NTC only appears in the banks of selectors S1 and S2, i. e., the selectors terminating the trunks TK1 and TK2 from the master office, and more specifically appear in the upper or top level of these selectors which level, as before mentioned, is vacant in selector S and therefore it will be obvious that whereas an operator at the master office can by means of a cord circuit and one of the trunks TK1 or TK2 reach a desired subscriber's line A, B, etc., by way of either the regular connector C or the special no-test connector NTC a local subscriber such as station X can only obtain a connection with these lines by way of the regular connector C, that is to say, a local subscriber can only reach another local subscriber's line if that line is idle, whereas an operator at the master office can obtain a connection with a local subscriber's line either by way of the regular connector C, if the desired line is idle or via the special no-test connector NTC regardless of whether the line is idle or busy.

Means whereby a subscriber such as X obtains connection with another subscriber such as A or B, which involves standard line finders, selectors and connectors form no part of the present invention and no detailed description thereof is necessary, it being sufficient to mention that when the calling subscriber removes his receiver from the hook a line finder LF seizes the line and extends it to an idle selector such as S following which the subscriber actuates his dial to transmit the code digits of the desired line followed by the digit designating the code ring of the wanted party line subscriber, which dial impulses successively control the movement of the wipers of the selector S, connector C and the code switch which forms a part of the connector.

Let us assume, however, that the subscriber B is a very large user of long distance toll facilities and frequently desires to communicate in rapid succession with a number of distant stations. As will be understood, the ordinary routine in handling such calls is for the subscriber to dial

the toll operator with whom he is connected by means of the usual facilities (not shown) and when the operator answers to give her the necessary details of the desired connections after which, unless the calls can be completed while the subscriber remains at his telephone, he will be told to replace his receiver on the hook and that he will be called as soon as the desired connections can be made. When the operator is ready with the first call, she will connect one of her cord circuits, for example OC1, with a trunk, for example TK1, and dial the regular code digits of the calling subscriber's line which, for example, may be 212 as indicated by the drawings. The first digit dialed will raise the wipers of the selector S1 to the proper level, for example the second level as shown, and at the conclusion of the pulses the selector will rotate its wipers into contact with the first set of terminals where they will remain if we assume the connector C to be idle. The operator is now connected to connector C and the next two digits dialed will raise and rotate the wipers of the connector into engagement with the bank terminals corresponding to the line of station B which as shown is the second set in the first level. The operator then dials the final or code-ringing digit of station B and when the subscriber answers ringing will be tripped.

When the subscriber restores his receiver to the switchhook at the end of the conversation, the supervisory lamp before the toll operator will be lighted. However, as other calls are to be completed in sequence to the same subscriber, the operator will not disconnect from the trunk at this time, but will immediately proceed with the next call.

When the operator is ready with the next call, as the regular connector C is still in the talking condition, and the ringing equipment is now locked out, she is unable to recall the subscriber over the original connection, i. e., cord OC1, trunk TK1, selector S1 and connector C but by means of special connector NTC and the special equipment associated with the line of subscriber B, comprising the present invention, she is able to accomplish this function in the following manner.

In order to ring the subscriber B under the above condition, the operator will connect a second cord OC2, for example, with another trunk TK2 to the community office, and first dial the level of the trunk selectors reserved for the special connector NTC which from the drawings is shown as the upper or top level of selectors S1 and S2. As selector S2 is associated with trunk TK2, and if we assume the selector to have ten levels, the operator will dial 0, i. e., transmit ten pulses by means of her dial, followed by the digit pulses 1 and 2 necessary to advance the special connector into engagement with the subscriber's line terminals which as before are the second in the first level. In this connection, as before mentioned, special connector NTC is only multiplied in selector levels accessible to the master office trunk which in the present case is the upper or tenth level of selectors S1 and S2 and therefore it will be evident that local subscribers of the community office as, for example, station X are unable to gain access to this connector, the reason for which is obvious.

When the selector S2 raises its wipers to the tenth level and rotates them into contact with the first set of terminals, battery through the lower winding of the so-called C relay 2 in the

connector NTC and over the C lead 3 causes the selector to extend the tip and ring of the trunk through to battery and ground in series with the upper and lower windings of the line relay 1. Relays 2 and 1 operate, followed immediately by the so-called B relay 4. Relay 2 in operating closes its contacts 5 thereby preparing the impulsing circuit of the vertical magnet VERT. Relay 4, at its contacts 7, grounds the C lead 3. The connector NTC with relays 1, 2 and 4 operated is now in readiness to receive the second and third digit impulses from the operator's cord at the master office. As the line of subscriber B terminates on the second terminals of the first level the wipers 8, 9 and 10 must be raised one step thereby requiring a single release and subsequent reoperation of relay 1. Therefore, when relay 1 releases, the pulsing circuit is closed to the vertical magnet in parallel with the upper winding of relay 2 and the wipers are raised to the first level, the vertical off-normal contacts 12 are opened thereby opening the starting circuit through the lower winding of relay 2 and the contacts 13 are closed thereby preparing a circuit to operate the release magnet 14. When relay 1 reoperates, relay 2 releases and transfers the pulsing circuit from the vertical magnet to relay 11 in parallel with the rotary magnet ROT.

When the operator transmits the next or third series of impulses, two in this case, relay 1 releases and reoperates twice. On the first release of relay 1, relay 11 operates in parallel with the rotary magnet ROT in the following circuit: Ground, back contact of relay 1, contacts 15 of relay 4, back contacts of relay 2, and from this point one branch extends through the winding of relay 11 to battery and the other branch can be further traced over contacts 16 of relay 17, contacts 18 of relay 19, conductor 20, contacts 21 of relay 22 and winding of rotary magnet ROT, also to battery. Relay 11 in operating closes the following circuit to operate relay 23: Ground, contacts 24 of relay 4, contacts 26 of relay 22, contacts 27 of relay 11, contacts 28 of relay 17 and conductor 34 to battery through the upper winding of relay 23. Relay 23 operates and locks over its contacts 30 in series with the lower winding of relay 17 to ground at contacts 24 of relay 4 in the following circuit: Ground, contacts 24 of relay 4, conductors 25 and 31, contacts 30 of relay 23, contacts 32 of relay 33, contacts 34 of relay 22, lower winding of relay 17, conductor 34 and upper winding of relay 23 to battery. Relay 23 at its contacts 35 also connects its lower winding in parallel with the upper winding of relay 17. Relay 17 does not operate at this time, however, as its lower winding is short circuited at contacts 27 of relay 11.

In response to the transmission of two dial pulses the rotary magnet ROT moves the wipers 8, 9 and 10 two steps into contact with the second terminal of the first level of the connector switch during which interval relays 4 and 11 remain operated.

When relay 1 reoperates following the second impulse, relay 11 after a short interval releases thereby opening its contact 27 and removing the short circuit from the lower winding of relay 17 which relay thereupon operates in the following circuit: Ground, contacts 24 of relay 4, conductors 25 and 31, contacts 30 of relay 23, contacts 32 of relay 33, contacts 34 of relay 22, lower winding of relay 17 and the upper winding of relay 23 to battery.

Relay 17 in operating opens its contacts 16

thereby interrupting the circuit of rotary magnet ROT and closes its contacts 36 thereby extending the impulse circuit to the rotary magnet 37 of the minor or ringing code selector switch and at its contacts 38 completes an energizing circuit for relay 39 which can be traced from ground, contacts 24 of relay 4, contacts 26 of relay 22, conductor 40, contacts 38 of relay 17 and winding of relay 39 to battery. Relay 39 operates in turn operating relay 19 over its contacts 41 to ground at contacts 24 of relay 4. Relay 19 locks to ground at contacts 24 of relay 4 over its contacts 41 and at its contacts 18 introduces another break in the previous circuit for the rotary magnet ROT. Relay 19 also closes its contacts 42 thereby operating relay 43, the circuit for which can be traced from ground at contacts 24 of relay 4, contacts 26 of relay 22, conductor 40, contacts 42 of relay 19 and winding of relay 43 to battery. Further, relay 19 closes its contacts 44 and 45 thereby shunting the normally opened contacts 46 and 47 of relay 33 by ring-back condensers 48 and 49, respectively.

Relay 43 in operating closes a listening circuit between the tip and ring of the line and the wipers 8 and 9 including condensers 50 and 51. The connector is now in the verification position, the operator at the master office is connected to the called subscriber's line and is able to determine if the line is in use by listening for conversation.

If the line is idle the operator can ring the subscriber's station B by dialing the final or code digit which operation is as follows: Relay 1 follows the impulses of the last series dialed by the operator and when it releases for the first impulse, it recloses the circuit for relay 11 which reoperates in parallel with the rotary magnet 37 of the code switch. Relay 11 in operating opens its upper contacts thereby opening the listening circuit previously mentioned and closes its contacts 27 thereby connecting ground to the upper winding of relay 17 and the lower winding of relay 23. Relay 23 releases at this time due to the fact that the flux generated in the lower winding opposes and neutralizes the flux in the upper winding.

When relay 23 releases, it opens the previously mentioned circuit through its lower winding at its contacts 35 and opens the circuit through its upper winding and the lower winding of relay 17 at its contacts 30. Relay 17 holds operated, during the pulses, over its contacts 55, contacts 27 of relay 11, contacts 26 of relay 22 and contacts 24 of relay 4 to ground.

The code switch MS is moved forward under control of the rotary magnet and on the first step actuates the off-normal switch 56 to close its contacts thereby preparing circuits to operate the release magnet 57 and relay 22.

Relays 4 and 11 remain operated during the pulsing.

At the end of the last impulse, relay 11 releases and recloses at its upper contacts the listening circuit previously referred to. Relay 11 also opens its contacts 27 thereby deenergizing the upper winding of relay 17 which thereupon releases to open at its contacts 38 the circuit for relay 39 which releases. Relay 17 also opens its contacts 36 to disconnect the rotary magnet 37 and, by closing its contacts 53, connects the lower winding of relay 22 to the third wiper 10 of the connector switch. When relay 39 releases it opens, at its contacts 41, the operating circuit for relay 19, but relay 19 remains operated through its contacts 41 to ground at contacts

24 of relay 4. The release of relay 39 recloses the ring-back circuit including condensers 48 and 49 in shunt to contacts 46 and 47 of relay 33. Relay 39 in releasing also closes its lowermost back contacts thereby connecting ground at contacts 24 of relay 4 through the lower winding of relay 22 to the wiper 10. The test terminal of the line of subscriber B, which line is special, is not multiplied to the corresponding terminal in the bank of connector C and therefore it is always at battery potential and relay 22 will operate which locks through its upper winding and contacts 57 and contacts 58 of relay 4 to ground. Relay 22 in closing its contacts 54 connects direct ground over conductor 52 to the wiper 10. Further, relay 22 closes its contacts 59 thereby connecting ground over contacts 60 of relay 33 to the ringing machine start lead 61 which extends to the ringing machine, not shown. Relay 22 further connects relay 62 across the tip and ring of the line, opens at contacts 26 the ground connection for relay 43 and at contacts 63 and 65 connects the upper winding of relay 23 to the so-called pick-up lead 66 from the ringing machine which can be traced from battery, upper winding of relay 23, contacts 63 of relay 22, contacts 32 of relay 33, contacts 64 of relay 23 and contacts 65 of relay 22 to the pick-up lead 66 which will be grounded at the ringing machine at the proper point in the ringing cycle. Relay 43 releases and reopens the listening circuit. It will be noted at this time that the line of subscriber B is special in that an auxiliary line circuit is connected between the subscriber and the regular subscriber's line circuit which auxiliary circuit comprises a relay 67 and small capacity condensers 68 and 69 for the purpose of providing the special sequence call feature which is a characteristic of the present invention and therefore when relay 39 releases and closes its lowermost back contacts to complete a circuit from ground through the lower winding of relay 22, to the conductor 52 and the third wiper 10 of the connector, relay 67 operates thereby introducing condensers 68 and 69 in the connection between the line of subscriber B and the bank terminals of regular connector C which terminals we have assumed are engaged by the wipers of that connector and held in that position from the master office.

The capacity of condensers 68 and 69 is very small (of the order of .04 microfarad or smaller, depending on the characteristic of the ringing current employed) and therefore they introduce a high impedance between the tip and ring bank terminals of the two connectors through which when ringing current is applied to the line of subscriber B by connector NTC only a small portion will be transmitted back to the master office through connector C which small current is only sufficient to serve as an indication to the operator that the called subscriber B is being rung.

When the ringing equipment (not shown) starts a new cycle of code rings, the pick-up lead 66 is grounded in a well-known manner thereby reoperating relay 23 in a circuit which can be traced from ground on the pick-up lead 66, contacts 65 of relay 22, contact 64 of relay 23, contacts 32 of relay 33, contacts 63 of relay 22, and upper winding of relay 23 of battery. Relay 23 thereupon locks over its contacts 30 to ground at contacts 24 of relay 4 and closes its contacts 70 and 71 thereby connecting the segments 72 and 73 of the switch MS to the ring and tip wipers 8 and 9. Depending on the position of

the switch MS the selected ringing code will be transmitted to the called line in series with the upper winding of relay 33 which relay will operate when the called subscriber answers. If the last digit dialed is between 1 and 5, the top wiper 74 of switch MS will connect the selected generator lead to the top or ring wiper 8 and the tip wiper 9 will be connected through the lower wiper 79 of switch MS and the upper winding of relay 33 to battery. If the digit dialed is between 6 and 0, the above connection will be reversed with respect to the wipers.

As before mentioned, a small portion of this ringing current will flow through the condensers 68 and 69 and the connector C to the trunk TK1 and thence to the operator at the master office as an audible ringing tone.

When the called subscriber B answers by removing his receiver from the switchhook, the relay 33 operates in series with the subscriber's set in the following circuit: ground on the selected generator lead, segment 72 and wiper 74, of the switch MS, resistance lamp 75, contacts 70 of relay 23, contacts 76 of relay 33, ring conductor of the connector, wiper 8 and the selected bank terminals, over the subscriber's line, through the subscriber's set and back to the connector and wiper 9, contacts 77 of relay 33, contacts 71 of relay 23, resistance lamp 78, wiper 79 and segment 73 of the switch MS, conductor 80 and upper winding of relay 33 to battery. Relay 33 operates and locks over its lower winding to ground at contacts 58 of relay 4. Relay 33 also opens its contacts 76 and 77 thereby disconnecting ringing through the code switch MS, by opening its contacts 32, releases relay 23, and at its contacts 46 and 47 closes the line through, and by opening its contacts 60 removes ground from the ringing machine start lead 61.

Relay 62 which is bridged across the tip and ring conductors operates and reverses battery and ground back through the selector S2 and trunk TK2 to the operator thereby extinguishing the cord supervisory lamp (not shown) as an indication that the subscriber has answered. At this time the vertical off-normal contacts 12 are open and contacts 13 are closed, the contacts of the code switch off-normal springs 56 are closed and relays 1, 4, 33, 19, 62 and 22 are operated.

When the operator notes from her supervisory lamp on cord OC2, that the subscriber B has answered, she disconnects the cord from the trunk TK2 whereupon the circuit of relay 1 is opened which relay thereupon releases thereby releasing relay 4 which in releasing removes ground at its contacts 24 from the conductor 52 which is connected to the third wiper 10 of the connector thereby releasing relay 67 in the subscriber's line and removing the high impedance condensers 68 and 69 between this line and the bank terminals of connector C. The release of relay 4 also initiates the release of connector NTC which restores to normal in readiness for another call. Conversation now proceeds in the usual manner at the end of which, if there are still other calls to be completed, the subscriber will restore his receiver but the operator will not disconnect her cord circuit OC1 from the trunk TK1 thereby still holding the subscriber's line in readiness for completion of the next call.

When the operator is ready to establish the next connection, she will again connect the cord OC2 to the trunk TK2 and transmit digit impulses as before to seize and ring on the sub-

scriber's line. This process will be repeated as long as the operator has calls to be completed. When the series of calls are completed, the operator will disconnect from trunk TK1 whereupon connector C releases in the usual manner and the subscriber's line is free for other calls.

If connector NTC is used merely to verify the busy or idle condition of a regular subscriber's line, such as the line at subscriber A, for example, ground will not be connected to conductor 52 and wiper 10 and the line will not be made busy to other connectors, unless already busy or the final digit is dialed. In this case, however, the operator will not (in most cases) dial the final or code ringing digit and after verification will immediately release the special connector.

In case it is desired to make connector NTC inaccessible to the selectors such as S1 and S2, busy key 81 can be operated, thereby removing battery from conductor 3 leading back from relay 2 to the selector.

What is claimed is:

1. In an automatic telephone exchange, a subscriber's line, a first connector switch having access thereto, and for making said line busy when connected thereto, a "no test" connector having access to and adapted to seize said line regardless of its busy condition, means in said "no test" connector for applying ringing current to said line, and means in said line responsive to seizure by said "no test" connector to connect a high impedance between the line and the first connector, to exclude from the first calling line all but a small amount of the ringing current applied to the called line by the no-test connector.

2. In an automatic telephone exchange, a subscriber's line, a first connector switch having access thereto, and for making said line busy when connected thereto, a "no test" connector having access to and adapted to seize said line regardless of its busy condition, means in said no test connector for applying ringing current to said line, and means in said line responsive to seizure by said "no test" connector to connect a small capacity condenser between the line and the first connector.

3. In an automatic telephone exchange, a subscriber's line, a first connector adapted to seize said line only if idle, and to thereafter make said line busy, a second connector adapted to seize said line regardless of its busy or idle con-

dition, means for transmitting impulses to move said second connector into connection with said line, means in said second connector responsive to the transmission thereto of a predetermined number of impulses after said line has been seized to apply ringing current to said line, and means associated with said line responsive to its seizure by said second connector to interpose a condenser between said line and said first connector.

4. In an automatic telephone system, a subscriber's line, a first connector and a "test" connector, each having access to said line, said test connector being adapted to seize said line regardless of its prior seizure by said first connector, means in said test connector responsive to dial pulses transmitted thereto subsequent to its seizure of said line to cause ringing current to be connected to the line, and means associated with the line responsive to its seizure by said test connector to introduce a relatively high impedance between said first connector and the line.

5. In an automatic telephone system, first and second connectors, a telephone line terminating in contact of both connectors, said first connector being arranged to seize said line only when idle and said second connector being arranged to seize said line regardless of its busy or idle condition, and means in said line responsive to seizure thereof by said second connector to interpose a high impedance between said line and the contacts of the first connector on which said line terminates.

6. In an automatic telephone exchange, a first calling line, a called line, a first connector switch having access to said called line and controlled over said first calling line, said first connector switch being adapted to make said called line busy when connected thereto, a second calling line, a no-test connector controlled over said second calling line and having access to and adapted to seize said called line regardless of its busy condition, means in said no-test connector controlled over said second calling line for applying ringing current to said called line, and means in said called line responsive to seizure of the line by the no-test connector to introduce a high impedance in the connection between said first connector and the called line to exclude from the first calling line all but a small amount of the ringing current applied to the called line by the no-test connector.

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