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H. W. ULRICH

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PREPAYMENT TELEPHONE SYSTEM

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2 Sheets-Sheet 1

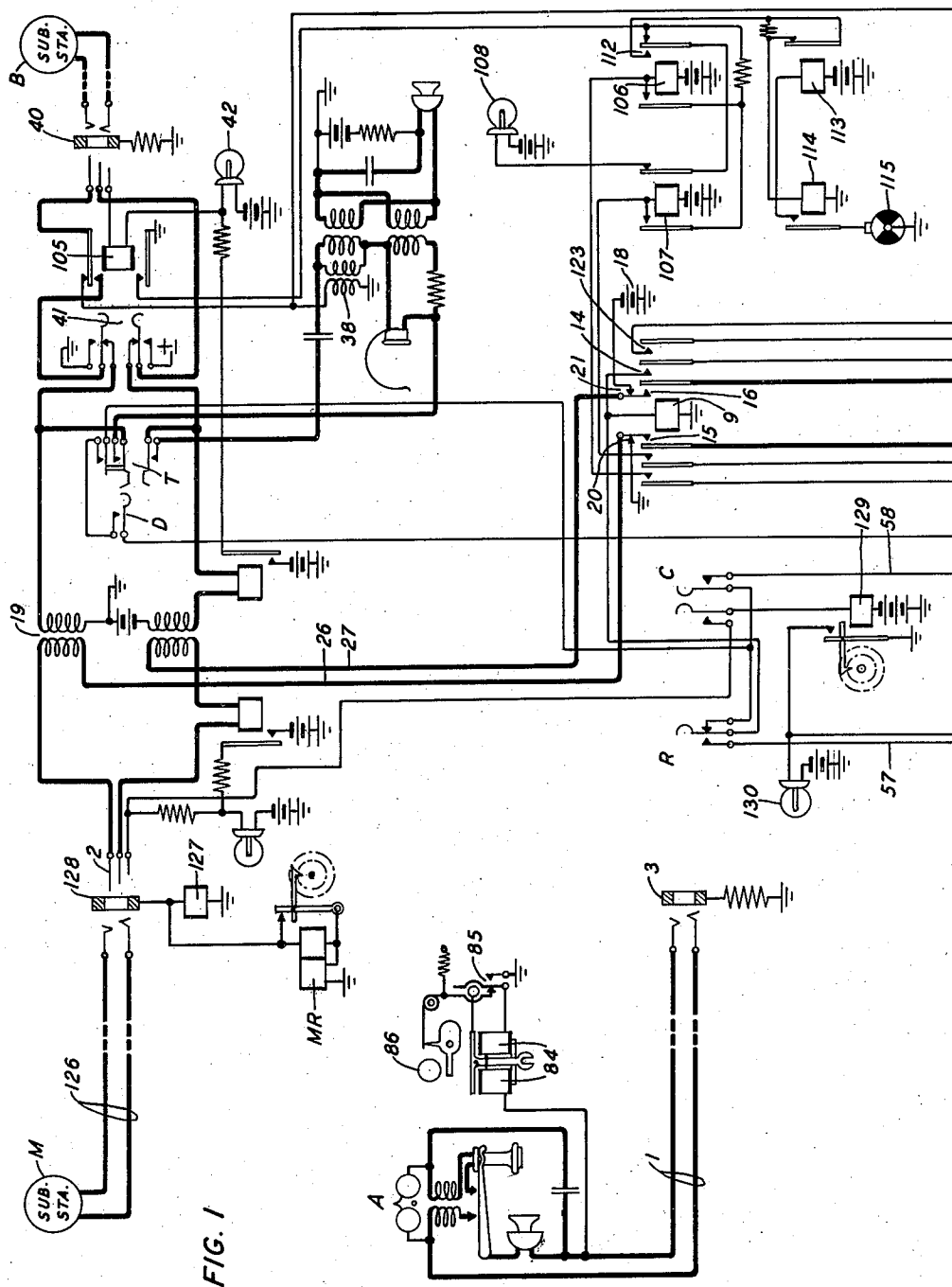


FIG. 1

INVENTOR

H. W. ULRICH

BY

H. L. Krugman

ATTORNEY

Aug. 30, 1938.

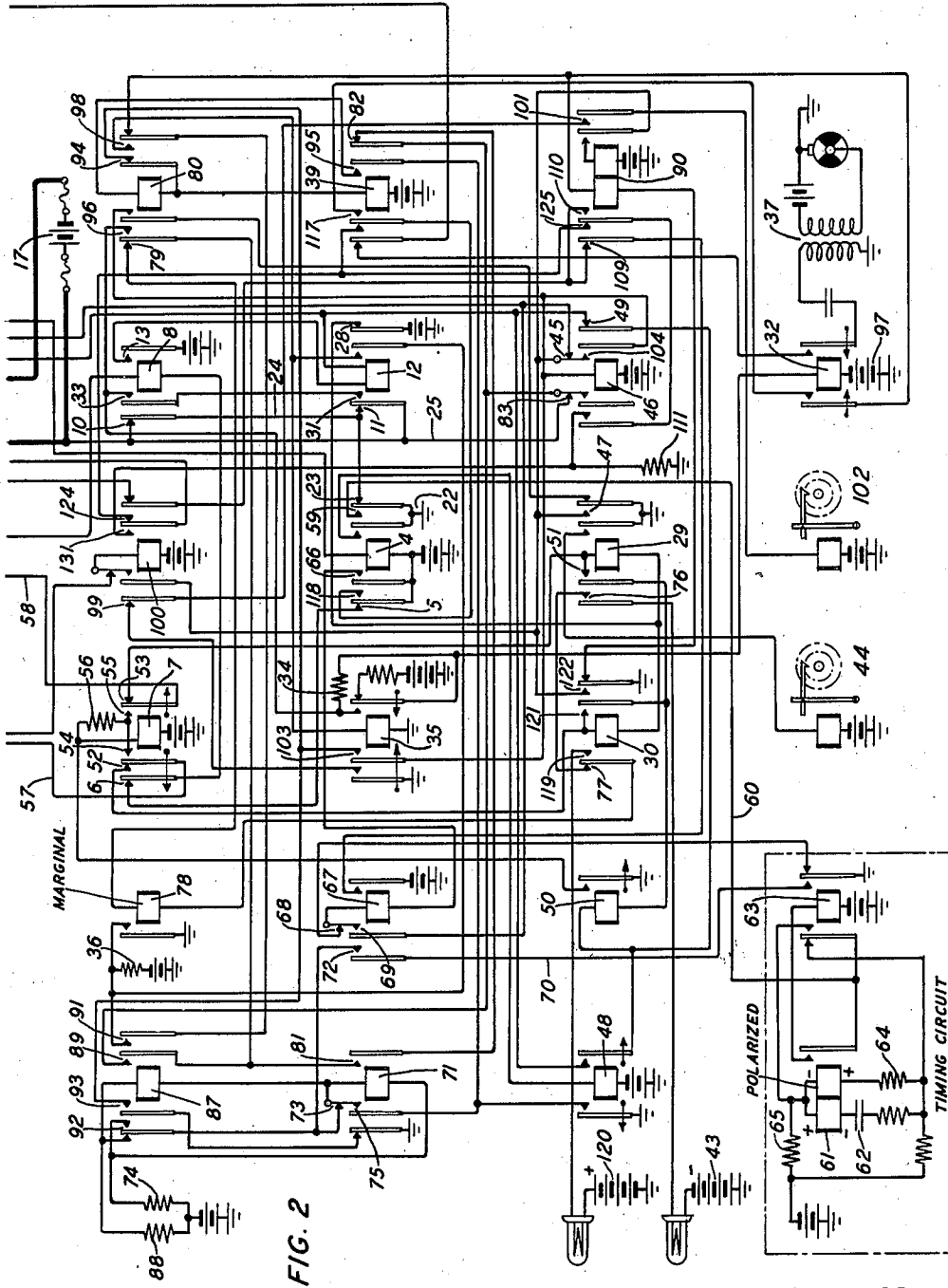
H. W. ULRICH

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2 Sheets-Sheet 2



INVENTOR
H.W. ULRICH

BY

ATTORNEY

UNITED STATES PATENT OFFICE

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PREPAYMENT TELEPHONE SYSTEM

Horace W. Ulrich, Newark, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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9 Claims. (Cl. 179-6.3)

This invention relates to an arrangement for telephone subscribers' switchboards designed to automatically test prepayment coin box subscribers' lines in order to detect fraudulent attempts to obtain service without depositing the required coin.

In a copending application Serial No. 35,226 filed August 8, 1935 for Anderson et al. which makes reference to an earlier filed application Serial No. 8,588 filed February 28, 1935 for Henry Hovland, a system is described having in brief, the following features:

A. A lamp signal common to the operator's position which is steadily lighted when the operator actuates a key associated with one of her cord circuits for the purpose of disposing a coin at a subscriber's station, which lamp is automatically caused to flash in case no ground is encountered on the line when the coin disposal current is first applied to the line or when a ground is present on the line at the time of the first application of current which is not caused to disappear thereby.

B. A second lamp signal is caused to flash in unison with the first lamp in the latter case, i. e. when the ground persists on the line after the first application of disposal current.

C. A tone test key which is operated in conjunction with the talk key of the cord prior to operation of the coin disposal key will cause a characteristic tone to be heard in the operator's receiver if ground is present on the line at the time which normally may be construed as indicating that the subscriber has deposited a coin in the box.

D. A guard lamp individual to the cord circuit is lighted each time the cord is plugged into an out trunk jack or called line and remains lighted until the operator actuates the coin disposal key associated with that cord.

E. Substitution of a non-grounded source of talking current for the usual grounded central office battery when a coin disposal key is operated which source remains connected to the calling line in place of the central office battery during the period coin potential is being applied to the line.

The present invention is an improvement on the arrangement described in the before-mentioned Anderson et al. application in that certain modifications, changes and additions, dictated by experimental use of the original arrangement have been made to render the system more efficient and satisfactory from a service standpoint.

One object of the present invention therefore

is to give the operator a beat indication if the coin, which may be in the box, is not disposed of due to failure of the disposal mechanism at the subscriber's station on the first application of coin disposal current, but to prevent its being disposed of by a second current application thereby making it possible for the operator after challenging the subscriber to initiate a second cycle of test current application which usually should dispose of the coin thus doing no injustice to the subscriber.

Another object is to reduce the number of signal lamps required for a position.

Another object is to prevent interference with the automatic test operation, when once started, by the accidental operation of a coin disposal key associated with another cord circuit from that over which the test is being made.

Still another object is to prevent the repetition of a test cycle on the same line in case the operator holds the coin disposal key operated for a longer interval than it takes the test circuit to complete one cycle.

A further object is to prevent a beat indication in case a cord circuit is plugged into a line having a call counting device connected in the sleeve circuit and the operator actuates one of the coin disposal keys, which key is arranged to control the call counter on such a connection, as well as to transmit coin disposal current on coin box lines.

A still further object is to give the operator a visual indication of the progress of a second test cycle initiated at some later time during the progress of a call, as for example, the collection of a coin deposited for overtime.

A feature of the invention whereby the first object is attained resides in reducing the voltage of the second and succeeding impulses of the test cycle from the high voltage sufficient to actuate the coin disposal mechanism at the station to a value which is ineffective to dispose of the coin if it was not disposed of by the first or high voltage impulse, but which is still sufficient to give a beat indication.

A feature in accordance with the second object resides in the elimination of the two common or position lamp signals employed in the Anderson et al. arrangement referred to, and the utilization of the individual guard lamp per cord of that arrangement which serves the three-fold purpose of a guard lamp which lights as soon as the calling plug is inserted in the out jack and remains steadily lighted until the coin disposal key is operated and also which flashes

either when no ground is encountered on the line by the first application of coin disposal current or when ground persists after the first impulse is applied and until the second impulse is transmitted.

A feature whereby the third object is attained resides in an arrangement whereby when the position circuit has been started the common lead from all cord circuits to the position circuit is opened and is not reclosed until the test cycle has been completed thereby preventing interference with the operation of the position circuit in case a coin disposal key of another cord should be operated during the test cycle then in progress.

A further feature whereby the fourth object is attained resides in preventing the position circuit from completely restoring to normal as long as the coin collect key remains operated thereby making it necessary to release the operated disposal key in order to enable all the position relays to restore in readiness for the start of a new cycle.

A feature whereby the fifth object is attained resides in extinguishing the coin disposal lamp when a message register operates in response to operation of a coin disposal key arranged for the dual function of coin control and message register operation.

A feature whereby the sixth object is attained resides in causing the coin disposal lamp to re-light in response to reoperation of a coin disposal key at any time after the first test cycle has been completed and before the called line has been disconnected, after which it is extinguished or flashed in the same manner as in the case of the first test cycle.

The invention will be understood from the following description when read in connection with the accompanying drawings:

Fig. 1 of which shows, at the left, two calling subscribers' lines, one commonly known as a message rate line, i. e. one equipped at the central office end with an electromagnetic message register or counter adapted to be operated by the operator, once for each completed connection, and the other line equipped at the subscriber's station with a coin box of the usual prepayment type and at the right of Fig. 1, a called subscriber's line. The remainder of Fig. 1 together with Fig. 2 represents an operator's cord circuit and the necessary positional equipment arranged in accordance with the present invention to establish a conversational connection between either of the calling stations and the called station.

A detail description of the operation of the circuit arrangement shown on the drawings follows:

COIN BOX LINE CALLS

It will first be assumed that the coin box subscriber A, shown at the left of Fig. 1, desires to be connected with a called subscriber B, shown at the right of Fig. 1.

By one well-known arrangement for coin box lines, the line circuit at the central office may be so arranged as to necessitate the deposit of a coin in the box at the calling subscriber's station in order to attract the attention of the operator which method we may call the "nickel first" method, or, by another well-known arrangement of the line circuit, it may only be necessary for the subscriber to lift his receiver from the hook to display the line lamp at the central office, a coin being deposited later, at the request of the operator, which is usually referred to as the "nickel

last" method. Such coin box lines usually have this line lamp at the switchboard colored in some distinctive fashion to warn the operator that such lines require some prescribed action, and special attention, in order to insure payment for each completed connection.

The above-referred to "nickel last" method, which is the one most commonly used for subscribers' coin box lines, as above stated, necessitates that the operator request the subscriber to deposit a coin immediately following his giving the number of the wanted line, which coin is then collected by the operator as soon as the called subscriber answers.

In order that fraudulent attempts to avoid payment by grounding the line in some other manner than by a coin, certain features of the invention, for detecting such fraudulent practices, are resorted to and hereinafter described.

Assuming that the line circuit 1 is arranged on a "nickel last" basis, as soon as the operator notes the lighted line lamp, not shown, she inserts plug 2 of her cord circuit into jack 3 and inquires the number of the wanted line and immediately thereafter requests the subscriber to deposit a coin, usually a nickel.

Tone test for ground

The operator then proceeds to make the usual click test of the called line for a busy condition, by touching the tip of the plug to the line jack, and at the same time tests the calling line for coin ground by operating the detector key D associated with the cord (the talking key T remaining operated). A circuit can now be traced from battery, contacts 5 of relay 4, contacts 6 of relay 7, winding of relay 8, contacts of the detector key D and talk key T, normal contacts of the coin return key R and the winding of the cord circuit relay 9 to ground. Relays 8 and 9 operate in this circuit.

Relay 9 in operating, first closes its inner contacts 15 and 16 thereby connecting the auxiliary battery 17, in parallel with the regular cord circuit battery 18, between the left-hand windings of the cord circuit repeating coil 19. The complete attraction of the inner left and right armatures of relay 9 thereafter opens the contacts 20 and 21 thereby disconnecting the regular battery 18 from the cord and leaving the auxiliary battery 17 connected in its place.

With relays 8 and 9 operated a circuit is closed to operate relay 12 which can be traced from battery, contacts 13 of relay 8, winding of relay 12, contacts 14 and the winding of relay 9 to ground.

The operation of relay 8 also opens its contacts 10 thereby removing a parallel path around the contacts 11 of relay 12. This is to insure that the positional ground 22 is removed from the auxiliary battery 17 after relay 9 has operated and that it will be reconnected before relay 9 is finally released. With relays 8 and 12 released, two paths are provided for the positional ground 22 to auxiliary battery 17, one of which paths can be traced from ground 22, contacts 23 of relay 4, conductor 24 and contacts 10 of relay 8 to the positive pole of battery 17, and the other path may be traced from ground, contacts 23, contacts 11 of relay 12 and conductor 25 to the battery 17. The operation of relay 8 opens its contacts 10 and interrupts first path from ground 22 to battery 17, but the second path is not opened until relay 12 operates to open its contacts 11.

It will be further noted that ground is not re-

moved from the upper left winding of repeating coil 19 until relay 9 has completely attracted its inner left armature. From the foregoing it will be obvious that the sequence of operations is as follows: First, when relay 9 initially closes its contacts 15 and 16, battery 17, which is still grounded over contacts 11 of relay 12, is connected in parallel with the cord circuit battery 18 across the cord by way of conductors 26 and 27. Second, when relay 9 is fully operated, its contacts 20 are opened and relay 12 operates to open its contacts 11 thereby finally removing the last ground connection to battery 17 and therefore this battery is now ungrounded and connected across the cord in place of battery 18.

Relay 12 in operating also opens its contacts 28 thereby removing battery from the windings of relays 29 and 30 which will prevent these relays from operating in case a coin key such as R or C in another cord should be operated while the present coin test is being made.

Relay 12 also closes its contacts 31 which connects relay 32 to the tip conductor of the cord over a circuit which can be traced from the tip winding of repeating coil 19, conductor 26, contacts 15 of relay 9, contacts 31 of relay 12, contacts 33 of relay 8, resistance 34 and winding of relay 32 to battery, and further, relay 12 energizes slow operate relay 35 in a circuit which can be traced from battery, resistance 36, inner right contact of relay 12 and winding of relay 35 to ground. Slow relay 35 finally operates and at its outer right contact removes the shunt from the winding of relay 32 which, until this time has prevented relay 32 from operating. Now, if ground is present on the line, which for the present may be assumed to indicate the presence of coin in the box at the subscriber's station, relay 32 will operate over the circuit previously traced from the tip of the line, conductor 26 and contacts of relays 9, 12 and 8. The operation of relay 32 connects at its right-hand contact the tone source 37 to the operator's telephone set coil 38 in an obvious circuit including the outer left back contact of relay 39. Upon hearing the tone in her receiver the operator releases the key D which in turn releases relays 8, 9, 12, 35 and 32.

If no ground is present on the line, relay 32 will not operate and no tone will be heard by the operator who will then challenge the calling subscriber and request payment before completing the establishment of the desired connection.

Operator plugs up called line

Assuming that a ground is now present on the line the operator proceeds to extend the calling line by plugging the other end of the cord circuit into the called subscriber's line jack 40 and rings the called subscriber by means of the ringing key 41.

Collecting the coin

The foregoing test may also be made by the operator while she is receiving the details of the wanted connection, and if she receives the tone signal it will obviously not be necessary to request the deposit of a coin. As soon as the called subscriber answers, as indicated by the illumination of supervisory lamp 42, the operator proceeds to collect the coin in the calling subscriber's box by operating the coin collect key C thereby completing the following circuit for again operating relay 9 and also relay 29: Ground, winding of relay 9, normal contacts of key R and the right-hand closed contacts of key C, right back contact of relay 7, winding of relay 29 and contacts 28 of

relay 12 to battery. Operation of relay 29 closes a locking path for itself and relay 9 which can be traced from ground, winding and contact 14 of relay 9, contacts 49 of relay 46, winding of relay 50, contacts 51 and winding of relay 29 and contacts 28 of relay 12 to battery which circuit is not effective, however, to operate relay 50 until the key C is restored. Relay 29 also completes an obvious circuit for operating the collect register 44. With both relays 9 and 29 operated a circuit is closed to operate relay 4 which can be traced from battery, winding of relay 4, outer right contact of relay 9, contacts 45 of relay 46 to ground at contacts 47 of relay 29. Relay 4 closes its contacts 66 to operate relay 67 provided the timing interrupter circuit (shown in the lower left corner of Fig. 2) is not operating for another position. This circuit can be traced from battery, contacts 66 of relay 4, winding and contacts 68 of relay 67 to ground at the right back contact of relay 63. Relay 67 locks up over its contacts 69 in the following circuit: Battery, contacts 66 of relay 4, winding and contacts 69 of relay 67, contacts 45 of relay 46 and contacts 47 of relay 29 to ground.

Operation of relay 9 also disconnects the cord circuit battery 18 from the cord and substitutes the auxiliary battery 17 therefor which, prior to operation of relay 4, is connected to ground 22 at contacts 23 of relay 4, but when relay 4 operates and opens its contacts 23, ground 22 is disconnected from battery 17, and the tip of the cord. Further, operation of relay 4 closes, at its inner right contacts, an obvious circuit to operate relay 48 which relay in operating closes, at its right-hand contact, a path in shunt to contact 49 of the release relay 46, which contacts are included in the previously traced locking circuits for relays 9 and 29.

When key C is released (it only being necessary to operate this key momentarily) the short circuit is removed from relay 50 and this relay now operates in the previously traced locking path for relays 9 and 29.

Relay 50 operates relay 7 in an obvious circuit which relay opens its contacts 52 and 53 and closes contacts 54 and 55 thereby disconnecting conductors 57 and 58 from relays 30 and 29, respectively, and connects these conductors together, through resistance 56, to ground at relay 50.

When relay 4 operated it also connected ground at its contacts 59 to lead 60 extending to the timing circuit, shown at the lower left corner of Fig. 2, which causes polarized relay 61 to operate, after a short interval of the order of .2 second depending on the capacity of condenser 62. The circuit for operating relay 61 can be traced from ground, contacts 59 of relay 4, conductor 60, outer left contact of relay 63, resistance 64, right-hand winding of relay 61 and resistance 65 to battery. During the time required for condenser 62 to become charged, the left-hand winding of relay 61 will also be energized and will oppose the right-hand winding thereby preventing the relay from operating until the condenser is charged at which time the current in the left-hand winding will decrease to zero and the relay will operate. When relay 61 operates it closes a circuit to operate relay 63 in a circuit which can be traced from ground, contacts 59 of relay 4, contacts of relay 61 and winding of relay 63 to battery. Relay 63 in operating, opens its left-hand back contact and interrupts the operating circuit of relay 61 which after an interval releases, depending on the time required for condenser 62 to discharge

through the left-hand winding. Therefore, relays 61 and 63 will alternately operate and release approximately 2 to 2½ times per second as long as relay 4 remains operated.

5 Relay 63 in closing its inner right contact, completes a circuit to operate relay 71 which can be traced from ground, inner right contact of relay 63, contacts 72 of relay 67, contacts 73 and winding of relay 71 and resistance 74 to battery. Relay 10 71 in operating closes its locking contacts 75 to hold itself operated to ground at the left contacts of relay 48 and also connects at its contacts 81, the negative coin battery 43 (110 volts) to the tip of the cord and line over the following circuit, battery 15 43, contacts 76 of relay 29, contacts 77 of relay 30, winding of relay 78, contacts 79 of relay 80, contacts 81 of relay 71, contacts 82 of relay 39, contacts 83 of relay 46, contacts 15 of relay 9 and conductor 26 of the tip winding of repeating 20 coil 19 and thence to the tip of the line and the subscriber's station where the circuit passes through the winding of coin magnet 84 to ground at contacts 85 which contacts are closed if a coin 25 86 is in the box. Further, when relay 71 energizes an operating path for relay 87 is closed at contacts 75 but this relay is shunted by ground at the inner right contacts of relay 63 over contacts 72 of relay 67 and its own outer left contacts.

As the timing interrupter circuit continues to 30 function relay 61 soon releases thereby opening the energizing circuit for relay 63 which releases and opens its inner right contact thereby removing the shunt circuit from relay 87 which relay then operates in a circuit from ground, left-hand contacts of relay 48, contacts 75 of relay 71, 35 winding of relay 87 and resistance 88 to battery.

Relay 87 in operating closes its contacts 89, a shunt path around the contacts 81 of relay 71 and 40 contacts 82 of relay 39 in the before traced path for coin battery 43 to the tip of the line.

In case a coin condition exists on the tip of the line, i. e., ground is present, relay 78 will operate in the previously traced coin battery circuit and short-circuit the left-hand winding of relay 90 45 which relay was conditioned for operation by the closure of contacts 91 of relay 87 when that relay operated. Relay 90, therefore, is prevented from operating if ground exists on the tip of the line when the first impulse of coin battery is applied to the line, i. e., if relay 78 operates. 50

When the timing circuit relays 61 and 63 operate the second time, relay 63 short-circuits relay 71 which releases. This circuit can be traced from ground, right front contact of relay 63, 55 contacts 72 of relay 67, contacts 92 of relay 87 to the lower terminal of the winding of relay 71. As the upper terminal of this relay is also connected to ground over its contacts 75 it therefore releases. Relay 87, however, is held operated, 60 when relay 71 releases, over contacts 73 of relay 71, contacts 72 of relay 67 and front contacts of relay 63 to ground. Relay 71 in releasing opens, at contacts 81, the initially traced circuit for the coin battery 43 to the tip of the line but this 65 circuit is maintained over contacts 89 of relay 87 which relay is held operated.

When relay 71 released and relay 87 operated, a circuit was closed to operate relay 39 which can be traced from ground, outer left back contacts 70 of relay 71, contacts 93 of relay 87, contacts 94 of relay 80 and winding of relay 39 to battery. Relay 39 opens, at its contacts 82, another point in the initially traced circuit for the coin battery 43 to the line but this battery still remains connected to the line over contacts 89 of the operated 75

relay 87 which contacts shunt both contacts 81 of relay 71 and contacts 82 of relay 39. Relay 39 in operating closes its contact 95 thereby connecting ground to the upper terminal of relay 80 thus short-circuiting it, the lower terminal of this 5 relay being also connected to ground at its contacts 94.

When the timing circuit relays 61 and 63 release for the second time the release of relay 63 10 opens the holding circuit of relay 87 which relay releases and breaks its contacts 93 which disconnects ground from contacts 94 of relay 80, and the lower winding terminal of relay 80 and from the winding of relay 39. Relay 39 does not release as it now holds operated in series with relay 80, 15 which operates, in a circuit traced from battery, winding of relays 39 and 80, contacts 95 of relay 39 and the left-hand front contacts of relay 48. Relay 87 in releasing also opens at its contacts 89 the circuit for the coin battery 43 to the line 20 which has now been connected to the line for about six-tenths of a second.

When relay 80 operated it opened its contacts 79 and closed its contacts 96 thereby preparing a 25 secondary coin test circuit for connecting battery 97 (approximately 50 volts) to the tip of the line in place of the higher (110 volts) voltage battery 43 which circuit is, however, open at contacts 89 of relay 87. The reason for making the secondary coin test with a lower voltage battery is outlined in 30 the hereinbefore mentioned first object and feature of the invention.

On the third closure of timing relays 61 and 63 relay 71 again operates but performs no function other than to prepare the circuit to operate relay 35 35 87 when relay 63 releases.

When relays 61 and 63 release relay 87 again operates which closes the previously prepared test circuit from battery 97 to the tip of the line which can be traced from battery 97, winding of relay 40 32, resistance 34, contacts 96 of relay 80, contacts 89 of relay 87, contacts 83 of relay 46, contacts 15 of relay 9 (Fig. 1) and conductor 26 to the tip of the line. This second test is applied approximately four-tenths of a second after the first test 45 impulse is discontinued.

When relay 80 operated it also closed its contacts 98 thereby preparing a circuit to operate slow relay 35. When relay 35 operates, after a short delay, it short-circuits the resistance 34 50 thereby connecting the full potential of battery 97 through relay 32 to the line.

Prior to operation of relay 35, relay 32 is shunted at the right back contact of relay 35 and hence cannot operate until relay 35 operates even 55 though ground is still present on the line which will be discussed later on.

Relay 35 in operating also closes its outer left contact, thereby connecting ground over contacts 99 of relay 100 to the open contacts 101 of relay 60 90, thereby preparing a circuit to operate the "beat" register 102.

Now, if the coin condition (ground) was removed from the line, in the usual manner immediately following the cessation of the first test 65 impulse, relay 32 will not operate under the second test condition.

On the fourth closed period of relay 63 relay 71 releases whereupon it closes its left-hand back contacts and completes a previously prepared circuit to operate the release relay 46 which can be traced from ground, left back contact of relay 71, contacts 93 of relay 87, contacts 103 of relay 35 and winding of relay 46 to battery, which relay 70 46 operates and locks up over its contacts 75

104 to ground at contacts 47 of relay 29, opens, at its contacts 45, the connection between battery 97 and the line, and also opens the circuit of relays 4 and 67 which thereupon release and completes a circuit to operate the coin disposal relay 107 which extinguishes the guard lamp 108 (Fig. 1) which was lighted when the calling plug was inserted in the called line jack 4 by virtue of the operation of sleeve relay 105.

Relay 107 in operating locks up over its contacts to ground on the sleeve relay 105.

It will be noted that, as before mentioned, the guard lamp 108 was lighted as soon as the cord circuit was connected to the called line and was not extinguished until after the key C was operated and the coin disposal circuit arrangement went through its operation cycle. This lighted lamp insures that the operator does not neglect to dispose of the coin as it is necessary to operate either key C or R to extinguish it, or disconnect from the called line.

Release of relay 4 reconnects ground 22, by way of conductor 24 and contacts 10 of relay 8, to the auxiliary battery 17 and to the tip of the line, opens its contacts 59 thereby removing ground from relay 61 and stopping the interrupter timing circuit and at its inner right contacts releases relay 48.

The release of relay 48 opens at its right-hand contact the previously traced locking circuit for relays 9 and 29, including relay 50, which relays thereupon release and at its left-hand contacts removes ground to release relays 71, 87, 80 and 39.

The release of relay 50 opens the circuit of relay 7 which releases, which completes restoration of the coin disposal circuit to normal.

In case the operator holds collect key C operated during the complete cycle of operation of the position coin control circuit, relay 50 will remain short-circuited, as previously described, under which condition relays 29, 46 and 9 remain operated under direct control of the collect key C thus preventing the position circuit from going through repeated cycles on prolonged closures of the collect key. When the collect key C is held operated until the cycle is completed and then released, it releases relay 29 which releases relay 46 thereby closing the contact 49 which again prepares the circuit for locking relays 9 and 29 when a key C is again operated and subsequently released and also closes contact 45 thereby preparing an energizing circuit for relay 4 which, when operated, restarts a second cycle.

In case another collect key at the position is operated after the first key is released but before the present collect cycle is completed, relay 7 will be held operated, after relay 50 releases, over resistance 56, the newly operated collect key and the winding of the cord circuit relay corresponding to relay 9, thus preventing the position from completely restoring to normal. That is to say all keys must be released for a sufficiently long period to permit the disposal circuit to complete its cycle and restore before a key is again operated to start a new cycle of operation.

In cases where a coin has been collected in the normal manner causing the guard lamp 108 to be extinguished and it should be necessary to request and collect a second coin as an overtime charge, without disconnecting the cord from the called line, a second operation of the collect key C will initiate a second cycle of operation of the position circuit and when relay 4 operates battery

will be connected over contacts 118 of relay 4, left-hand inner normal contacts of relay 39, contacts 124 of relay 100, and the left-hand middle contacts of relay 9 to the upper terminal of relay 107 thereby short-circuiting it and causing its release and the consequent relighting of lamp 108, from which point the circuit functions the same as for the collection of the first coin.

No ground on line when collect key operated

In case the calling subscriber has failed to deposit a coin before the collect key C is operated, ground will be absent from the tip of the line and relay 78 will not operate. Therefore, when relay 87 operates in response to the first release of relay 63, the flashing relay 90 will operate in a circuit which can be traced from ground at the outer right contact of relay 30, left-hand winding of relay 90, outer right contacts of relay 80, contacts 91 of relay 87 and resistance 36 to battery. Relay 90 operates in this circuit and locks in an obvious circuit through its right-hand winding to ground at contact 47 of relay 29. At its contacts 101, relay 90 closes the previously prepared circuit to operate the "beat" register 102 from ground at the outer left contact of relay 35. At its contact 109, relay 90 disconnects battery, supplied at the right-hand contacts of relay 67, from the upper terminal of relay 106, thereby removing the short-circuit from this relay and, at contacts 110, relay 90 connects the outer left armature of relay 46 to the same relay (106). When the circuit has completed its cycle, release relay 46 operates as before described to restore the circuit to normal. The operation of relay 46 closes its outer left contact, thereby connecting ground through resistance 111 to relay 106 which now operates. Relay 106 in operating opens its outer right normal contacts thereby removing the steady ground from guard lamp 108 and at contact 112 it connects lamp 108 to ground through the back contacts of relay 113 and winding of relay 114 which operates, thereby connecting the grounded interrupter 115 to the winding of relay 113 which alternately operates and releases once per second. Relay 106 in operating locks itself to ground at sleeve relay 105, therefore lamp 108 will continue to flash, as an indication of a non-standard condition at the subscriber's station, until the operator removes the plug from the called line jack 40 which unlocks relay 106.

Ground persists on line after first impulse is terminated

If ground is present on the tip of the line when the first impulse of 110 volt battery is connected, and still persists when relay 35 operates following the third release of the timing circuit (relay 63), relay 32 operates in series with the 50 volt battery 97 to the ground at the subscriber's station thereby closing a circuit to operate the flashing relay 90 which can be traced from ground at the right back contact of relay 30, left-hand winding of relay 90, left-hand contact of relay 32, contact 117 of relay 139 and contact 118 of relay 4 to battery. Relay 90 locks up, as before, over its right-hand winding, inner right contact and contact 47 of relay 29 to ground and when the collect cycle has been completed and the release relay 46 retracts its armature, relay 106 operates to transfer the guard lamp 108 to ground through the winding of relay 114 over the contact of relay 113 whereupon lamp 108 flashes as before independent of the rest of the position circuit, which is now restored, until the operator

withdraws the plug from jack 40. This flashing lamp, as before, is an indication of a non-standard condition at the subscriber's station and requires the operator's attention.

5 In this last case mentioned, i. e., if ground persists after the first impulse is disconnected, the circuit of the 50 volt battery 97 to the line includes the winding of relay 78 as in the case when the 110 volt battery 43 is connected, but in this 10 latter case relay 78, which is marginal does not reoperate on the lower potential of battery 97 which is the same condition encountered in normal operation when the ground disappeared following the discontinuance of the first impulse of 15 110 volt battery. The reason for reducing the potential of the second test impulse, as referred to earlier in the specification, is to prevent collection of a coin which, due to some faulty condition of the coin box, was not disposed of when 20 the first impulse was transmitted.

In either of the foregoing unstandard conditions indicated by flashing of lamp 108, the operator will disconnect the called line and challenge the subscriber requesting him to deposit a coin. 25 If he had not done so originally he will do so now and the operator will again plug up the called line and reoperate key C whereupon the circuit will go through a second cycle, the first 110 volt impulse of which should then dispose of the ground and extinguish lamp 108. 30

If the subscriber's coin box is sluggish or for some other reason does not release the coin at the end of the first impulse, or if the subscriber has fraudulently grounded the line at his station 35 to simulate the coin ground, which ground, obviously, will not be removed by the 110 volt impulse, this condition will also be indicated by the flashing of lamp 108 and the operator will, as before, disconnect the called line and challenge the subscriber. If the subscriber insists he has deposited 40 a coin and the lamp 108 again flashes at the end of the second test cycle, the operator will report the line as out of order and, depending on the circumstances, will either refuse the subscriber's 45 service or establish the desired connection without further discussion. If the ground at the station was fraudulently connected, the subscriber will, generally, remove it at once upon being challenged and either deposit a coin, which will 50 then be collected in the manner herein described or will abandon the call.

Returning the coin

If for any reason the operator desires to return 55 a deposited coin to the calling subscriber, the return key R is operated which operates relays 9 and 30 in the following circuit, ground, winding of relay 9, left contacts of key R, contact 52 of relay 7, winding of relay 30, to battery at contacts 60 28 of relay 12.

The operation of relay 30 prepares, at its contacts 119, a circuit for connecting the positive 110 volt coin battery 120 to the line, which circuit, however, is not completed until the first closed 65 period of the timing circuit, and relay 71 operates. Relay 30 also, in closing its locking contact 121, locks up in series with relays 9 and 50 in a circuit which can be traced from ground, winding and contact 14 of relay 9, contact 49 of relay 46, winding of relay 50, contact 121 and the 70 winding of relay 30 and contact 28 of relay 12 to battery. Relay 50 operates in this circuit and closes its contacts thereby operating relay 7 which, in operating, disconnects conductors 57 75 and 58 from the position circuit and connects

them together through resistance 56 to ground at relay 50.

Relay 30, in operating, also operates relay 4 in a circuit which can be traced from ground, contacts 122 of relay 30, contacts 45 of relay 46, 5 contacts 123 of relay 9 and winding of relay 4 to battery. Further the operation of relay 30 removes ground at its outer right contact from the left-hand winding of the flashing relay 90 thereby preventing this relay from operating under the 10 "return coin" condition. The operation of relay 4 closes a circuit to operate relay 67 which in operating locks up over its contact 68 and the contacts 45 of relay 46 to ground at contacts of relay 30. Relay 67 in operating short-circuits 15 relay 106.

Relay 4 also closes an obvious circuit to operate relay 48 and closes, at its contact 59, a circuit to energize relay 61 in the timing circuit, which timing circuit then functions in the before-de- 20 scribed manner to operate relay 71 which closes its contacts 81 to complete the previously prepared circuit from positive battery 120 to the line which circuit includes relay 78 which relay will operate if a ground is present on the line. Under 25 the "return" condition operation of relay 78, however, performs no useful function.

On the first open period of the timing circuit relays, relay 87 operates and on the next closed period of the timing circuit, relay 71 releases. 30 With relay 87 operated and 71 released, relay 39 operates which closes at its contact 95 a circuit from ground at relay 48 to the upper terminal of relay 30 which relay, however, cannot operate in series with relay 39, until the ground on its lower 35 terminal is removed by the release of relay 87 which, however, occurs at the end of the second open period of the timing circuit. At this time, however, relay 30 operates in series with relay 39 and the circuit from battery 120 of the line is 40 opened, first at contacts 89 of relay 87. As the coin battery circuit is opened, relay 78 will release, if operated.

Operation of relay 30 operates release relay 46 in a circuit which can be traced from battery, 45 winding of relay 46, inner left contact of relay 80 and outer right back contacts of relay 29 to ground. Relay 46 locks, over its contacts 104, to ground at contact 122 of relay 30 and at its outer left contact closes a circuit to operate relay 107, 50 thereby extinguishing guard lamp 108, which lamp as before mentioned was lighted as soon as the calling plug was inserted in jack 40 of the called line.

The circuit for operating relay 107 can be 55 traced from battery, winding of relay 107, left-hand middle contact of relay 9, contact 124 of relay 100, contact 125 of relay 90, outer left contact of relay 46 to ground through resistance 111. Relay 107 in operating locks up, at its contacts, 60 to the sleeve relay 105 thereby preventing lamp 108 from relighting. Relay 46 also stops the timing circuit by opening its contact 59 and releases relays 4, 67, 48, 30, 50, 7 and 9. The circuit is then restored to normal. 65

"MESSAGE RATE" LINE CALLS

It will now be assumed that the message rate subscriber M shown in the upper left corner of Fig. 1 desires to be connected with subscriber B. 70 As such message rate line circuits are well known no description is necessary except to state that such lines employ the usual common battery line circuit and are characterized merely by the addition of a grounded message register or meter 75

MR connected to the sleeve circuit of the line in parallel with the usual sleeve cut-off relay indicated on the drawings as 127. Therefore, to call, the subscriber merely lifts his receiver from the hook which lights the line lamp (not shown) at the central office, in the usual manner.

As in the case of coin box lines such message rate lines are characteristically indicated by some distinctive coloring of the line lamp which warns the operator that some further action is required, on her part, as soon as the connection is completed, in order to register the call on the subscriber's line meter.

When the operator notes the lighted line lamp, not shown, she inserts plug 2 in jack 128, inquires the number of the wanted line and proceeds to establish the desired connection by plugging into jack 40, thereby lighting guard lamp 108.

As the operator is aware, by the color of the calling signal, that the line is of the message rate type, no tone test in this case is necessary.

In the case of a message rate line, it is not necessary to register the call at the beginning of the conversation, but due to the fact that the same operator is handling both coin box and message rate lines and the coin box lines require that a coin be collected at the start of conversation in order to prevent the subscriber from obtaining service without payment, it is desirable to make it a uniform practice that the operator also register message rate calls at the same stage of the connection as in the case of the coin box line, i. e., as soon as the called subscriber answers. Further, in order to conserve apparatus it is possible, as hereinafter described to arrange the collect key C so that it serves a dual purpose, i. e., either as a coin collect key if the calling line is provided with a coin box or as a message register key if the calling line is equipped with a message counting device or register. Therefore, because of the arrangement of the apparatus and circuits and to simplify operating practice, the operator is instructed to operate key C as soon as the called subscriber answers, i. e. when the call supervisory lamp 42 is extinguished, in all cases irrespective of the character of the calling line.

In this case we have assumed that the calling line is a message rate line and therefore when the supervisory lamp 42 is extinguished, indicating that the called subscriber has answered, the operator presses key C, this time to operate the call meter or register MR connected to the subscriber line.

When key C is operated the position register 129 operates in series with the line register MR, thereby lighting the message register pilot lamp 130 in parallel with the message register relay 100. Operation of key C also operates relays 9 and 29 as before described in connection with disposal of a coin. When relay 29 operates it completes, at its contact 47, a locking circuit for relay 100 which relay remains locked until the position circuit has gone through its complete cycle and releases relay 29 as described under the condition of no ground on the coin box line.

Relay 100 operated opens its contacts 124 thereby removing the short circuit from relay 107 and closes its contact 131 thereby operating relay 107 which relay opens the circuit of lamp 108 and locks up to the sleeve relay 105. Relay 100 also opens its contact 99 thereby preventing operation of the "beat" register 102 when relay 90 operates following the first open period of the timing circuit.

Under the condition described, operation of

relay 100 prevents lamp 108 from flashing and also prevents the "beat" register 102 from operating when the position circuit, in passing through its operation cycle, does not find ground on the tip of the line when the coin battery 43 is first connected which is the normal condition in the case of a message rate line.

What is claimed is:

1. In a prepayment coin system for telephone exchanges, calling subscribers' stations, a central office, lines connecting said calling stations and central office, called lines, a device at each calling station adapted to connect ground to the line responsive to the insertion of a coin therein, a plurality of link circuits at the central office each adapted to connect one of said calling lines to one of said called lines, automatic means initiated at the central office for periodically transmitting a predetermined plurality of current impulses to a calling line over a connected one of the link circuits to dispose of a deposited coin at the connected station and remove the ground therefrom, a signal device individual to the connected link circuit, and circuit means for controlling said device, said circuit means being adapted to display said device when the link is connected to the called line, to retire the device if the first current impulse encounters ground on the calling line and the second does not, and to alternately retire and display the device at a definite periodic rate either if the first impulse transmitted does not encounter ground or the second impulse does encounter ground.

2. In a prepayment coin system for telephone exchanges, a calling subscriber's station and line, a called subscriber's line, a central office terminating said lines, a device at the calling station adapted to connect ground to the line responsive to the deposit of a coin therein, a link circuit at the central office adapted to connect said calling and called lines, means initiated at the central office for transmitting current of a predetermined potential to the calling line over said link circuit to dispose of the deposited coin and remove the ground from the line, and a signal lamp and circuit means for controlling said lamp associated with the link circuit said circuit means being adapted to first light said lamp when the link is connected to the called line, to extinguish it on the disposal of the coin at the calling station and relight it in response to the reinitiation of said current transmission means prior to the disconnection of said link from the called line.

3. In a prepayment coin system for telephone exchanges, a calling subscriber's station, a central office, a line interconnecting said calling station and central office, called lines, a device at the calling station adapted to connect ground to the line responsive to the deposit of a coin therein, a plurality of link circuits at the central office each being adapted to connect said calling and one of said called lines, switching means individual to each link circuit adapted when operated to initiate periodic application of current impulses of a predetermined potential to the answering end of the respective link circuit and thence to the connected calling line to dispose of said coin at the calling station and to remove ground from the line, and means to prevent the operation of a switching means associated with any other link circuit from affecting the application of current impulses already initiated to a first link circuit.

4. In a prepayment coin system for telephone exchanges, a calling subscriber's station, a cen-

tral office, a line connecting said calling station and the central office, called lines, a device at the calling station adapted to connect ground to the line responsive to the deposit of a coin therein, a link circuit at the central office adapted to connect said calling and one of said called lines, switching means associated with the link circuit adapted when operated to initiate the periodic application of a predetermined number of current impulses to the link circuit and thence to the line to dispose of the coin at the calling station thereby removing ground from the line, and means for preventing a cyclic repetition of said impulses if the switching means is held operated after said predetermined number of impulses have been transmitted.

5. In a prepayment coin system for telephone exchanges, a central office, prepayment coin box lines terminating thereat, a message rate line also terminating thereat having a call meter associated with the sleeve circuit thereof at the central office, a cord circuit adapted to extend either of said lines to a called line, a signal lamp, and circuit means for controlling said lamp associated with said cord circuit said circuit means being adapted to light said lamp in response to the connection of either of said lines to a called line, a key associated with said cord adapted when operated to initiate means for transmitting impulses of current to said cord circuit and thence to the answered line to control a coin box mechanism if associated therewith and to control the sleeve circuit of the answered line to actuate a call meter if associated therewith, means for causing said lamp to flash at a steady rate in case the cord circuit is connected to a coin box line and no ground is present on the line when the cord circuit key is operated, and means for extinguishing said lamp and preventing its flashing when the call meter in an answered message rate line operates in response to the operation of said cord circuit key.

6. In a prepayment coin system for telephone exchanges, a calling subscriber's station, a central office, a line connecting said calling station and central office, called lines, a device at the calling station adapted to connect ground to the line in response to the deposit of a coin therein, a cord circuit at the central office adapted to connect said calling and one of said called lines, a signal lamp and circuit means for controlling said lamp associated with the cord circuit said

circuit means being adapted to light said lamp when the cord is connected to the called line, and automatic means initiated at the will of an operator for transmitting a first impulse of current to the cord circuit and thence to the line of sufficient potential to dispose of a deposited coin at the calling station and to remove the ground from the line and to transmit a predetermined number of successive impulses of such reduced potential as to be ineffective to dispose of the coin, which may be present in the device of the calling station after the first impulse is transmitted, to extinguish said lamp if no ground is present on the line when the second and reduced impulse is transmitted and to cause said lamp to flash if the second and reduced impulse encounters ground.

7. A system in accordance with claim 1, characterized in this that said signal device is adapted to be redisplayed, before said link is disconnected from the called line, in response to a reinitiation of said automatic means and thereafter controlled as described in accordance with the presence and absence of ground on the calling line.

8. In a prepayment coin system, a cord circuit arranged to control a coin box on a calling line, a signal lamp and circuit means for controlling said lamp associated with said cord said circuit means being adapted to light said lamp in response to connection of said cord to a called line and to characteristically indicate the disposal or absence of a coin in said coin box.

9. In a prepayment coin system a calling line equipped with a prepayment coin box, a called line, a cord circuit adapted to interconnect said calling and called lines, means for transmitting current of a predetermined potential to said calling line to control said coin box, and a signal lamp and circuit means for controlling the lamp associated with said cord said circuit means being adapted to light said lamp when the cord circuit is connected to the called line, extinguish it in response to removal of a deposited coin condition on the calling line when said current is initially transmitted and flash it at a predetermined rate if a deposited coin condition is absent when said current is initially transmitted or such a condition is present and persists after said initial transmission.

HORACE W. ULRICH.