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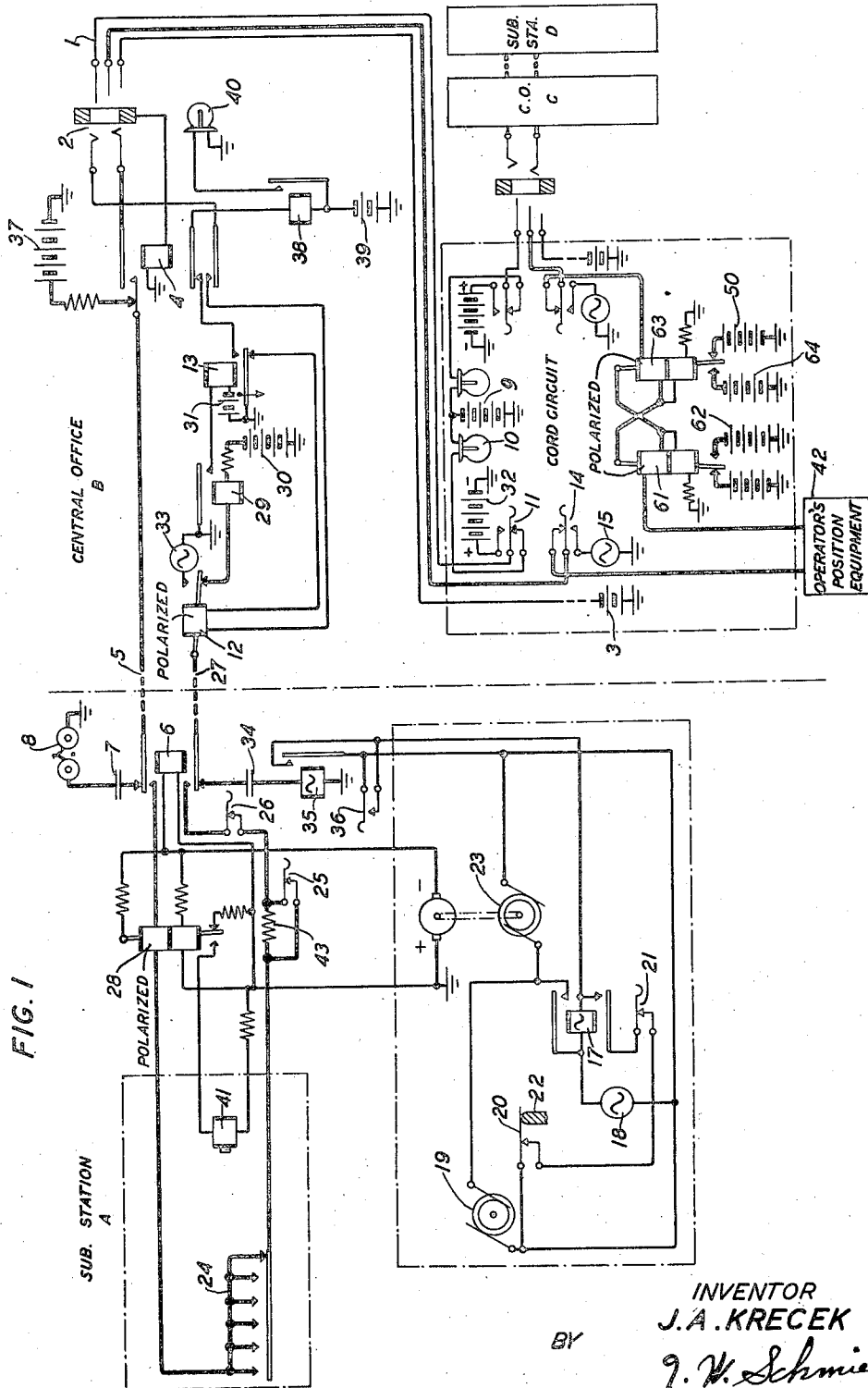
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2,032,421

TELETYPEWRITER SYSTEM

Filed Nov. 1, 1934

5 Sheets-Sheet 1



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TELETYPEWRITER SYSTEM

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5 Sheets-Sheet 2

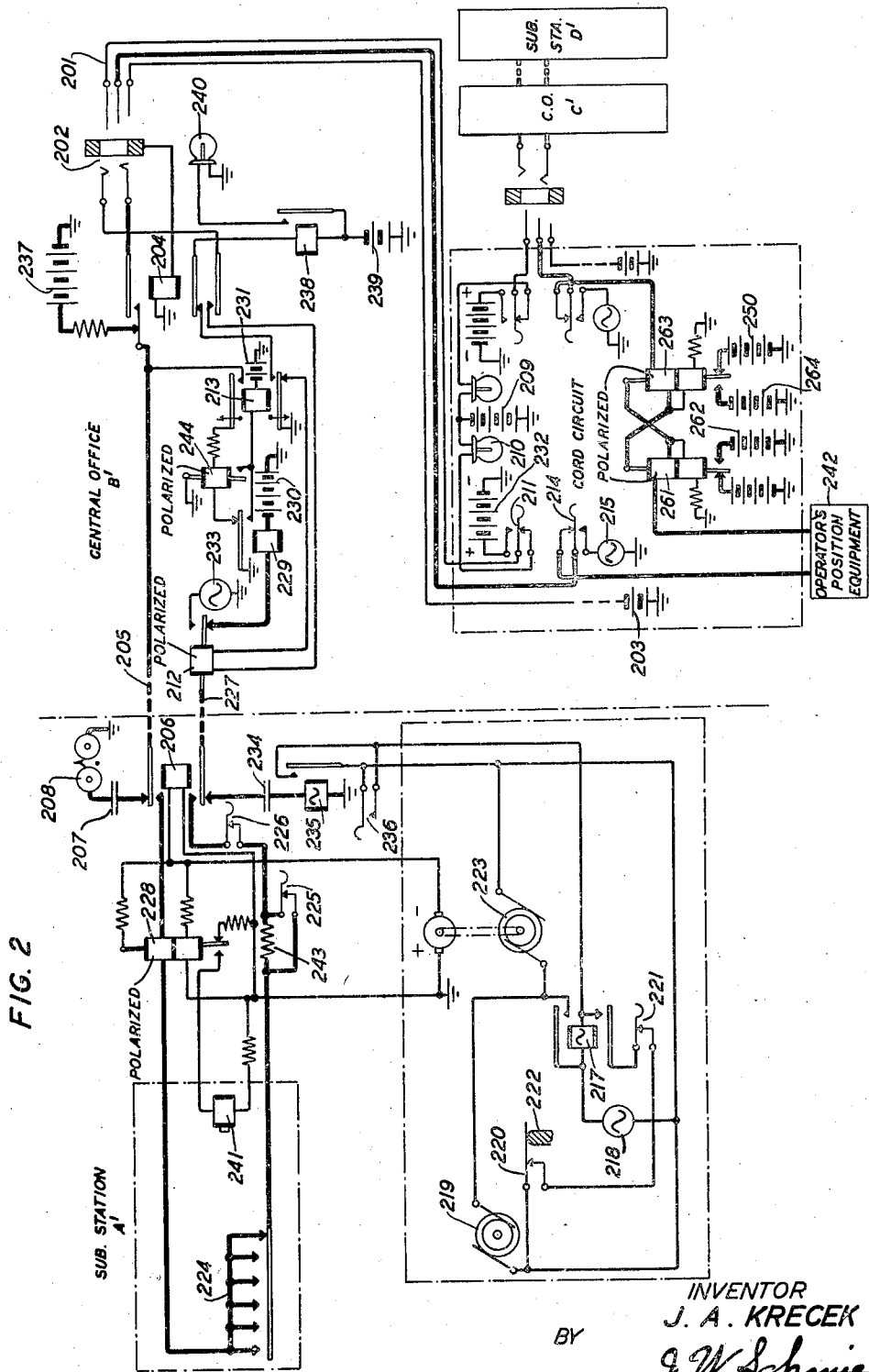


FIG. 2

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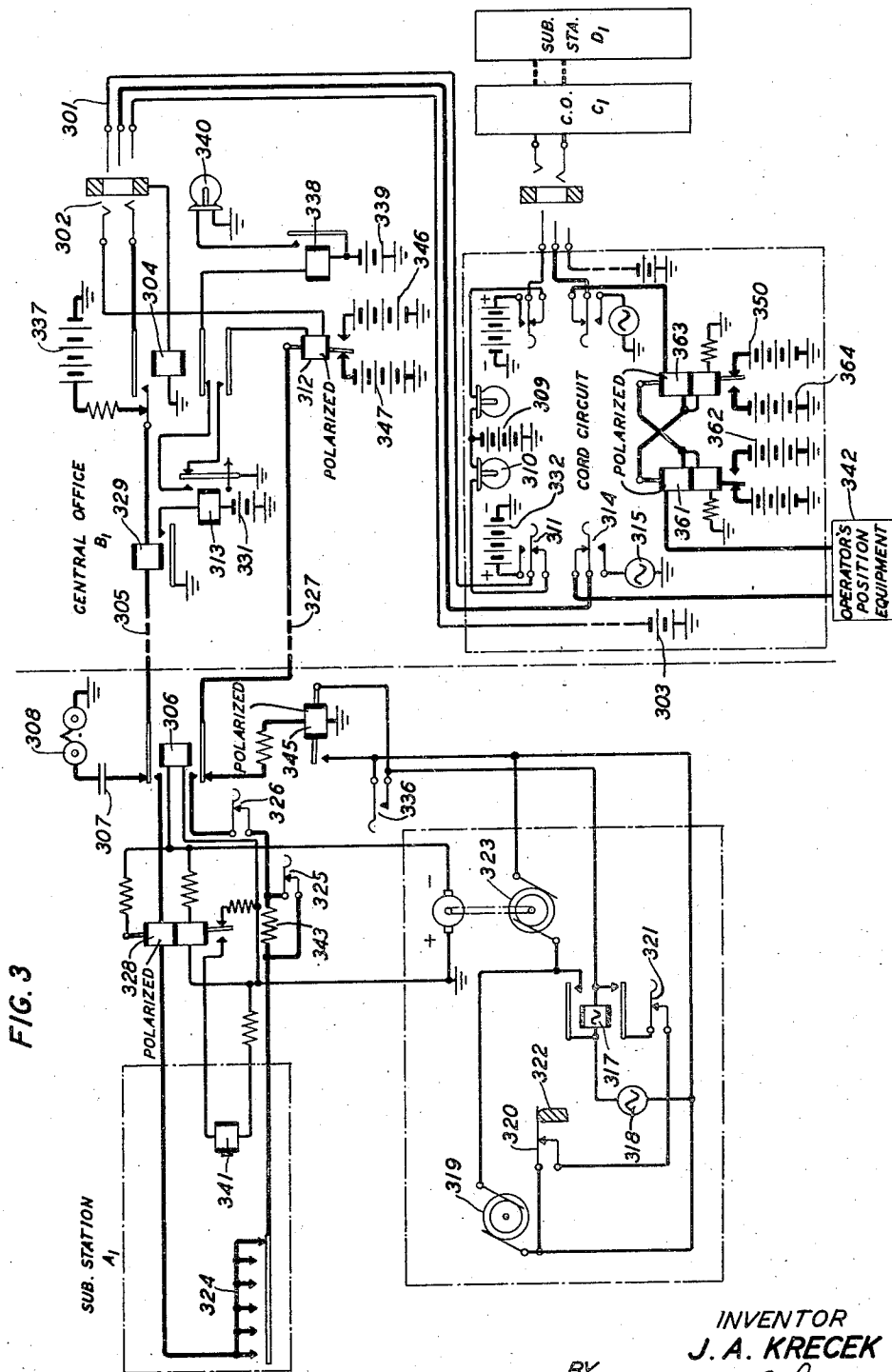
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TELETYPEWRITER SYSTEM

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5 Sheets-Sheet 3



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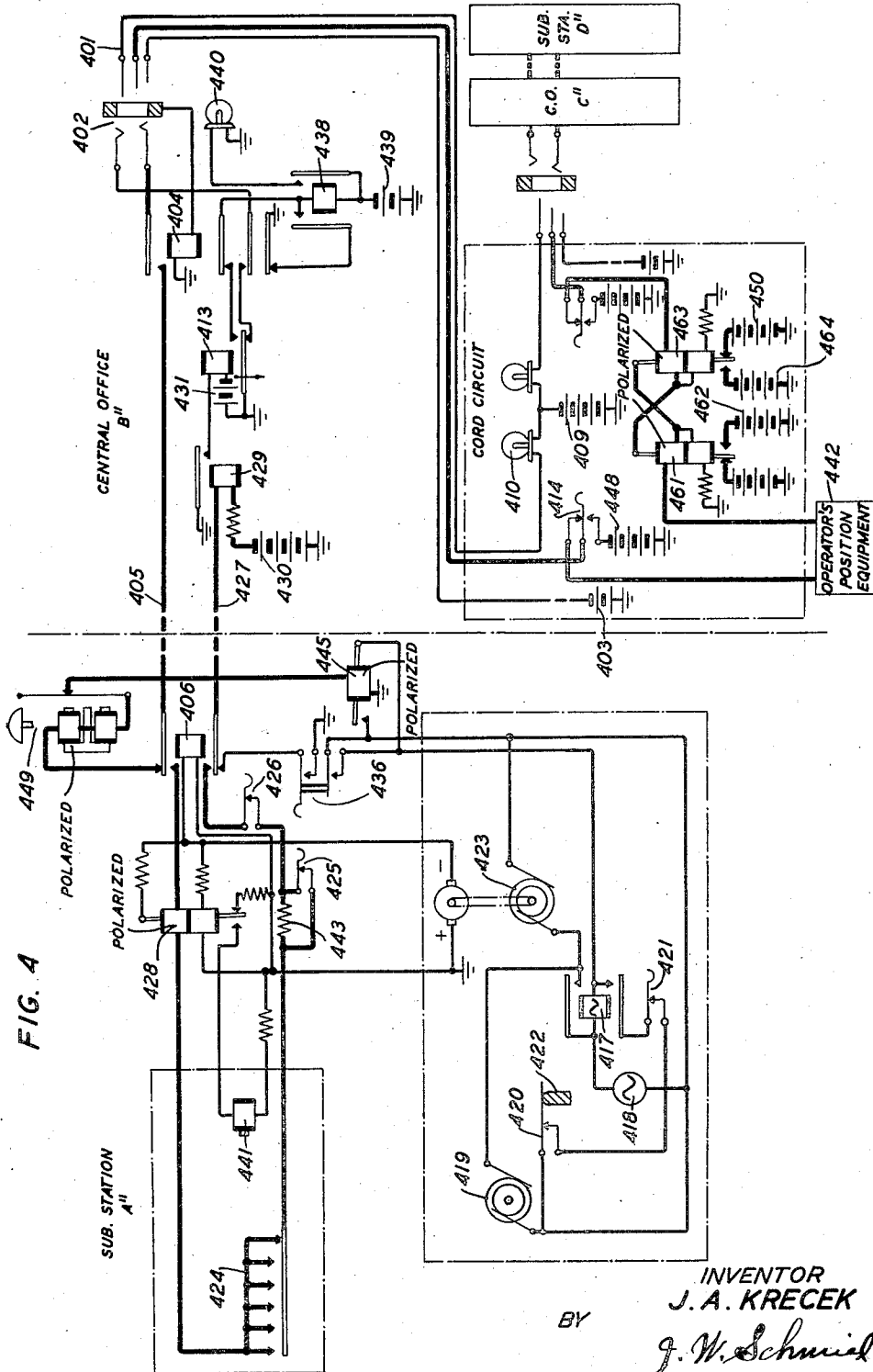
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TELETYPEWRITER SYSTEM

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5 Sheets-Sheet 4



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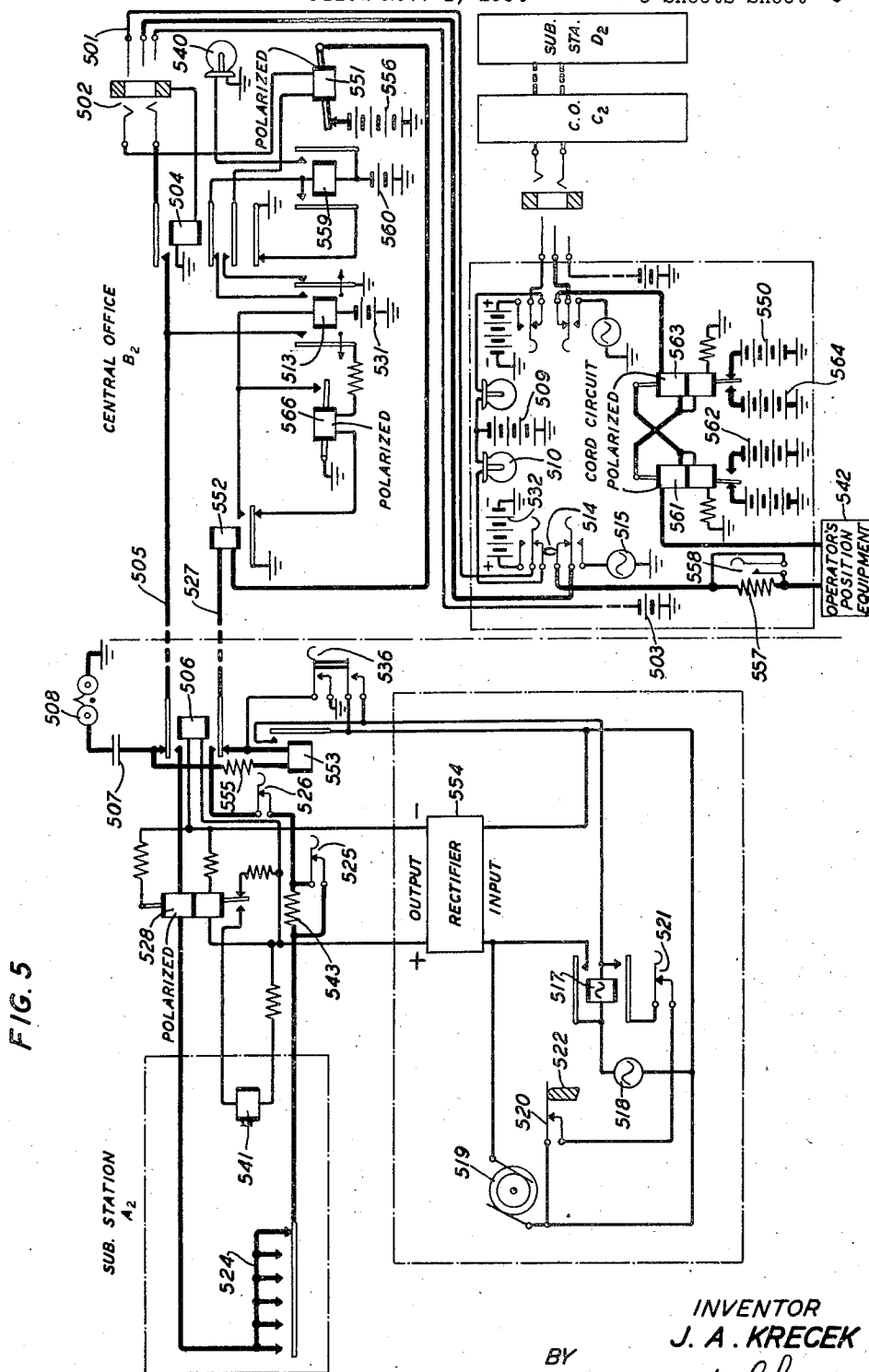
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TELETYPEWRITER SYSTEM

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5 Sheets-Sheet 5



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2,032,421

TELETYPEWRITER SYSTEM

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Application November 1, 1934, Serial No. 750,922

17 Claims. (Cl. 178—2)

This invention concerns improvements in normally open loop teletypewriter circuits. These improvements relate principally to means for reducing trouble caused by differences in ground potential.

In normally open loop teletypewriter circuits, much trouble is experienced because of differences in ground potential. This trouble occurs chiefly with various signaling arrangements, such as call, recall, and answer signaling arrangements. It is also quite objectionable in that it sometimes causes faulty or unintentional operation of instrumentalities for starting unattended motors because, in many normally open loop systems, the teletypewriter motor in an unattended station is designed to be started when the operator at a central office closes and applies current to the line. In exceptional cases, differences in ground potential might originate enough current to start the motor at an unattended station. This, of course, is objectionable in that it results in needless use of the local power supply and the teletypewriter motor at an unattended station.

Accordingly, one object of this invention is to reduce trouble caused by differences in ground potential by so arranging teletypewriter circuits that the grounds will all be located at one station, namely the central office.

Another object of this invention is to provide an improved arrangement for enabling a subscriber to send a break signal without encountering trouble caused by differences in ground potential and without giving a recall signal to the central office operator at the same time.

Still another object of this invention is to provide an improved calling arrangement for enabling an operator to call a subscriber.

A further object of this invention is to provide an improved arrangement for enabling an operator to start a teletypewriter motor at an unattended station.

In accordance with this invention, when a subscriber wishes to transmit a recall signal, he momentarily opens the line thereby causing a relay at the central office to release. In releasing, this relay puts ground upon a circuit for momentarily lighting a lamp at the central office thereby attracting the attention of the operator. When a subscriber wishes to transmit a break signal, he does so by operating a key which shunts a resistance into the line. This resistance reduces the line current to an amount small enough to effect a break signal but large enough to prevent a recall signal being given the operator.

A modification of the invention enables a cen-

tral office operator to call a subscriber by closing the loop and applying positive current to the line thereby causing a direct current polarized bell at the subscriber's station to ring. This modification also enables an operator to start the motor at an unattended station by applying negative current to the line whereas another modification of the invention enables an operator to start an unattended motor by applying positive current to the line.

These and other features of the invention will be described in detail in connection with the drawings in which:

Fig. 1 represents the preferred embodiment of the invention;

Fig. 2 illustrates a modification of the circuit shown in Fig. 1;

Fig. 3 shows another form of the invention which employs positive current for starting the motor of an unattended station;

Fig. 4 represents an alternative form of the invention which uses negative current for starting the motor of an unattended station; and,

Fig. 5 illustrates still another modification of the invention.

Fig. 1 shows a normally open teletypewriter circuit extending from subscriber's station A to central office B and then to central office C and subscriber's station D. Central office C and subscriber's station D have both been represented by rectangles because they are similar respectively to central office B and subscriber's station A which have been shown in detail. In this circuit all the relays are normally in a non-operated condition and no instrumentalities are operated until either an operator or a subscriber originates a call. The teletypewriter of the subscriber at station A may be connected to the teletypewriter equipment 42 of the operator at central office B or of the operator at central office C. Also, it may be connected to the teletypewriter of the subscriber at station D. It is to be understood, of course, that this number of stations and offices has been shown simply to illustrate the invention whereas in actual practice there may be several central offices each of which may be associated with many subscribers' stations. Furthermore, there might be only one central office having several subscribers' stations associated therewith and adapted to be interconnected for mutual communication.

If the operator at central office B wishes to call a subscriber, such as the subscriber at station A, the operator will insert plug 1 into jack 2. This closes a circuit for negative current from 55

battery 3 to pass through the sleeve contacts of plug 1 and jack 2, through relay 4, and then to ground thereby operating relay 4. When relay 4 operates in response to negative current from battery 3, its top armature closes the ringing circuit from the ring contacts of plug 1 and jack 2, over the top armature and contact of relay 4, line conductor 5, armature and contact of non-operated relay 6, condenser 7, ringer 8, and then to ground.

The inner bottom armature of relay 4 also closes at this time but performs no useful function. The outer bottom armature of relay 4 operates and closes a path for negative current from battery 9 to pass through lamp 10, key 11, tip contacts of plug 1 and jack 2, outer bottom armature of relay 4, through relay 12, bottom contact and armature of slow-to-release supervisory relay 13, and then to ground. The closing of this last mentioned circuit causes lamp 10 to be lit as an indication to the operator at central office B that the station equipment at station A is not yet cut-in. Relay 12 does not operate at this time because it is polarized so as to operate on positive current and not on negative current.

To call the subscriber at station A, the operator at central office B momentarily operates key 14 which causes alternating current from generator 15 to be applied to the ringing circuit described above. This ringing current will cause ringer 8 to be intermittently operated.

If the subscriber is present at station A and wishes to answer the operator's call, the subscriber can do so by momentarily closing his call or answer key 36. This closes a path through alternating current relay 17 and a source 18 of alternating current thereby energizing relay 17. Upon being thus energized, relay 17 operates both its armatures and locks-up through its bottom armature. At the same time, an energizing path is closed for operating the subscriber's teletypewriter motor 19 from source 18, through motor 19, top armature of operated relay 17, and then back to source 18. Motor stop contacts 20 are opened by an upward thrust of stunt bar 22 in response to the reception by station A of a pre-assigned stop signal, such as upper case H, transmitted over the line from central office B. When relay 17 operates, an energizing path is also closed for operating motor-generator 23 from source 18 through the top armature of relay 17, motor-generator 23, and then back to source 18.

When motor-generator 23 is operated, it generates direct current which supplies biasing current to the bottom winding of line relay 28 and tends to maintain the armature of relay 28 in the position shown in the drawings. Direct current from motor-generator 23 also operates relay 6 which closes both its armatures thereby closing the normally open line circuit. The line circuit will now lead from line conductor 5, over the top armature and contact of relay 6, through line relay 28, sending contacts 24, break key 25, recall key 26, bottom contact and armature of relay 6, back to central office B over line conductor 27, armature and contact of non-operated relay 12, through relay 29, battery 30, and then to ground. Since key 14 was only operated momentarily, when it is restored to the position shown in the drawings, positive current from battery 30 will be applied to the line circuit and will operate relay 29.

The operation of relay 29 closes a path from ground, through its armature and contact, through slow-to-release relay 13, battery 31, and

then to ground. This results in the operation of relay 13 which closes its armature thereby removing ground from the energizing circuit for lamp 10. This causes lamp 10 to be extinguished thus indicating to the operator at central office B that the subscriber at station A has cut-in his teletypewriter and that communication may now take place. Relay 13 is of the slow-to-release type in order to hold over during the transmission of printer signals, otherwise the lamp 10 might be unintentionally lit.

The subscriber at station A can recall the operator at central office B by momentarily opening his recall key 26 while relay 6 is operated and the line is closed. Operation of recall key 26 opens one side of the line; namely, the side including line conductor 27. This opens the energizing circuit for relay 29 and causes it to become non-operated. When relay 29 releases its armature, it opens the energizing circuit to relay 13 and causes it to become non-operated and to release its armature after a certain time delay. The release of the armature of relay 13 puts ground upon the energizing circuit for lamp 10. This causes lamp 10 to light and to give a recall signal to the operator who then comes in on the circuit with her teletypewriter and communicates with the subscriber at station A. When the subscriber closes recall key 26, relay 29 and relay 13 become operated again and lamp 10 is extinguished.

In case station A is unattended, there will be no response to the operator's ring. In this event, if the operator wishes to leave a message on the subscriber's teletypewriter, she may do so by starting the motor 19 of the unattended teletypewriter. To do this, key 11 is operated, thereby closing a circuit for positive current from battery 32 to pass through key 11, tip contacts of plug 1 and jack 2, lower bottom armature of operated relay 4, relay 12, contact and armature of non-operated relay 13, and then to ground. Since relay 12 is polarized to operate on positive current, it now operates. A path is now closed from alternator 33, through the top contact and armature of relay 12, over line conductor 27, bottom armature and lowest contact of non-operated relay 6, condenser 34, alternating current relay 35, and then to ground. This serves to energize relay 35 which then operates its armature. The operation of the armature of relay 35 has the same effect as the closing of key 36; namely, it closes a circuit for connecting source 18 of alternating current to the teletypewriter motor 19 thereby starting motor 19 and motor-generator 23. Significant current variations transmitted from central office B out over the line will actuate relay 28 which, in turn, will actuate receiving relay 41 at station A and communication can thus be had.

After termination of this communication, the operator at central office B may stop the motor 19 of the teletypewriter at station A and also disconnect the source 18 of alternating current. To do this, the operator transmits a preassigned signal, such as upper case H. This causes an upward thrust of stunt bar 22 thereby opening motor stop contacts 20. This opens the locking up circuit for relay 17 which then becomes non-operated with the result that the path from source 18 to motor 19 is opened. Consequently, motor 19 stops and stays stopped until relay 17 is energized again. The operator then withdraws plug 1 from jack 2 thereby causing the release of relay 4. The line is thus restored to its nor-

mally open condition with all relays non-operated.

When the subscriber at station A desires to call the operator at central office B, he may do so by momentarily operating his call or answer key 36. This closes a path for alternating current from source 18 to operate relay 17. Relay 17 locks-up in the manner described above and connects alternating current from source 18 to motor-generator 23 and to the teletypewriter motor 19 thereby starting both motor-generator 23 and teletypewriter motor 19. Relay 6 will be operated by direct current from motor-generator 23 as described above. This closes a circuit for positive current from battery 37 to pass through the top released armature of relay 4, over line conductor 5, top armature of operated relay 6, upper winding of relay 28, sending contacts 24, break key 25, recall key 26, bottom armature of relay 6, line conductor 27, released armature of relay 12, through relay 29, battery 30 and then to ground.

Relay 29 is thus energized and operates its armature to close a circuit from battery 31, through relay 13, and then to ground. As a result, relay 13 becomes operated and closes a path from ground, through its armature, upper bottom contact and armature of non-operated relay 4, through relay 38, battery 39, and then to ground. This energizes relay 38 which operates its armature and closes a path from battery 39, armature and contact of relay 38, through line lamp 40 in the switchboard, and then to ground. Line lamp 40 becomes lit as a result and serves to indicate to the operator at central office B that communication is desired.

The operator at central office B, in answering the call, will insert plug 1 in jack 2. This will close a path for negative current from battery 3 to pass through the sleeve of plug 1 to energize relay 4 as has been described above. Relay 4 will now operate its armatures and thereby open the path through its bottom armature for energizing relay 38. This will cause the release of relay 38 and its armature will open the energizing circuit for line lamp 40 with the result that lamp 40 will become extinguished. Communication can now take place as described above.

If the subscriber at station A wishes to discontinue communication with the operator at central office B, he can transmit a disconnect signal by opening his local stop key 21, which causes relay 17 to release thereby disconnecting the source 18 of power supply and causing motor 19 to stop running. Motor-generator 23 also stops thereby causing relay 6 to release. Relay 6, in releasing, opens the energizing circuit for relay 29 and causes it to release. When the armature of relay 29 is released, it opens the energizing circuit for relay 13 causing relay 13 to release also. The release of the armature of relay 13 closes a circuit from ground, armature of relay 13, through the winding of relay 12, lowest bottom armature of operated relay 4, jack 2, tip of plug 1, key 11, lamp 10, battery 9, and then to ground. As a result, lamp 10 will be lit. This disconnect signal can be distinguished from a recall signal because a recall signal causes only a momentary lighting of lamp 10, whereas a disconnect signal causes lamp 10 to be lit until the operator removes plug 1 from jack 2.

In case the subscriber at station A has his teletypewriter connected to that of the subscriber at station D and wishes to transmit a break signal to the subscriber at station D, he may do so by opening his break key 25. The

opening of break key 25 removes the shunt across resistance 43. Resistance 43 is high enough to decrease the line current in the upper winding of polarized relay 61 sufficiently to enable the current in its lower winding to move its armature to its right contact. This applies negative current from battery 62 to the line leading to central office C and subscriber's station D. However this line already has negative current applied to its other end at central office C by a battery comparable to battery 30 at central office B. The negative current from these two batteries equals and opposes each other thus preventing any current from flowing in that line. This, in effect, is equivalent to an opening of that line and causes the teletypewriter at subscriber's station D to become inoperative thereby indicating to the subscriber at station D that the subscriber at station A desires to interrupt him.

At the same time, resistance 43 leaves the current in the line from station A to central office B sufficiently large to maintain relay 29 operated. This in turn, maintains relay 13 operated and prevents lamp 10 from lighting. In other words, it prevents a recall signal from being unintentionally given to the operator at central office B.

Fig. 2 shows a circuit which is somewhat similar to the circuit shown in Fig. 1. One point of difference is that central office B' of Fig. 2 includes a polarized relay 244 for facilitating the reception of a break signal transmitted from a distant station, such as subscriber's station D'. This modification of the invention enables a break signal to be given the subscriber at station A' without unintentionally giving a recall signal to either the operator at central office B' or C'.

When the subscriber at station D' transmits a break signal, he does so in the manner described for Fig. 1. That is, he operates a break key comparable to break key 225 which removes the shunt from a resistance similar to resistance 243. This resistance is large enough to decrease the line current in the upper winding of a polarized relay at central office C', similar to polarized relay 263, sufficiently to enable the current in its lower winding to move its armature to its bottom contact. This applies negative current from a battery like battery 262 to the line leading to central office B' and subscriber's station A'. However, this line already has negative current applied to its other end at central office B' by battery 230 at central office B'. The negative current from these two batteries equals and opposes each other thus preventing any current from flowing in that line. This, in effect, is equivalent to an opening of that line and causes the teletypewriter at the subscriber's station A' to become inoperative thereby indicating to the subscriber at station A' that the subscriber at station D' desires to interrupt him.

This causes relay 229 to release its armature and open the energizing circuit to supervisory relay 213. Because relay 213 is of the slow-to-release type, relay 213 does not immediately release, but remains operated for a certain time delay. As soon as relay 229 releases, its armature closes a path from ground, through polarized relay 244, armature of operated relay 213, line conductor 205, and then in parallel to battery 250 and battery 230. The reduced amount of negative current from battery 230 which is left in the line, although too small to reoperate relay 229 is large enough to operate relay 244. Relay 244, in operating, closes a path from ground, through its armature, relay 213, battery 231, and 75

then to ground. This path serves to maintain relay 213 operated. As long as relay 213 remains operated, the path for energizing relay 244 remains closed.

Thus, by means of relay 244 maintaining closed an energizing path for relay 213, relay 213 keeps its armatures operated. As long as the bottom armature of relay 213 remains operated, the path for lighting supervisory lamp 210 will be open. On the other hand, if it were not for relay 244 keeping relay 213 energized, relay 213 would now release its armatures, the bottom one of which would close the energizing path for lamp 210. This would light lamp 210 and cause the operator to come in on the circuit with her position equipment 242. Since she is not wanted at this time, this would be an annoyance to the subscribers. This is obviated by this modification of the invention which, as just described, enables a break signal to be given the subscriber at station A' without unintentionally giving a recall signal to either the operator at central office B' or C'.

Fig. 3 illustrates a system which operates in a manner quite similar to that shown in Fig. 1 except that it employs a different method for enabling an operator at a central office to start the teletypewriter motor at an unattended subscriber's station.

It can be seen in Fig. 3 that, in the normally unoperated condition of the circuit, negative current from battery 347 will pass through the armature of non-operated polarized relay 312, over line conductor 327, through the bottom armature of non-operated relay 306, polarized relay 345 and then to ground. However, relay 345 is so polarized as to operate on positive current but not on negative current. Therefore, under the above conditions, it will remain non-operated.

When an operator at a central office, such as central office B₁, wishes to start the teletypewriter motor of an unattended subscriber's station, such as station A₁, she does so by first inserting plug 301 in jack 302. This closes a path for negative current from battery 303 to operate relay 304 as described for Fig. 1. The operator then momentarily operates key 311 to its upper position thereby closing a path for positive current from battery 332 to pass through key 311, tip contacts of plug 301, and jack 302, relay 312, bottom armature and contact of operated relay 304, armature of non-operated relay 313, and then to ground. Since relay 312 is polarized to operate only on positive current, it now operates its armature.

This applies positive current from battery 346 to line conductor 327 instead of negative current from battery 347. The positive current from battery 346 will energize polarized relay 345 and cause it to operate its armature. The operation of the armature of relay 345 has the same effect as the closing of key 336; namely, it closes a circuit for connecting source 318 of alternating current to the teletypewriter motor 319 thereby starting motor 319. At the same time, it connects source 318 to motor generator 323 thereby supplying direct current to operate relay 306 which closes the normally open line. Communication may now take place.

In the circuit shown in Fig. 4, the functioning is similar to that described for the circuit shown in Fig. 1 except that a direct current bell 449, polarized so as to operate only on positive current, is used for calling a subscriber and an unattended start is made by applying negative current to the

line. There are also a few other differences that will appear from the following description.

The operator at a central office, such as central office B'', can call a subscriber at a station, such as station A'', by inserting plug 401 into jack 402. This connects negative current from battery 403 to relay 404 with the result that relay 404 operates its four armatures. The closing of the middle bottom armature of relay 404 closes a path from battery 409, through lamp 410, tip contacts of plug 401 and jack 402, middle armature of operated relay 404, armature of non-operated relay 413, and then to ground. This causes lamp 410 to light. Lamp 410 is extinguished when the subscriber answers the operator's call as will be explained subsequently.

The closing of the top armature of relay 404 closes a path for positive current from battery 450 to pass through the operator's position equipment 442, over key 414, ring contacts of plug 401 and jack 402, top armature of operated relay 404, out over line conductor 405 to station A'', top armature of non-operated relay 406, through polarized direct current bell 449, through relay 445, and then to ground. Since bell 449 is polarized so as to operate on positive current but not on negative current, it now operates and calls the subscriber at station A''. Relay 445 is polarized to operate on negative current, but not on positive current. Consequently, relay 445 does not operate at this time. In case a steady ring of bell 449 is not desired, battery 450 may be intermittently applied to the ring lead in the cord circuit by any well-known means.

The subscriber answers the operator's call by momentarily closing his call or answer key 436. This closes a path which enables alternating current from source 418 to operate alternating current relay 417 which locks-up through its bottom armature. Relay 417, in operating, connects the power supply source 418 to the teletypewriter motor 419 and, at the same time, connects the power supply source 418 to motor generator 423. Direct current from motor generator 423 will cause relay 406 to operate its armatures. This closes a path from ground through battery 450, key 414, plug 401, jack 402, top armature of operated relay 404, line conductor 405, top armature of operated relay 406, line relay 428, sending contacts 424, break key 425, recall key 426, bottom armature of operated relay 406, line conductor 427, relay 429, battery 430 and then to ground. As a result, relay 429 will operate its armatures.

This closes a path from battery 431 through relay 413 and then to ground. Consequently, relay 413 will now operate its armature. This opens the path from battery 409, through lamp 410, plug 401, jack 402, middle bottom armature of operated relay 404 to the ground connected to the armature of relay 413. With ground removed from this energizing circuit for lamp 410, lamp 410 will now be extinguished thereby indicating to the operator at central office B'' that the subscriber at station A'' has answered. Relay 413 is of the slow-to-release type so that it will not be unintentionally released by accidental openings of the line and also so that it will hold over during the transmission of signals. Otherwise, it might unintentionally release and close the path for lighting lamp 410. This would attract the attention of the operator and considerable confusion might ensue.

If station A'' is unattended and the operator at central office B'' wishes to cause the teletypewriter at station A'' to type a certain message,

she can do so in the following manner. First, she must insert plug 401 in jack 402 in order to enable current from battery 403 to operate relay 404. Then she moves key 414 to its lower position. This sends negative current from battery 448 out over line conductor 405, through polarized bell 449, through polarized relay 445 and then to ground. Since bell 449 is polarized to operate on positive current but not on negative current, it will not be operated now. However, since relay 445 is polarized so as to operate on negative current and not on positive current, it will operate now. The closing of the armature of relay 445 has the same effect as the closing of key 436. Consequently, the teletypewriter motor 419 and motor-generator 423 will now be operated. Relay 406 will operate and connect the line to the printer equipment for communication purposes.

The station equipment may be restored to its normally unoperated condition by the transmission of a stop signal which will cause an upward thrust of stunt bar 422 thereby opening motor stop contacts 420. This opens the locking-up circuit for relay 417 and disconnects the power supply source 413 from motor 419 and motor-generator 423. This causes relay 406 to release its armatures.

The subscriber can call the operator by momentarily closing his call or answer key 436. This starts his teletypewriter motor 419 and motor-generator 423 in the manner described above. As a result, relay 406 will be operated, and will cut-in the station printer equipment. However, relay 406 will not be energized by direct current from motor-generator 423 until after a certain time delay required for motor-generator 423 to become operated. During this interval of time a path will be closed for current from battery 430 to pass through relay 429, over line conductor 427, bottom armature of non-operated relay 406, top set of contacts of key 436 and then to ground.

This causes relay 429 to operate its armature and to thereby close a path from battery 431 through relay 413 to ground thereby operating relay 413. Relay 413, in operating, closes a path for negative current from battery 439 to pass through relay 438, upper bottom armature of non-operated relay 404, armature of operated relay 413, and then to ground. As a result, relay 438 will become energized and lock up through its left armature subject to the operation of relay 404. Its right armature will close a path for current from battery 439 to light line lamp 440 thereby indicating to the operator at the central office B' that the subscriber's station A' desires attention. By the time relay 406 becomes energized and opens the energizing path for relay 429, relay 438 will have locked up, thus maintaining lamp 440 lighted until the operator answers the call.

When the operator answers the call she will insert plug 401 in jack 402 thereby enabling current from battery 403 to operate relay 404. The operation of the lower bottom armature of relay 404 will open the locking-up circuit for relay 438 which will now release. This, in turn, will extinguish line lamp 440.

Recall and break signals can be transmitted in a manner similar to that described for the circuit shown in Fig. 1.

In the circuit shown in Fig. 5, the operator at a central office, such as central office B₂, can call a subscriber at a subscriber's station, such as station A₂ in the following manner. First, the op-

erator inserts plug 501 in jack 502. This closes a path for current from battery 503 to pass through and operate relay 504. The operator then closes key 514. The lower set of contacts of key 514 close a path for ringing current from alternator 515 to pass through plug 501 and jack 502, over the top armature of operated relay 504, out over line conductor 505, to station A₂, through condenser 507, ringer 508 and then to ground. The operation of ringer 508 serves to attract the attention of the subscriber.

At the same time, the upper set of contacts of key 514 close a path, after relay 504 has operated, for positive current from battery 532 to pass through plug 501, jack 502, relay 551, middle bottom armature of operated relay 504, armature of non-operated relay 513, and then to ground. Since relay 551 is polarized so as to operate on positive current, but not on negative, it will operate now. Relay 551, in operating its armature away from its contact, prevents relay 552 from being operated. Since the operation of relay 513 is dependent upon the operation of relay 552, relay 513 will now be non-operated.

When the operator ceases ringing, she restores key 514 to the position shown in the drawings, thereby establishing a path for negative current from battery 509 to travel through lamp 510, key 514, tip contacts of plug 501 and jack 502, through relay 551, middle bottom armature of operated relay 504, armature of non-operated relay 513 and then to ground. Since relay 551 is polarized so as to operate on positive current, but not on negative current, it will become non-operated and will release its armature to close its contact.

At the same time, positive current from battery 550 will pass through the operator's position equipment 542, high resistance 557, key 514, ring contacts of plug 501 and jack 502, top armature of operated relay 504, out over line conductor 505, over the top armature of non-operated relay 506, through resistance 555, relay 553, bottom armature of non-operated relay 506, line conductor 527, relay 552, armature of non-operated relay 551, battery 556, and then to ground. Resistances 555 and 557 are high enough to reduce the line current to an amount too small to operate either relay 553 or relay 552.

If the subscriber at station A₂ is present when the operator at central office B₂ rings, he can answer by closing his call or answer key 536. The lower set of contacts of key 536 will connect power supply source 518 to the teletypewriter motor 519 and rectifier 554 in the manner described for the circuits shown in the other figures. Direct current from rectifier 554 will now operate relay 506 which, in operating its armatures, will connect the line to the station printer equipment. Since the resistance of the printer equipment is lower than that of resistance 555, the line current will now be increased to an amount large enough to operate relay 552. Relay 552, in operating, closes a path from ground through its armature, relay 513, battery 531, and then to ground. This enables relay 513 to operate its armatures thereby opening the energizing path for supervisory lamp 510. Consequently, lamp 510 becomes extinguished, thus indicating to the operator that the subscriber's printer equipment has been cut into the line.

In case station A₂ is unattended, the operator at central office B₂ can start the teletypewriter motor 519 by first inserting plug 501 in jack 502. This enables current from battery 503 to operate relay 504 and to apply positive current from

battery 550 to the line in the manner described above. The operator now closes key 558 thereby short-circuiting high resistance 557. This increases the line current to an amount large enough to operate relay 553. When relay 553 closes its armature, it connects power supply source 518 to the teletypewriter motor 519 and rectifier 554 in the same manner as when key 536 is closed.

When the operator has finished sending the message, she sends a motor-stop signal which operates stunt bar 522 thereby opening motor-stop contacts 520. This opens the energizing circuit for motor 519 and motor generator 554 and causes them to release.

The subscriber at station A₂ can call the operator at the central office B₂ by momentarily operating his call or answer key 536. The upper contacts of key 536 supply ground to the path leading from battery 556, through the armature of non-operated relay 551, to relay 552. This operates relay 552 which closes a path for operating relay 513 as described above. Relay 513 then closes a path from ground through its right armature, upper bottom armature of non-operated relay 504, relay 559, battery 560, and then to ground. This causes relay 559 to operate and to lock-up through its left contact, armature of non-operated relay 504, and then to ground. This locking-up circuit is opened when relay 504 is operated. At the same time, an energizing path is closed from battery 560, right armature of operated relay 559, lamp 540 and then to ground thereby lighting lamp 540. This serves to attract the attention of the operator at central office B₂ and to indicate to her that the subscriber at station A₂ desires attention.

When key 536 is operated, its lower contacts connect power supply source 518 to teletypewriter motor 519 and rectifier 554. Although key 536 is operated only momentarily, relay 517 locks up through its lower contact and armature and maintains the connection of power supply 518 to motor 519 and rectifier 554. Direct current from rectifier 554 will operate relay 506 thereby connecting the line to the station printer equipment. This opens the energizing circuit for relay 552 and causes it to release. The release of relay 552 causes the release of relay 513. However, lamp 540 is not extinguished at this time because relay 559 is locked up by a path through its left armature and over the lower bottom armature of relay 504.

When the operator at central office B₂ answers the call from the subscriber at station A₂, she inserts plug 501 into jack 502 thereby closing a path for operating relay 504. Relay 504, in operating its lower bottom armature, opens the locking-up circuit for relay 559. Consequently, relay 559 releases and opens the energizing circuit for lamp 540 thereby extinguishing lamp 540.

Break and recall signals may be transmitted in a manner similar to that described in the circuit shown in Fig. 2.

The above circuits have been shown and described in order to illustrate the principles of this invention. It should be understood that different arrangements employing the principles and features of operation of this invention may be designed. Accordingly, the invention is not to be limited to the arrangements shown in the drawings, but it is to be restricted only by the claims appended hereto.

What is claimed is:

1. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, a source of line current located at only one station and adapted to be applied to the line, and instrumentalities for reducing trouble caused by differences in ground potential, said instrumentalities including circuit means for grounding the source of line current at only the station at which it is located.

2. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, a source of signal current at one station, a ground connection at the same station for the source of signal current, said ground connection being normally disconnected from the source of signal current, and instrumentalities for connecting the ground to the source of signal current.

3. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, a source of signal current at one station, a ground connection at the same station for the source of signal current, said ground connection being normally disconnected from the source of signal current, and instrumentalities for connecting the ground to the source of signal current, said instrumentalities being located at the other station and being capable of being actuated from either station.

4. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, the first of said stations having a teletypewriter motor and a source of power supply for operating the motor, said source being normally disconnected from the motor, and instrumentalities for enabling the operator at the second station to start the motor by connecting the source of power supply to the motor, said instrumentalities including an electro-responsive device located at the first station, said device being responsive to alternating current, a source of alternating current at the second station, and control means at the second station for applying the source of alternating current to the electro-responsive device, said control means operating only on positive current.

5. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, a source of line current at only one station and adapted to be applied to the line, circuit means for grounding the line current at only the station at which it is located, recall instrumentalities for momentarily opening the line for giving a recall signal, break instrumentalities for reducing the signal current to an amount small enough to effect a break signal, but large enough to maintain the line closed for preventing a recall signal from being unintentionally effected.

6. A teletypewriter system having a central teletypewriter office, a subscriber's teletypewriter station, a normally open telegraph line extending from the subscriber's station to the central office, a source of signal current at the central office, a ground connection at the central office for the source of signal current, said ground connection being normally disconnected from the source of signal current, control instrumentalities at the central office and the subscriber's station for closing the normally open line and for connecting the ground connection to the source of signal current, recall instrumentalities at the subscriber's station for disconnecting the ground connection (after the control instrumentalities have con-

nected it to the source of signal current) from the source of signal current and for causing an indication of this to be given to the operator at the central office, a resistance at the subscriber's station, and break instrumentalities at the subscriber's station for shunting the resistance into the line (after the control instrumentalities have closed the line) for reducing the line current to an amount small enough to effect a break signal but large enough to prevent a recall signal from being given the central office operator at the same time.

7. A teletypewriter system having a central teletypewriter office, a subscriber's teletypewriter station, a normally open telegraph line extending from the subscriber's station to the central office, a source of signal current at the central office, a ground connection at the central office for the source of signal current, said ground connection being normally disconnected from the source of signal current, control instrumentalities at the subscriber's station for closing the normally open line and for connecting the ground connection to the source of signal current for communication purposes, recall instrumentalities at the subscriber's station for enabling the subscriber to momentarily disconnect the ground connection from the source of signal current (after the control instrumentalities have connected it to the source of signal current for communication purposes) and for causing an indication of this to be given to the operator at the central office, a resistance at the subscriber's station, and break instrumentalities at the subscriber's station for shunting the resistance into the line (after the control instrumentalities have closed the line for communication purposes) for reducing the line current to an amount small enough to effect a break signal but large enough to operate instrumentalities at the central office for preventing a recall signal from being given the central office operator, said instrumentalities including a polarized relay located at the central office.

8. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, a source of line current at one station and adapted to be applied to the line, circuit means for grounding the line current at only the station at which it is located, recall instrumentalities for momentarily opening the line for giving a recall signal, break instrumentalities for reducing the signal current to an amount small enough to effect a break signal but large enough to maintain the line closed for preventing a recall signal from being unintentionally effected, said break instrumentalities including a polarized relay.

9. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, the first of said stations having a teletypewriter motor and a source of power supply for operating the motor, said source being normally disconnected from the motor, and instrumentalities for enabling an operator at the second station to start the motor by connecting the source of power supply to the motor, said instrumentalities including an electro-responsive device at the first station, said device being responsive to alternating current, a source of alternating current at the second station, and control means at the second station for applying the source of alternating current to the electro-responsive device, said con-

trol means being operable only by current of a preassigned polarity.

10. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, the first of said stations having a teletypewriter motor and a source of power supply for operating the motor, said source being normally disconnected from the motor, and instrumentalities for enabling an operator at the second station to start the motor by connecting the source of power supply to the motor, said instrumentalities including an electro-responsive device at the first station, said device being responsive to alternating current, a source of alternating current at the second station, and control means at the second station for applying the source of alternating current to the electro-responsive device, said control means having a normally open energizing circuit, actuating means for closing said energizing circuit, and operating means for operating the actuating means, said operating means including a source of negative current.

11. A teletypewriter system having two teletypewriter stations, a normally open telegraph line extending from one station to the other, the first of the stations having a direct current polarized bell operable only by positive current, and the second of the stations having calling instrumentalities for closing the normally open line and for applying positive current to the line for operating the bell at the first station, said calling instrumentalities including electro-magnetic means for closing the line and a source of negative current for operating said electromagnetic means.

12. A teletypewriter system having a central teletypewriter office, a subscriber's teletypewriter station having a teletypewriter motor, a normally open telegraph line extending from the central office to the subscriber's station, control instrumentalities for closing the normally open line, and motor control means for enabling an operator at the central office to start the teletypewriter motor at the subscriber's station, said motor control means including a normally open energizing circuit for the motor, and a normally non-operated polarized relay located at the subscriber's station and connected into the line, said energizing circuit being closed by the operation of the polarized relay, said relay being operable only by negative current, and instrumentalities located at the central office for enabling an operator to apply negative current to the line for operating the polarized relay at the subscriber's station to close the energizing circuit for the motor.

13. A teletypewriter system having two teletypewriter stations, a telegraph line extending from one station to the other, the first of said stations having a teletypewriter motor and a source of power supply for operating the motor, said source being normally disconnected from the motor, and motor control means for enabling an operator at the second station to start the motor by connecting the source of power supply to the motor, said means including an impedance for reducing the line current, an instrumentality for increasing the line current, and an electro-responsive device operable by an increase in the line current for connecting the source of power supply to the motor.

14. A teletypewriter system having two teletypewriter stations, a normally open telegraph line extending from one station to the other, the

first of said stations having a teletypewriter motor and a source of power supply for operating the motor, said source being normally disconnected from the motor, and motor control means for enabling an operator at the second station to start the motor by connecting the source of power supply to the motor, said means including an impedance at each station for reducing the line current, an instrumentality at the second station for increasing the line current by short-circuiting the impedance at the second station, and an electro-responsive device at the first station operable by an increase in the line current for connecting the source of power supply to the motor.

15 15. A teletypewriter system having a subscriber's teletypewriter station connectible to a teletypewriter central office by a telegraph line, said subscriber's station having a teletypewriter motor and a source of power supply for operating the motor but normally disconnected therefrom
20 by the armature of an alternating current relay also located at the subscriber's station and connected into the line, a source of alternating current at the central office normally disconnected
25 from the line by the armature of a relay located at the central office and polarized to operate on negative current, and control means at the central office for applying negative current to the polarized relay whereby the source of alternating
30 current is connected to the line for operating the alternating current relay to connect the subscriber's power supply source to his motor.

35 16. A teletypewriter system having in combination a teletypewriter central office, a subscriber's station having teletypewriter apparatus, a telegraph line extending from the subscriber's station to the central office, said telegraph line being nor-

mally disconnected from the subscriber's teletypewriter apparatus, said central office having a calling lamp with an energizing circuit which is normally open at the armature of a first relay located at the central office and normally unoperated, an energizing circuit at the central office for the first relay, said energizing circuit being normally open at the armature of a second relay which has an energizing circuit which is normally open at the armature of a third relay which is normally unoperated and connected into the telegraph line, control means at the subscriber's station for connecting the line to the subscriber's teletypewriter apparatus and for applying current to the line to operate the third relay thereby operating the second and first relays in turn with the consequent illumination of the calling lamp.

17. A teletypewriter system having in combination a teletypewriter central office, a subscriber's station having teletypewriter apparatus, a telegraph line extending from the subscriber's station to the central office, control means for connecting the line to the subscriber's teletypewriter apparatus, a disconnect lamp located at the central office and having an energizing circuit which is open during communication at the armature of a first relay, said first relay being operated by an energizing circuit which is closed during communication by the armature of a second relay which is operated at that time, and a control instrumentality at the subscriber's station for causing the second relay to release its armature to open the energizing circuit of the first relay whereby the energizing path for the disconnect lamp is closed and the lamp illuminated.

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