

April 20, 1937.

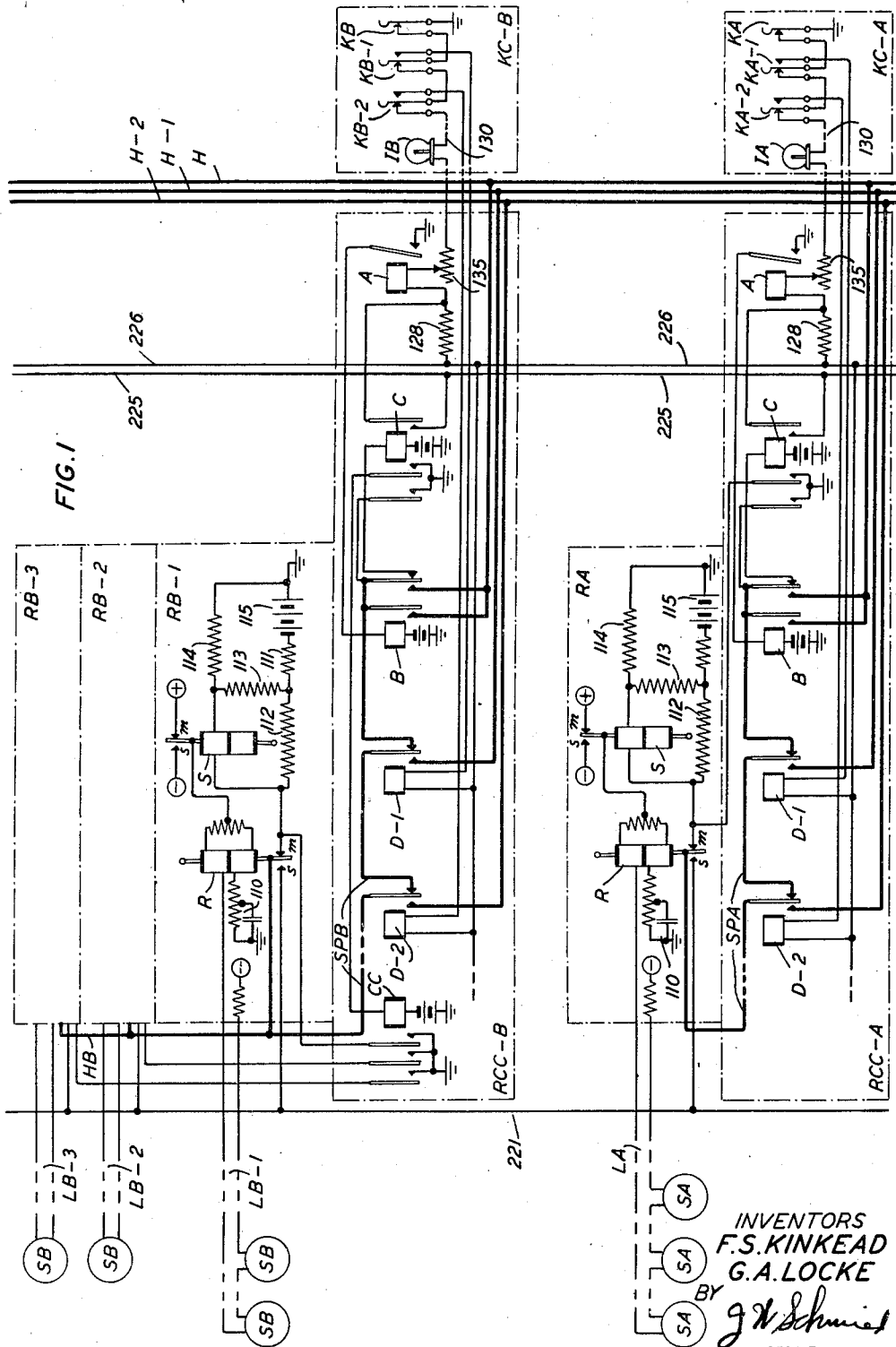
F. S. KINKEAD ET AL

2,077,936

TELEGRAPH CIRCUIT

Filed Aug. 31, 1935

4 Sheets-Sheet 1



April 20, 1937.

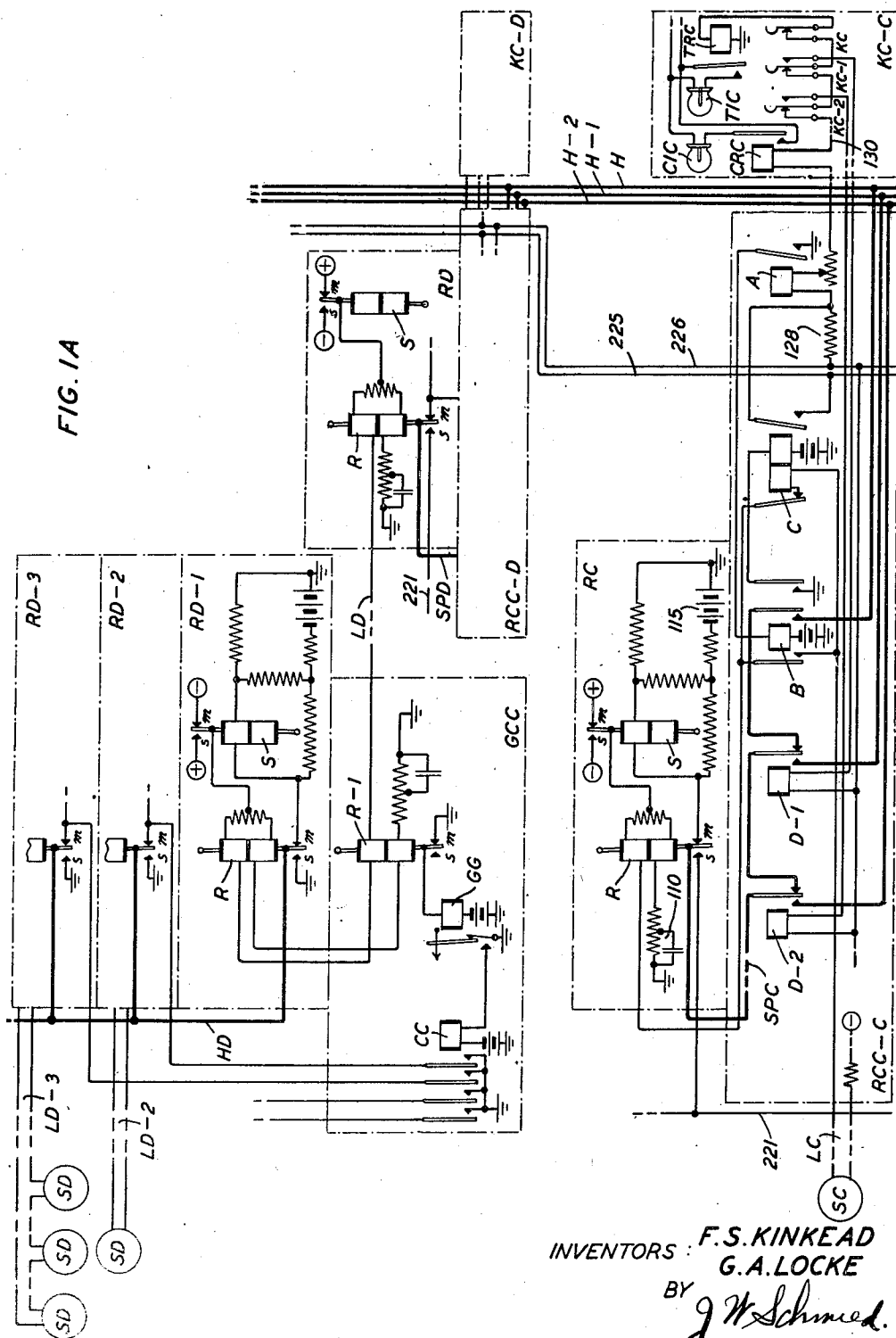
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TELEGRAPH CIRCUIT

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4 Sheets-Sheet 2



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TELEGRAPH CIRCUIT

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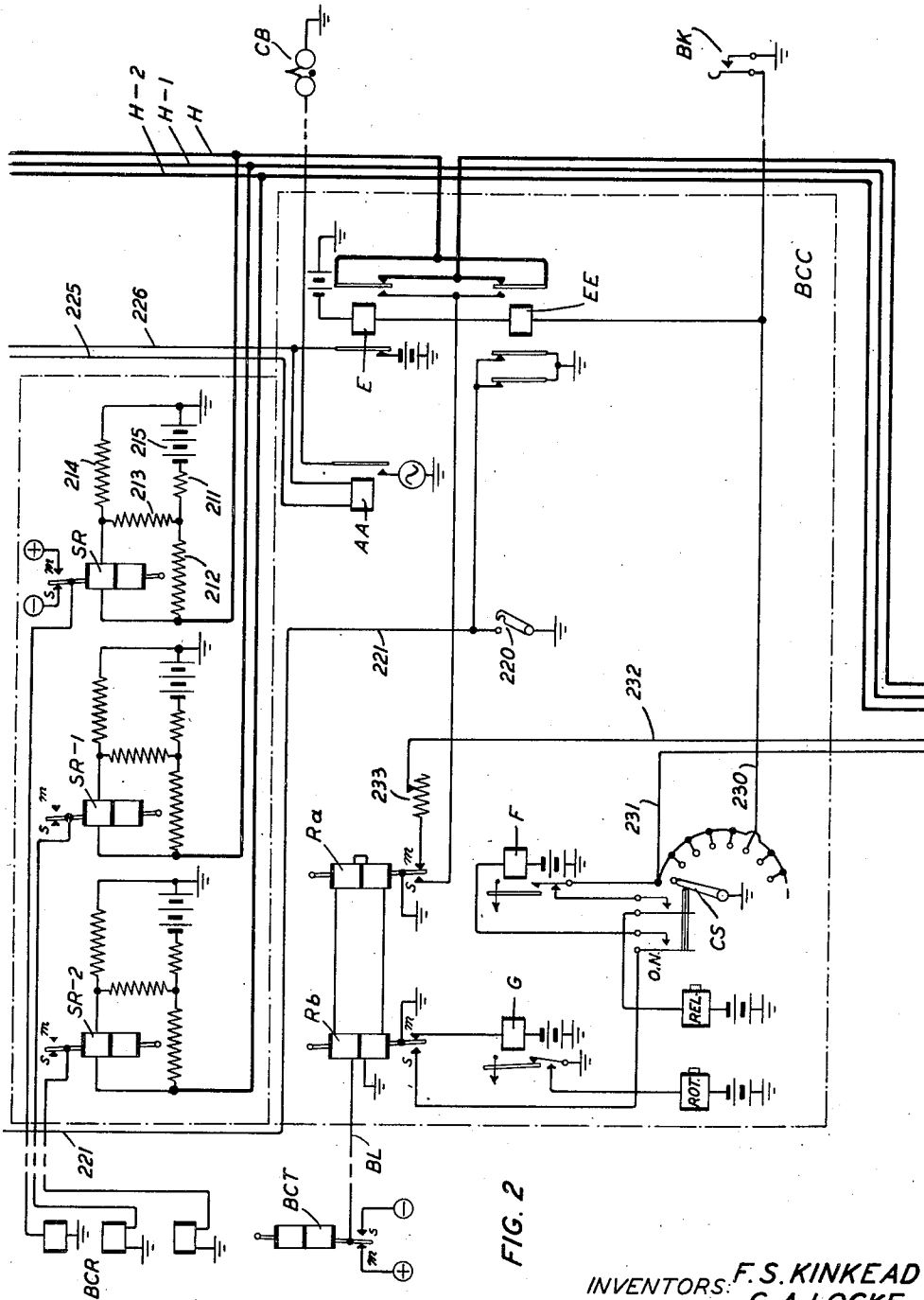


FIG. 2

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TELEGRAPH CIRCUIT

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4 Sheets-Sheet 4

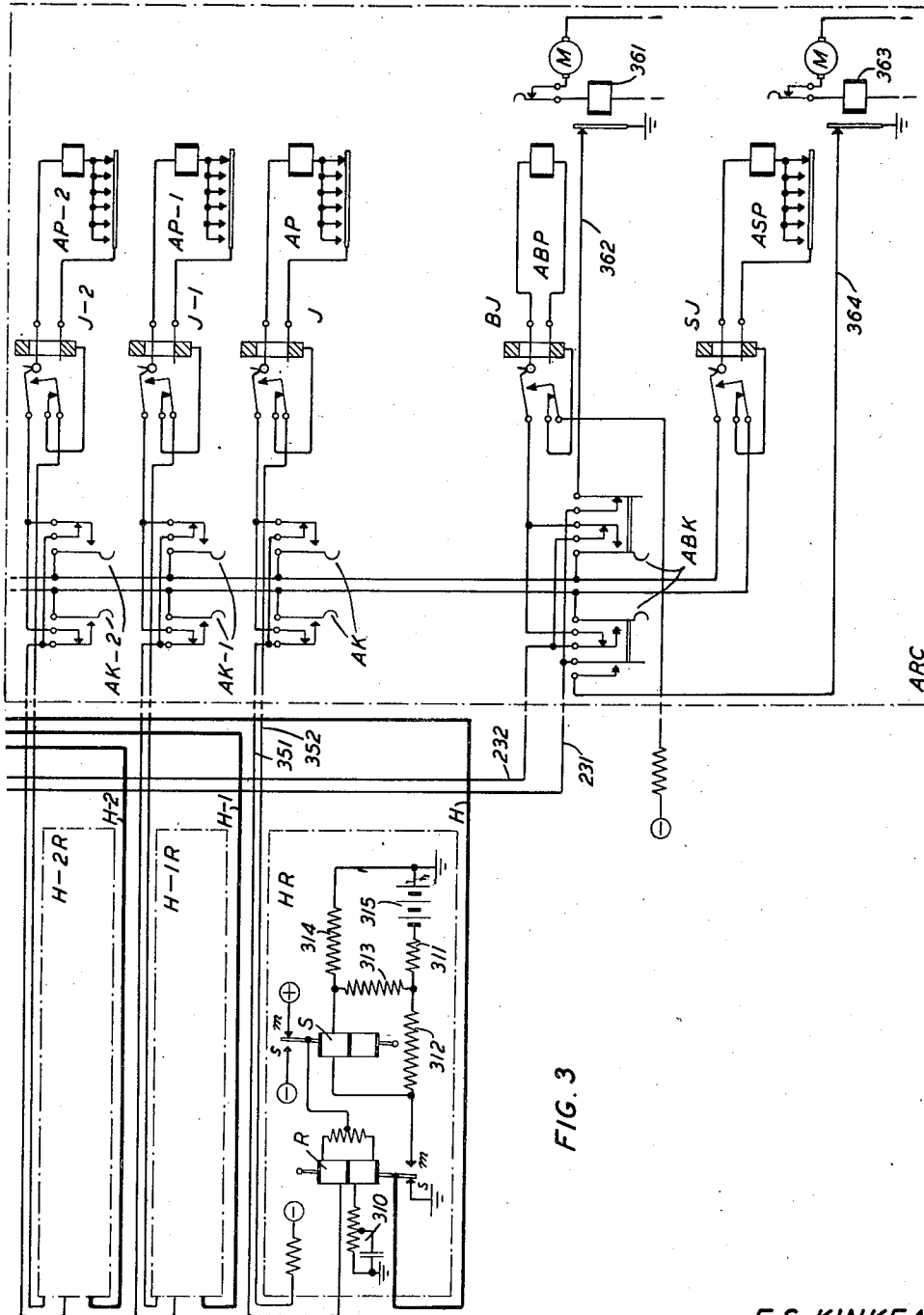


FIG. 3

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2,077,936

TELEGRAPH CIRCUIT

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Application August 31, 1935, Serial No. 38,676

18 Claims. (Cl. 178—2)

This invention relates to telegraph switching systems and more particularly to systems of this type in which telegraph lines can be interconnected for communication by an attendant at a switching station. The invention also relates to systems of this type in which a plurality of stations can be interconnected simultaneously for broadcasting or conference purposes.

It is an object of the invention to provide a switching system in which telegraph lines or telegraph loops may be interconnected for two-way communication. More particularly, it is an object to provide a system in which more than two stations or lines can be directly interconnected for two-way communication between them.

It is a further object to provide an equipment whereby a plurality of separate interconnections may be simultaneously set up to establish two-way communication within each of a plurality of groups of lines.

It is a further object to provide a system of this type in which a large plurality of the line circuits or loops may be interconnected for broadcasting and conference purposes irrespective of whether or not these lines are already in communication; and it is a specific object to arrange for the restoration of the set-up of the various connections after the broadcasting has ceased.

It is still another object of the invention to arrange the system in such a manner that the calling lamp and operator's key at the switching system may be located at a point remote from the repeater bay and relay rack without the use of an excessive number of control wires.

Other objects of the invention have to do with simplification, efficiency and low cost in a system of this type.

In a telegraph switching system arranged in accordance with the invention, each line circuit is permanently terminated at the main repeater station in a simple repeater permitting of two-way communication; a call relay is associated with the line for control of a call lamp on the attendant's switchboard included in a one-wire series circuit connected to a plurality of locking keys; the series circuit also includes a winding of a control relay for cutting through the line to an interconnecting circuit. Other control or switching relays are assigned to each line circuit for cutting the line through to other interconnecting or link circuits depending upon which key is depressed by the operator.

In the preferred form of the system, the two-

way repeater associated with each line is of the interconnecting type in which the local side of the repeater is adapted for operation with a great number of other similar repeaters for two-way communication. Such a repeater is described in patent application Serial No. 32,866, filed by Kinkead and Locke on July 24, 1935.

When a line calls, the corresponding call lamp will be lighted without the line being cut through; the attendant presses a key for a link circuit which is idle and thereby cuts the line through to that link, which normally is connected through a similar interconnecting repeater to the attendant's printer set. Upon exchange of information between the line and the attendant, the attendant presses keys for such other lines as are desired for communication with the calling line and corresponding to the selected link circuit, thereby operating control relays for cutting the lines through to the link circuit.

For broadcasting purposes the arrangement is such that all the control or switching relays associated with the first or main link are automatically operated by a call signal from the broadcasting station to cut all lines through to that link, and simultaneously therewith the switching relays for all other links, which may have been operated by the keys, are automatically released, thereby disconnecting the associated lines from all other link circuits. Upon cessation of broadcasting, all the control circuits are automatically restored and inasmuch as the attendant's keys have remained in locked position, such control or switching relays will again be operated as were used in setting up the connections before the broadcast call, so that those connections will be reestablished.

The broadcasting arrangement may be made in different manners. Thus, any one of the lines may request a broadcast set-up and the attendant, by depressing a single key, will bring about the necessary switching operation and, by restoring the key after the broadcast, reestablish the previous interconnection. In accordance with another arrangement the broadcasting may be from a special station, remote from the switching station, and equipped with remote control apparatus for setting up the broadcast connection to all stations on the first link and subsequently restore the previous interconnection. For this purpose an automatic switching device responsive to a predetermined signal code will bring about the necessary switching operations required for setting up the broadcast connection and for restoring the original intercon-

nection. The device furthermore serves to connect the special broadcasting line to the first link. The broadcasting line may be equipped with either a one-way or a two-way repeater.

5 Other features of the invention will become apparent from a reading of the following detailed description of a specific embodiment of the invention.

The invention will be described as applied to a police system for which it is particularly adaptable and reference will be made to the accompanying drawings which show the equipment of a repeater and switching station for a state police system and in which

10 Figs. 1 and 1—A illustrate different repeater and control circuits directly associated with the incoming lines;

Fig. 2 shows the special control circuit associated with the line from headquarters; and

20 Fig. 3 shows the attendant's equipment for recording of all messages transmitted over the system.

Throughout the system shown in the drawings, a number of links or hubs H, H—1 and H—2 are shown which are one-wire circuits for interconnection of the various repeaters; any number of these interconnecting or link circuits may be provided in accordance with the requirements.

As shown in Fig. 3, each link circuit is connected with a hub repeater HR, H—1R, H—2R to individual attendant's recorder sets AP, AP—1, AP—2, respectively.

As shown in Fig. 2, each link or hub is connected with one repeater SR, SR—1, SR—2, respectively, over individual lines to recorders BCR at the broadcasting station or headquarters. In Fig. 2 there is also shown a broadcasting control circuit BCC for receiving signals over the line BL from the broadcasting transmitter BCT and for impressing signals on the first or main link circuit H.

In Fig. 1, the link circuits are shown connected through a relay control circuit RCC—A and through a repeater RA to a line circuit LA which is shown as including three stations connected in series and located some distance apart. In Fig. 1, the link circuits are similarly shown connected to a relay control circuit RCC—B to a group of repeaters RB—1, RB—2, RB—3, connected in multiple and operating into the line circuits LB—1, LB—2, LB—3 to outlying stations SB. The line circuit may include different numbers of stations.

In Fig. 1—A, the link circuits are shown connected through a relay control circuit RCC—C through a repeater RC to a line circuit LC; the arrangement of circuits RCC—C and repeater RC are shown to illustrate an alternative to the arrangements shown in Fig. 1.

60 In Fig. 1—A the link circuits are also shown connected through a relay control circuit RCC—D and a repeater RD operating over the line circuit LD into a distant group of repeaters RD—1, RD—2, RD—3, which, in turn, operate into line circuits LD—2 and LD—3, which may have different numbers of stations serially included in them.

The stations SA, SB, SC and SD may be assumed to be scattered over a state and to each include a teletypewriter equipment for reception and transmission of telegraph messages, operating on the start-stop principle as is well known. Thus, a group of stations such as SD may cover a remote section of the state and would be connected through a group of repeaters such as the

repeaters RD—2, RD—3, and the group will be connected over a long line circuit to the main repeater station by means of repeaters RD—1 and RD.

Stations such as SA, SB and SC may be assumed to be located in an area surrounding the main repeater station; their line circuits thus will be connected directly to repeaters in the main station.

The headquarters is, in the present instance, assumed to be located some distance from the main repeater station and is equipped with recorders BCR individual to each link circuit in the repeater station for recording of all messages in the whole system. One of these recorders being associated with the main or broadcasting link, a home record will be made at headquarters of messages transmitted from headquarters. The transmitting relay BCT shown in Fig. 2 may be operated in any desirable manner, such as from a teletypewriter keyboard.

In the particular embodiment described in connection with the drawings, it is assumed that the repeaters and relays of the main station are located, for example, in a telephone exchange building where the power supply and maintenance service already is available and that the attendant's switching and recording station may be located for convenience in a different building, perhaps several miles removed from the telephone exchange. Thus, all the repeater equipment of the main station shown in the drawings to the left of the hub circuits H, H—1 and H—2 is located in the telephone exchange building and the attendant's equipment shown to the right of the hub circuits in the various figures is located in the distant switching station. For this reason, the relay control circuits have been designed in such a manner that the number of wires for connecting the attendant's station with the repeater station will be as small as reasonably possible.

In general, the arrangement is such that any one of the substations may call the attendant as by operating the calling bell CB shown in Fig. 2 and by lighting an indicator lamp, such as IA, IB, CIC, representing the line, or the lines with which the calling station is grouped. The attendant then operates a key for associating the line with an idle hub circuit and an attendant's recorder. Upon reading the request of the calling station, the attendant operates keys associated with the called line or lines and also associated with the selected link circuit, thereby interconnecting the calling and the called lines with the attendant's recorder. Two-way communication may then be carried on in any manner between the lines and will be recorded at both the attendant's station and headquarters. At the cessation of the conversation, the lines are disconnected from the hub by the attendant restoring the operated keys, which are of the locking type.

When headquarters wishes to broadcast to all the stations, a special key is operated at headquarters for sending a seize-all signal to the broadcasting control circuit BCC in Fig. 2, thereby operating switch CS a corresponding number of steps to establish a connection and operate relays whereby all stations are cut through to the main or broadcasting hub H, including such stations as may already be in intercommunication over any of the other link or hub circuits. At the end of a broadcast, the previously established interconnections will be

reestablished by the restoration of switch CS to normal position.

The system is based on the hub type of repeater system disclosed in the Kinkead-Locke application already referred to. In that system, each line incoming to the repeater station has permanently assigned to it an interconnecting repeater which has a line side and a local side. The local side of the repeaters are directly interconnected by the one-wire hub circuit represented in the present instance by any of the link circuits H, H—1, H—2, etc. The hub circuit connects the armature of the receiving relay in the various repeaters in multiple, and the winding of the sending relay of each repeater is normally connected to the hub in the marking position of the receiving relay so that it at any time will be in condition to receive signals from the hub for transmission into its associated line circuit. A great number of sending relays may thus be simultaneously operated in multiple over the hub circuit. The receiving relay of any one of the repeaters will respond to incoming signals from its line circuit and in spacing position will place a ground on the hub circuit for operation of the sending relays of all the other repeaters. It is evident that in view of the multiple connection of such a large number of receiving relays to the hub circuit, the current load on the contacts of any one of the receiving relays will be heavy; for this reason the winding on the sending relay is connected into a bridge circuit, so that current reversals may be obtained with a comparatively small current passing over the marking contact of the receiving relay. It is also desirable to protect the contacts of the receiving relay by condensers and inductive loading. An arrangement of bridge circuit and contact protection suitable for this purpose is disclosed in an application Serial No. 32,858, filed by G. C. Cummings on July 24, 1935.

In the following, a description will be given of the operation of the system illustrated in the drawings under different conditions in order that the features and advantages of the invention may be more fully understood.

It will first be assumed that the system is in idle condition with all repeater relays, control relays and keys in the positions shown in the drawings, and also that the teletypewriter motors at all substations are at rest.

One of the stations SA now opens the line circuit LA, Fig. 1, by means of the usual break key and thus sends a break signal to the repeater RA. The line circuit LA is normally under current from positive potential at marking contact of the sending relay S through the upper operating winding of receiving relay R, over the line conductors and the three stations SA in series to negative potential at the repeater; relay R is held in marking position by this current. Current flows also through the lower or biasing winding of relay R from the marking potential at relay S through the balancing network 110 to ground, which current tends to move the armature to spacing but, being of only half the strength of the line current, is unable to do so. When now the break signal arrives, the line winding becomes currentless and relay R is operated to spacing by its biasing winding. The spacing contact of relay R is connected over conductor 221 to ground at the back contacts of relay EE in Fig. 2. This ground will now be extended over the spacing contact of relay R, spoke conductor SPA, over back contacts of relays

D—2, D—1 and B, through winding of relay C to battery, these relays being included in the relay control circuit RCC—A associated with repeater RA and line LA.

Relay C, on operating, connects a locking ground over the back contact of relay B to its own winding, connects ground to the marking contact of relay R for a purpose which will be described below, and at its right-hand front contact closes a shunt path for resistance 128. The series circuit including this shunt path may be traced from battery at the back contact of relay E, Fig. 2, through winding of relay AA, conductor 225, front contact of relay C, through winding of relay A, resistance 135, indicator lamp IA, and normally closed contacts of keys KA—2, KA—1, and KA to ground. Resistance 128 is connected over conductor 226 to battery at relay E in Fig. 2 and normally supplies enough current through relay A to operate that relay but not enough current to light the lamp IA; relay AA, Fig. 2, has a low resistance winding so that, due to the shunt path for resistance 128 completed by relay C, the current in the series circuit is now sufficient to light the lamp and thus indicate to the attendant that line LA is calling. Relay AA, on operating, applies ringing current to the calling bell CB, Fig. 2, for an audible signal.

The attendant's set AP, Fig. 3, is connected to the hub circuit H through the plug and jack J, and the motor of the set is normally running. The signaling circuit for the set AP may be traced from negative potential in hub repeater HR, conductor 352, alternate contact and sleeve of jack J, through the plug and the set, over the tip of jack J, two sets of normally closed contacts in multiple of attendant's key AK, conductor 351, upper line winding of relay R in hub repeater HR to positive potential at the marking contact of sending relay S. Relay R is operated to marking in this circuit and thereby connects the bridge circuit for sending relay S, including battery 315, over its marking contact to the hub conductor H which extends through back contacts in multiple of relays E and EE, Fig. 2, to the link or hub circuit H in Figs. 2, 1 and 1—A.

The attendant now operates key KA, Fig. 1, disconnecting ground from lamp IA, which becomes extinguished, and releasing relays A and AA. The bell signal stops and relay A in relay control circuit RCC—A in releasing operates relay B which at its back contact opens the locking circuit for relay C and at its front contacts cuts the hub circuit H through to the armature of relay R in repeater RA. Relay C, upon releasing, disconnects ground from the marking contact of relay R and opens the by-pass for resistance 128.

The break signal from station SA will have been discontinued at this time so that relay R will be in marking position when the hub circuit is cut through, thereby connecting the bridge circuit of sending relay S for operation by the attendant's set AP over the spoke conductor SPA and hub H. When the attendant now sends an answering signal by opening and closing the line circuit 351, 352, Fig. 3, relay R in repeater HR will respond in the same manner as described for relay R in repeater RA, Fig. 1. During a spacing signal, repeater HR will place a ground over the marking contact of relay R upon the hub H which will pass over the marking contact of relay R in repeater RA, Fig. 1 to operate relay S to spacing; relay S then applies negative or spacing potential through the line wind-

ing of relay R over the line circuit LA and stations SA to negative potential at the repeater RA. The line current becomes zero and operates all the stations SA to spacing. The current
 5 through the biasing winding of relay R in repeater RA now being reversed, this relay will remain in marking position. When repeater HR, Fig. 3 receives a marking impulse from the attendant's set AP, relay R disconnects ground
 10 from the hub and connects the hub to the bridge circuit of relay S in repeater HR; the disconnection of ground from the hub H removes ground from relay S in repeater RA, Fig. 1, which consequently returns to marking position, applying
 15 marking potential to the line circuit and retaining relay R in marking position.

The calling station SA may now state its requirements which may be for connection with the stations on the line circuits LB. The attendant then operates key KB, Fig. 1, thereby
 20 disconnecting ground from the series circuit through relay A and resistance 128 in the relay control circuit RCC—B over conductor 226, to battery at relay E, Fig. 2, causing relay A to release and operating relay B. The hub H thus
 25 will be cut through over the spoke conductor SPB to the armatures in multiple of the receiving relays R in the individual line repeaters RB—1, RB—2, and RB—3. Thus, the hub is extended
 30 over the marking contacts of these receiving relays to the bridge circuit of their corresponding sending relays and communication may now take place between the stations SA and the stations SB over the hub H. Whenever ground is ap-
 35 plied over the spacing contact of one of the receiving relays R to the hub, all the remaining sending relays connected to the hub will be operated to spacing to apply spacing potential to their individual line circuits; when ground
 40 is again removed, the sending relays return to marking position to apply marking potential to their individual lines.

If the request from station SA had also included for example the line circuit LC, the attendant would then also operate the key KC
 45 in the key circuit KC—C, Fig. 1—A, thereby also cutting the hub H through to repeater RC. Any and all of the stations SA, SB and SC would thus be in two-way communication over the com-
 50 mon link or hub H.

All the signals placed upon the hub H will pass through the hub repeater HR, Fig. 3, and will be recorded on the attendant's set AP. The signals will also be impressed upon the sending
 55 relay SR, which constitutes a one-way repeater. Relay SR operates in the same manner as the sending relays in the other repeaters and retransmits signals in any desirable manner to a recording equipment BCR at the broadcasting
 60 station or headquarters for recording of all messages over the hub H.

When observing that the conversation between line circuit LA and line circuit LB has come to an end, the attendant restores the keys KA and
 65 KB, thereby releasing relays B and again operating relays A in the relay control circuits RCC—A and RCC—B without lighting the lamps. The release of relays B disconnects the line repeaters from the hub H, and completes the circuit to re-
 70 lay C, which thus will be ready for the next call. Provision may be made for the attendant to send a special stop signal, in a well-known manner, thereby stopping all the motors at stations SA and SB, before restoring the keys KA and KB.

75 Assuming that the connection over hub H

between line circuit LA and line circuit LB is still maintained and that now a call is originated at station SC, Fig. 1—A, by a break signal, the line circuit may be traced as follows: From negative potential at the relay control circuit RCC—C
 5 over the line LC and station SC, left-hand winding and front contact of relay C, line winding of relay R, to positive potential at the marking contact of sending relay S in repeater RC. This line circuit will now be opened, causing relay C
 10 to release and relay R to operate to spacing. Relay C, in releasing, closes a shunt path about resistance 128, as previously described, thereby operating relay AA, Fig. 2, and causing the bell CB to ring and also lighting the lamp CIC in the
 15 key circuit KC—C.

The attendant's set AP—1 is associated with the second hub H—1 through the plug and jack J—1 and hub repeater H—1R. The attendant will then operate the key KC—1 in the key circuit
 20 KC—C, thereby extinguishing the lamp CIC and releasing relay A. Relay A operates relay B, which, on its left-hand front contact connects the line circuit LC through to the line winding of relay R in repeater RC. Relay B also operates
 25 relay C for cutting the first hub circuit H through to spoke conductor SPC leading to the armature of receiving relay R in repeater RC. By the operation of key KC—1, the operator also connects ground through the winding of relay D—1 to
 30 battery over conductor 226 and back contact of relay E, Fig. 2. The operation of relay D—1 disconnects the repeater RC from the contact of relay B and the first hub before relay B operates and switches the repeater RC into connection
 35 with the second hub H—1 and thereby connects the line LC into communication with the attendant's printer set AP—1.

Complying with the request from station SC, the attendant may now connect any other line
 40 circuit to the second hub by operation of the proper key. Thus, the second hub may be connected through relay control circuit RCC—D to the repeater RD for communication with the stations SD, Fig. 1—A. The repeater RD has its
 45 local side arranged in the same manner as, for example, repeater RA and the relay control circuit RCC—D may be equipped in accordance with the detailed showing for the relay control circuit RCC—C, Fig. 1—A, or RCC—A, Fig. 1. The re-
 50 peater RD has its line side connected over a line conductor LD through the line windings in series of polar relays R—1 and R to contacts of sending relay S of repeater RD—1. The marking poten-
 55 tial applied to this circuit at repeater RD is positive and the marking potential applied by repeater RD—1 is negative, causing a normal line current to flow for operation of the line relays to marking. When the sending relay in either repeater
 60 RD or RD—1 is operated to spacing the line circuit just described will be connected to the same potential at both ends, rendering it currentless and causing the distant receiving relay to operate to spacing. Thus, when signals are trans-
 65 mitted from the hub H—1 through sending relay S in repeater RD, relay S will retransmit the signals over line LD and operate relay R—1 and R accordingly.

The receiving relays R of the repeater group comprising repeaters RD—1, RD—2, RD—3, etc.,
 70 have their armatures directly interconnected by a local hub circuit HD, which in the marking position of the relays R is connected to the sending relays of the repeaters. When relay R in re- 75

peater RD—1 responds to spacing impulses from the line circuit LD it will apply ground to the local hub HD and thus operate all the other sending relays connected to the hub. Each sending relay then retransmits corresponding impulses over their associated line circuits LD—2, LD—3, etc., for operation of the various substations SD. Spacing impulses transmitted by any of the stations SD will operate the corresponding receiving relay to place ground on the hub circuit HD for operation of all the other S relays, including the S relay in repeater RD—1, which consequently retransmits the signals through relays R and R—1, without affecting these relays, and over the line circuit LD, operating relay R in repeater RD. From there, the impulses are repeated over the hub HD—1 into repeater RC and line circuit LC and over the one-way repeater SR—1, Fig. 2, to the recorder BCR at headquarters, as well as over hub repeater H—1R to the attendant's printer set AP—1, Fig. 3.

It will now be assumed that the two sets of connections established over the main hub H and the second hub H—1, in accordance with the description given above, are maintained and that a broadcast call arrives from headquarters to the broadcast control circuit BCC, Fig. 2. For this purpose, the transmitting equipment BCT at headquarters is operated by a special call key to send five long spacing impulses over the line BL, thereby operating receiving relays Ra and Rb.

Relay Ra in operating sends ground impulses over its spacing contact, resistance 233, conductor 232, two sets of contacts in multiple of the attendant's key ABK, Fig. 3, the tip side of jack BJ, to attendant's broadcast receiving printer ABP, over to sleeve side of jack BJ, to negative potential, causing the attendant's set ABP to be started up in any well-known manner. With the motor of the set running, relay 361 will be operated in the power supply circuit, thereby removing the ground from conductor 362 connected through contact on key ABK to conductor 231. Relay Rb in responding to the spacing impulses from headquarters interrupts at its marking contact the ground applied to slow releasing relay G, which is slow enough to make the relay non-responsive to ordinary telegraph impulses and yet respond to the special call impulses. Relay G, consequently, will release five times, each time applying ground to rotary magnet ROT of the counting switch CS which, therefore, makes five steps and stops on the segment connected to the conductor 230. As soon as switch CS leaves its normal position, a circuit will be closed over the off-normal contacts from the spacing contact of relay Rb to slow release relay F, which consequently will operate and will remain operated during the comparatively short intervals between the long call signals until the switch reaches its fifth position and relay Rb remains in marking position long enough to permit relay F to release. In this manner the ground applied by the switch-arm to the first four segments of the switch is prevented from operating the release magnet Rel.

The switch CS in its fifth position applied ground over conductor 230 to operate relays E and EE. Relay EE disconnects ground from conductor 221, thereby removing ground from the marking contacts of all the line circuit repeaters and converting them into one-way repeaters during the broadcasting period. In case this feature is not desired, the switching latch 220, Fig. 2, may be swung into position to permanently connect

ground to conductor 221, thereby permitting of two-way communication also during the broadcasting period as for conference purposes. Relay E, in operating, removes battery from conductor 226, thereby releasing relays D—1 in relay control circuit RCC—C and a corresponding relay in the relay control circuit RCC—D and any other D relay which may have been operated for connecting the hubs through to the line repeaters. The removal of battery from conductor 226 by relay E also causes the release of all A relays in the system which, in turn, causes the operation of all B relays which have not already been operated. In this manner, the main hub H will be cut through to all outgoing repeaters for communication of the broadcast to all substations.

When now the broadcasting station transmits ordinary signaling impulses slow release relay G will remain unaffected, and relay F will operate on the arrival of a first spacing signal and will remain energized during the transmission of ordinary telegraph signals. Relay Ra, Fig. 2, in responding to the signal impulse will repeat the impulses over its spacing contacts, resistance 233, conductor 232, key ABK, Fig. 3, into the attendant's broadcast printer ABP for recording of the broadcast. Relay Ra over its spacing contact repeats the signals over the front contacts in parallel of relays E and EE into the main hub H.

At the end of the broadcast, a special stop signal will be transmitted over the line circuit BL which will be applied to the hub H and cause all printer motors to stop including the motor for the attendant's printer ABP and releasing relay 316 in the power supply circuit for the motor of this printer. After the reception of this signal, relay Rb will remain in marking position, thereby causing relay F to release after an interval. Ground will therefore be applied from the back contact of relay 361, Fig. 3 over conductors 362 and 231, contact of relay F, off-normal contact of switch CS to the release magnet Rel which will cause the switch-arm CS to return to normal; the release circuit is also maintained in positions 1, 2, 3, 4 of the switch by ground from the switch-arm.

Relays E and EE now release to disconnect the broadcast line from the main hub and battery is again connected to conductor 226 for operation of all A relays for which the associated key circuit is in normal position. In the assumed case, relays A in the relay control circuits RCC—A and RCC—B will not be operated because the keys KA and KB have been operated to remove ground from the corresponding series circuits. The relays B in these two control circuits consequently remain operated and the main hub H remains in connection with the line circuits LA and LB. Thus, if it should be desired to continue the communication between these line circuits, any one of the stations SA and SB may transmit a starting impulse for starting the motors of all the other stations SA, SB over the main hub circuit for continuation of the communication.

Similarly the A relays in relay control circuits RCC—C and RCC—D will remain unoperated and relay D—1 in circuit RCC—C and the corresponding D relay in the circuit RCC—D will again be operated by battery over conductor 226 from relay E, Fig. 2, thereby reestablishing the connection from the second hub H—1 to the line circuits LC and LD which thus will be in readiness in case it should be desired to continue the conversation. However, if the conversation is not continued, the attendant will observe this on the

printer set AP—1 connected to the second hub H1 and the attendant will restore the key KC—1, Fig. 1—A, and the corresponding key in the key circuit KC—D.

5 A spare printer set ASP is provided which may be substituted for any one of the other sets by operation of the corresponding keys ABK, AK, AK—1, and AK—2 which will insert the spare set serially in the line circuit through the respective
10 jacks.

Special provision has been made to prevent a conversation from taking place between two stations at any point in the entire system without the attendant's knowledge and without being
15 recorded at the repeater station and headquarters.

Thus, when one of the stations SA transmits a break signal, the other stations SA on the same line circuit would be started up and it would
20 be possible for these stations to exchange messages before the attendant had connected the line circuit to a hub associated with a recorder. In order to prevent this, a ground is immediately placed on the marking contact of the receiving
25 relay of repeater RA by the operation of the relay C in the relay control circuit RCC—A; this ground operates the S relay of repeater RA to spacing, thereby rendering the line currentless and preventing communication between the
30 stations. As soon as the B relay has been operated by the operation of one of the keys in the key circuit KC—A, the C relay is released and the ground is removed from the marking contact of relay R and relay S returns to marking.
35 ing.

Depending upon the motor control system used at the teletypewriter stations, it will be possible by the grounding arrangement just described to not only prevent exchange of signals
40 between the stations without monitoring but also to prevent the motors of the teletypewriter equipment from starting. Thus with a teletypewriter equipment such as disclosed in Patent 1,904,164 to Morton et al. on April 18, 1933, at
45 the substations, the motor of each output included in a particular line or loop may be started by first opening at any point the normally closed loop and then again closing the loop. The motor will then continue to run during the subsequent
50 signaling until two specially assigned signals are impressed upon the loop; in the present instant the two special signals are two shift signals in immediate succession.

Thus when the calling station in sending the
55 break signal first opens the line, the contact operating mechanism in each printer on line LA takes its first step and relay C operates the sending relay S in repeater RA to spacing. Both line conductors will consequently be charged to
60 spacing potential when at the end of the break signal the line is again closed, and the contact operating mechanism in the printers will not take its second step and start the motor until the attendant has associated the line with a hub or
65 link, thereby releasing relay C and permitting relay S of repeater RA to return to marking position. The motors at station SA and at the attendants set AP may now be stopped at any
70 time by two successive shift signals from any of these stations or from any other set connected to the hub.

In the case of the line circuits LB—1, LB—2, and LB—3, communication might be established
75 between these line circuits over the repeaters

RB—1, RB—2, and RB—3 before the hub circuit HB was connected through to one of the link circuits by the attendant. In this case, the C relay will operate relay CC which, in turn, operates to place ground on the marking contacts
5 of the R relays in repeaters RB—1, RB—2, and RB—3 thereby operating the sending relays to spacing and preventing communication between the stations SB until a key in the key circuit KC—B has been operated; thereupon relay C
10 and relay CC will release to remove the ground and recondition the repeaters for two-way communication.

A similar arrangement may be provided for
15 repeater RC, Fig. 1—A.

For the remote groups of stations, such as the group of stations SD, Fig. 1—A, which may have their line circuits interconnected through a plurality of repeaters such as RD—2 and RD—3,
20 over a local hub HD, the grounding of the marking contacts of the various receiving relays is done by relay CC in the group control circuit GCC. When one of the stations SD calls by sending a long break signal, the signal will be repeated by repeater RD—1 over line LD to the
25 repeater RD at the main station. In this circuit, the receiving relay R of repeater RD—1 and its associated relay R—1 will remain in marking position whereas receiving relay R in repeater RD will be operated to spacing and in turn
30 will operate relay C in the relay control circuit RCC—D. As described for the relay control circuit RCC—A, the C relay in the relay control circuit RCC—D will place a ground on the marking contact of relay R in repeater RD
35 operating the sending relays of this repeater to spacing. The line LD will be connected to negative potential at repeater RD and to positive potential at repeater RD—1 and a current will flow
40 to operate relay R in repeater RD—1 and relay R—1 to spacing against the break signal from the calling line. Relay R—1 will remove ground from the normally operated relay GG, and where-
45 as this relay is sufficiently slow releasing to be non-responsive to ordinary signal impulse combinations, it will now have time enough to release and cause the operation to relay CC to prevent communication between the stations SD
50 before the end of the break signal from the calling station.

When the attendant at the main repeater station responds by operating one of the keys in the key circuit KC—D, the C relay in the relay control circuit RCC—D will be released and the
55 spacing condition will be removed from the line circuit LD. Relay R of repeater RD—1 and relay R—1 then operate to marking, causing relay GG to operate and relay CC to release, placing the line circuits RD—2 and RD—3 in condition
60 for two-way communication, at which time such communication will be recorded at the main repeater station and at headquarters.

If desired, the system may be arranged in such a way that upon request from any one of the substations, the attendant, by operating the broad-
65 casting key BK, Fig. 2 will arrange the system for broadcast from the calling station to all the other stations or for conference between all the stations. For this purpose, the broadcasting key will operate relays E and EE, Fig. 2, in the
70 same manner as does the switch CS, thereby removing the battery from conductor 226 and connecting all repeater circuits to the main hub.

The key circuit KC—C Fig. 1—A may be ar-
75

ranged exactly as the circuits KC—A and KC—B. A modified circuit has however been shown in the drawings which has certain advantages. Thus in instances, such as the present, where the key circuits KC are connected over comparatively long wires to the relay control circuit RCC, the lamps I may be subject to discharges due to atmospheric disturbances when directly connected between these conductors and ground, as shown in the key circuits KC—A and KC—B. This is avoided in key circuit KC—C by substituting for the calling lamp a relay CRC in the series circuit 130; relay CRC operates under the same conditions as cause the calling lamps IA and IB to light up, and it closes an auxiliary circuit for the calling lamp CIC.

The key circuit KC—C also includes a test lamp TIC which is normally extinguished by the normally operated test relay TRC, also included in the series circuit 130. Relay TRC is released when any one of the keys KC is operated and lamp TIC is lighted and in this case serves as a busy lamp. However, relay TRC would also release if, during idle condition of the line LC and its associated equipment, an accidental open should occur in the series circuit 130. Thus the lighting of lamp TIC when none of the keys KC is operated would indicate to the attendant that line LC is unable to call.

What is claimed is:

1. A telegraph switching system comprising a line circuit, call relay means responsive to calls on said line circuit, control relay means for cutting through said line circuit for communication with a signaling circuit, and a series circuit including a winding of said control relay means, resistance means, a device for indicating calls on said line circuit, and manual switching means for operation of said control relay means by opening of said series circuit, said call relay means having contacts for reducing the resistance of said resistance means in response to a call on said line circuit to make said device indicating without operating said control relay means.

2. A telegraph switching system, in accordance with claim 1, which further comprises remote control switching means having contacts for operation of said control relay means by opening said series circuit.

3. A telegraph switching system comprising a line circuit, call relay means having a winding normally energized over said line circuit when said line is closed, control relay means for cutting through said line circuit for communication with a signaling circuit, call indicating means responsive to release of said call relay means, manual switching means for simultaneous control of said control relay means and said indicating device, said control relay means having contact means for excluding said winding from said line circuit during communication.

4. A telegraph switching system comprising a plurality of line circuits each having a terminal circuit at a switching station, a local link circuit at said station, each of said terminal circuits including call relay means having a winding normally included in the associated line circuit for control of call indicating means, control relay means operative to connect said terminal circuit to said link circuit for communication through another of said terminal circuits and to exclude said winding from said line circuit, and manual switching means for operation of said control relay means.

5. A telegraph switching system in accordance with claim 4, further comprising remote control switching means common to said plurality of terminal circuits and responsive to calls over a special line circuit for operation of said control relay means in all of said terminal circuits.

6. A telegraph switching system comprising a plurality of line circuits each having a terminal circuit at a switching station for two-way communication, a local link circuit at said station, an attendant's circuit connected to said link circuit for receiving calls over said line circuits, control relay means included in each terminal circuit for cutting the associated line circuit through to said link circuit, and manual switching means associated with each of said terminal circuits for operation of said control relay means to cut through to said link circuit any number of said plurality of line circuits for two-way communication between them.

7. A telegraph switching system comprising a plurality of line circuits each having a terminal circuit at a switching station for two-way signaling, a first local link circuit at said station, a second local link circuit at said station, control relay means included in each of said terminal circuits for cutting the associated line circuit through to said first link circuit, first manual switching means associated with each of said terminal circuits for operation of said control relay means to cut through any number of said line circuits to said first link circuit for two-way communication between them, switching relay means included in each of said terminal circuits for switching the associated line circuit from said control relay means to said second link circuit, and second manual switching means associated with each of said terminal circuits for operation of said switch relay means to cut through any number of said line circuits to said second link circuit for two-way communication between them.

8. A telegraph switching system comprising a plurality of line circuits each having a terminal circuit at a switching station for two-way signaling, a plurality of local link circuits at said station for interconnection of said line circuits, each of said terminal circuits including a locking key and control relay means operable by said key for each of said link circuits for connecting the associated line circuit to any one of said link circuits, common switching means operable to a selective position for control of said control relay means to switch the connection of all line circuits set up by said keys to one of said link circuits from any other link circuit.

9. A telegraph switching system, in accordance with claim 8, in which said control relay means are connected for control by said locking keys and by said common switching means so that a subsequent operation of said switching means to another position will restore all the connections of line circuits to the different link circuits in accordance with the setting of said keys.

10. A telegraph switching system comprising a plurality of line circuits each having a terminal circuit at a switching station for two-way signaling, a plurality of local link circuits at said station for interconnection of said line circuits; each of said terminal circuits including first control relay means for cutting the line circuit through to the first of said link circuits, other control relay means for switching the line circuit to another of said link circuits, call relay means having a winding included in said line

circuit during idle condition, call indicating means and a plurality of locking keys included in a local call circuit, said call relay means having contact means for operating said call indicating means, said locking keys each having contacts to disconnect said indicating means and to operate a corresponding one of said control relay means, and said first control relay means being connected to be operated by all of said keys and having contacts to exclude said winding from the signaling path of said line circuit.

11. A telegraph switching system, in accordance with claim 10, further comprising a special line circuit having a terminal circuit at said switching station including common relay means and selective switching means operable to a predetermined condition in response to a signal over said special line to operate said common relay means, said common relay means having contacts for controlling said other control relay means to disconnect line circuits from the corresponding other link circuits and for controlling said first control relay means to cut through all of said plurality of line circuits to the said first link circuit.

12. A telegraph switching system comprising a plurality of line circuits and a special line circuit and interconnecting circuit means at a switching station, each of said line circuits having terminal equipment at said switching station, the terminal equipment for each of said line circuits comprising call relay means responsive to calls on said line circuit, control relay means for conditioning said line circuit for communication with said circuit means, and a series circuit including a winding of said control relay means, resistance means, a call indicating device, and manual switching means for operation of said control relay means by opening of said series circuit, the winding of said control relay means being normally energized when the associated line circuit is idle, said call relay means having contacts for reducing the resistance in said series circuit in response to a call to operate said indicating device without deenergizing said winding, and said series circuit being connected to a common current source, and the terminal equipment for said special line circuit comprising remote control contact means for operation of said plurality of control relay means in response to a broadcast call on said special line circuit by disconnecting said plurality of series circuits from said common current source when in a selected position and for connecting said source to said series circuits when subsequently moved to another position by a disconnect signal on said special line circuit.

13. A telegraph switching system comprising a plurality of line circuits terminating at a switching station, a plurality of link circuits, manually controlled relay means for each connection point between said line circuits and said link circuits for setting up of a plurality of two-way connections between said line circuits, characterized in this that said system further includes switching means for automatic control of said relay means to connect all of said line circuits to one of said link circuits for two-way communication between them in one position of said switching means and for restoring all manually set up connections between said line circuits and said link

circuits when subsequently operated to another position.

14. A plurality of telegraph stations, a repeater station, a line circuit interconnecting said stations, said repeater station including sending relay means for normally applying current condition and alternately applying no-current condition to said line circuit, said repeater station also including receiving relay means responsive to current impulses over said line circuit under said current condition, control relay means connected for operation by said receiving relay means in response to an open of said line circuit for operation of said sending relay means to apply the no-current condition to said line circuit.

15. A plurality of line circuits including telegraph stations, a plurality of repeater circuits for interconnection of said line circuits and including sending relay means for normally applying current condition and alternately applying no-current condition to said line circuits, receiving relay means responsive to current impulses over said line circuit under said current condition, and control relay means connected for operation by said receiving relay means in response to an open of said line circuits for operation of said sending relay means to apply the no-current condition simultaneously to all of said line circuits.

16. A plurality of line circuits including telegraph stations, a plurality of repeater circuits for interconnection of said line circuits and each including sending relay means for normally applying current condition and alternately applying no-current condition to the associated line circuit, and receiving relay means responsive to current impulses over said associated line circuit under said current condition, control relay means at one of said stations responsive to the no-current condition on the associated line circuit to apply reversed current condition to said line circuit to operate said receiving relay means of the associated repeater circuit, and slow-acting common relay means responsive to the operation of said receiving relay means to operate the sending relay means of the other of said repeater circuits to apply no-current condition to the other of said line circuits.

17. A line circuit, a plurality of telegraph stations on said line circuit each including recording mechanism arranged for automatic starting by an interruption and a subsequent restoration of the normal current condition on said line circuit, repeating means for termination of said line circuit and normally applying current condition to said line circuit, control relay means connected to said repeating means for operation in response to an open of said line circuit at one of said stations to in turn operate said repeating means to apply no-current condition to said line circuit to prevent starting of said plurality of recording mechanisms.

18. The combination, in accordance with claim 17, further comprising relay means and manually controlled contact means for restoring said control means and said repeater means to apply current condition to said line circuit and start said plurality of recording mechanisms.

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