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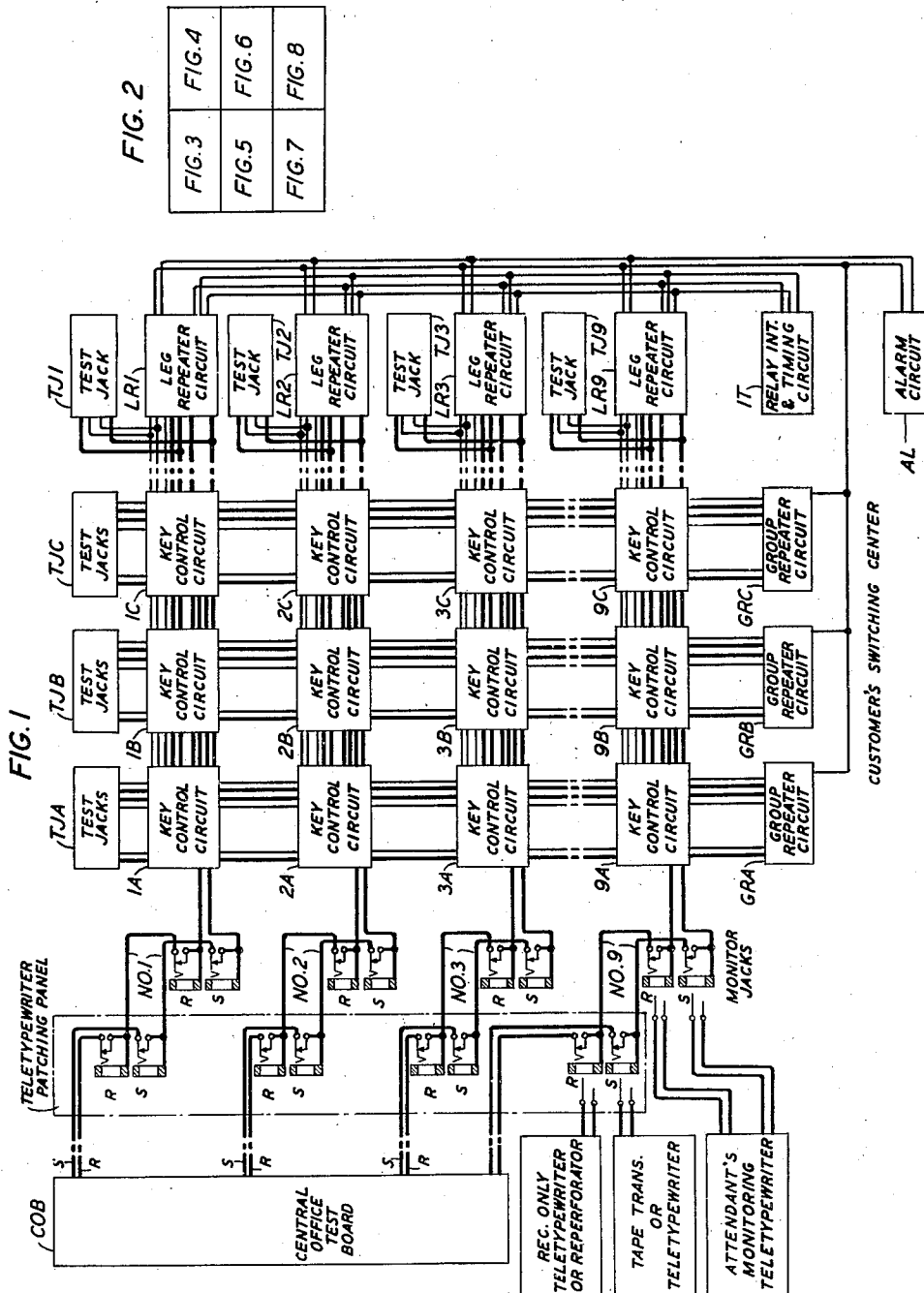
A. R. BONORDEN

2,255,596

TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 29, 1939

7 Sheets-Sheet 1



INVENTOR
A. R. BONORDEN
BY *JW Schmied*
ATTORNEY

Sept. 9, 1941.

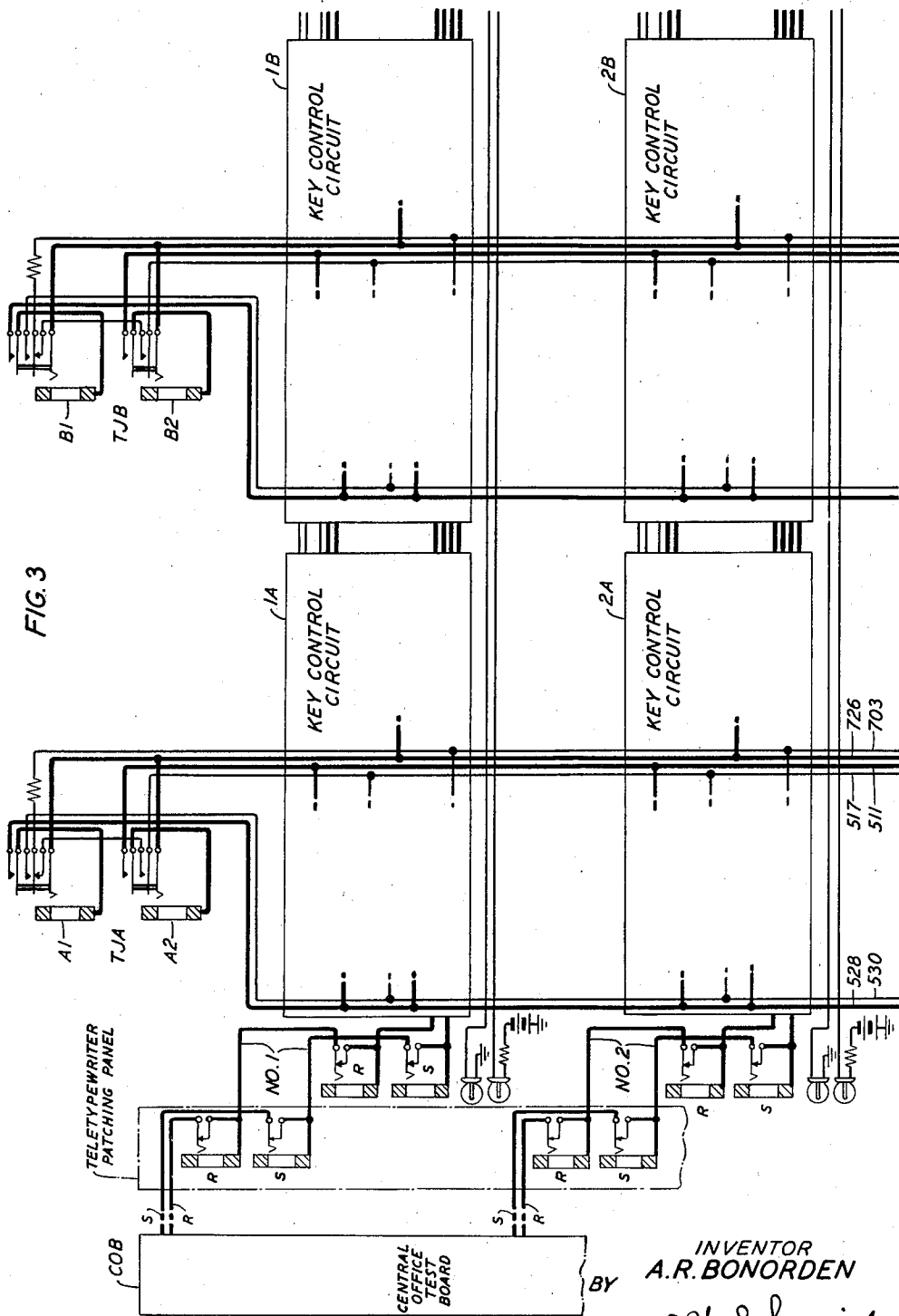
A. R. BONORDEN

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Filed Nov. 29, 1939

7 Sheets-Sheet 2



INVENTOR
A.R. BONORDEN

J W Schmied
ATTORNEY

Sept. 9, 1941.

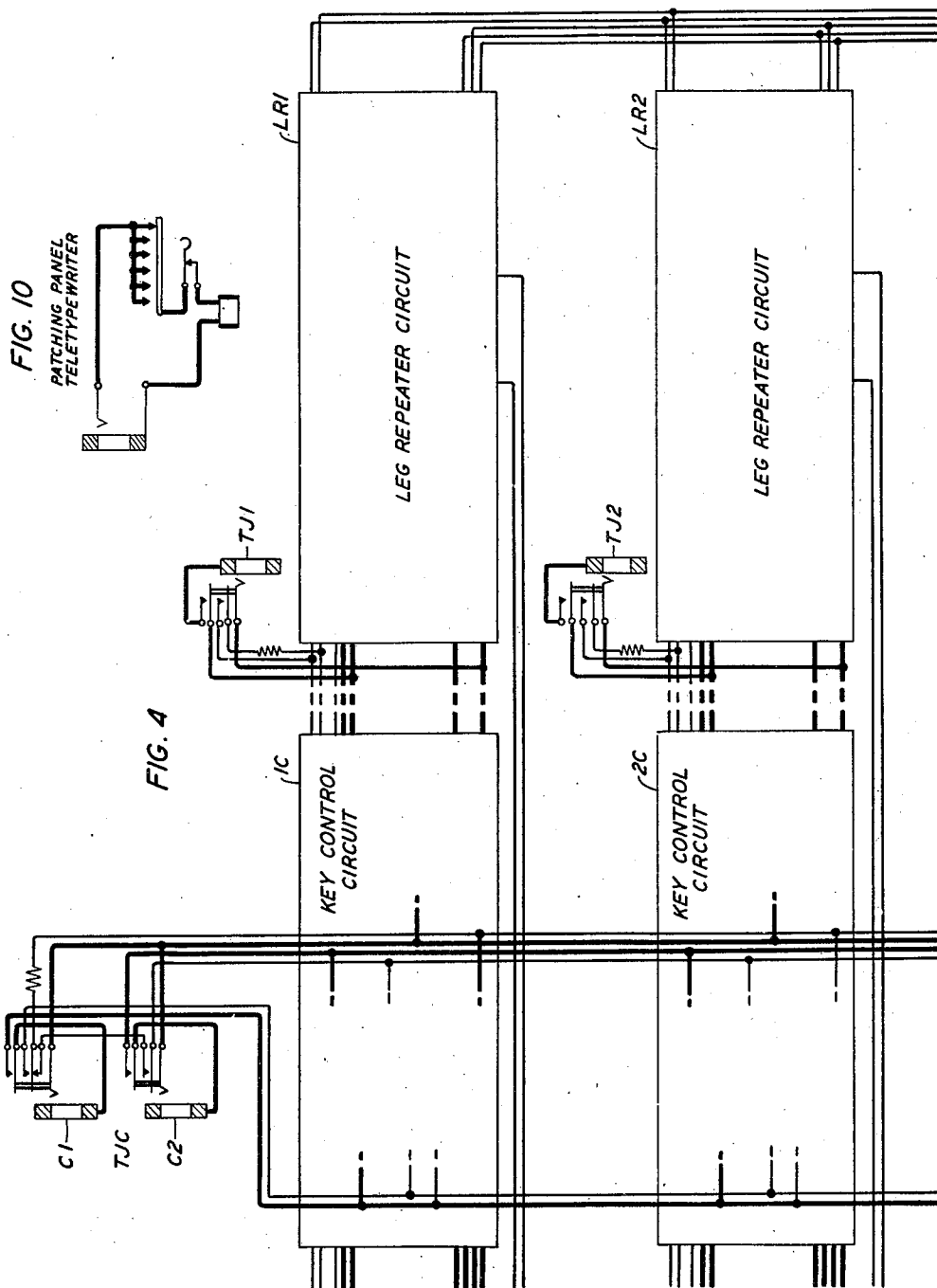
A. R. BONORDEN

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Filed Nov. 29, 1939

7 Sheets-Sheet 3



INVENTOR
BY A. R. BONORDEN

J. H. Schmied
ATTORNEY

Sept. 9, 1941.

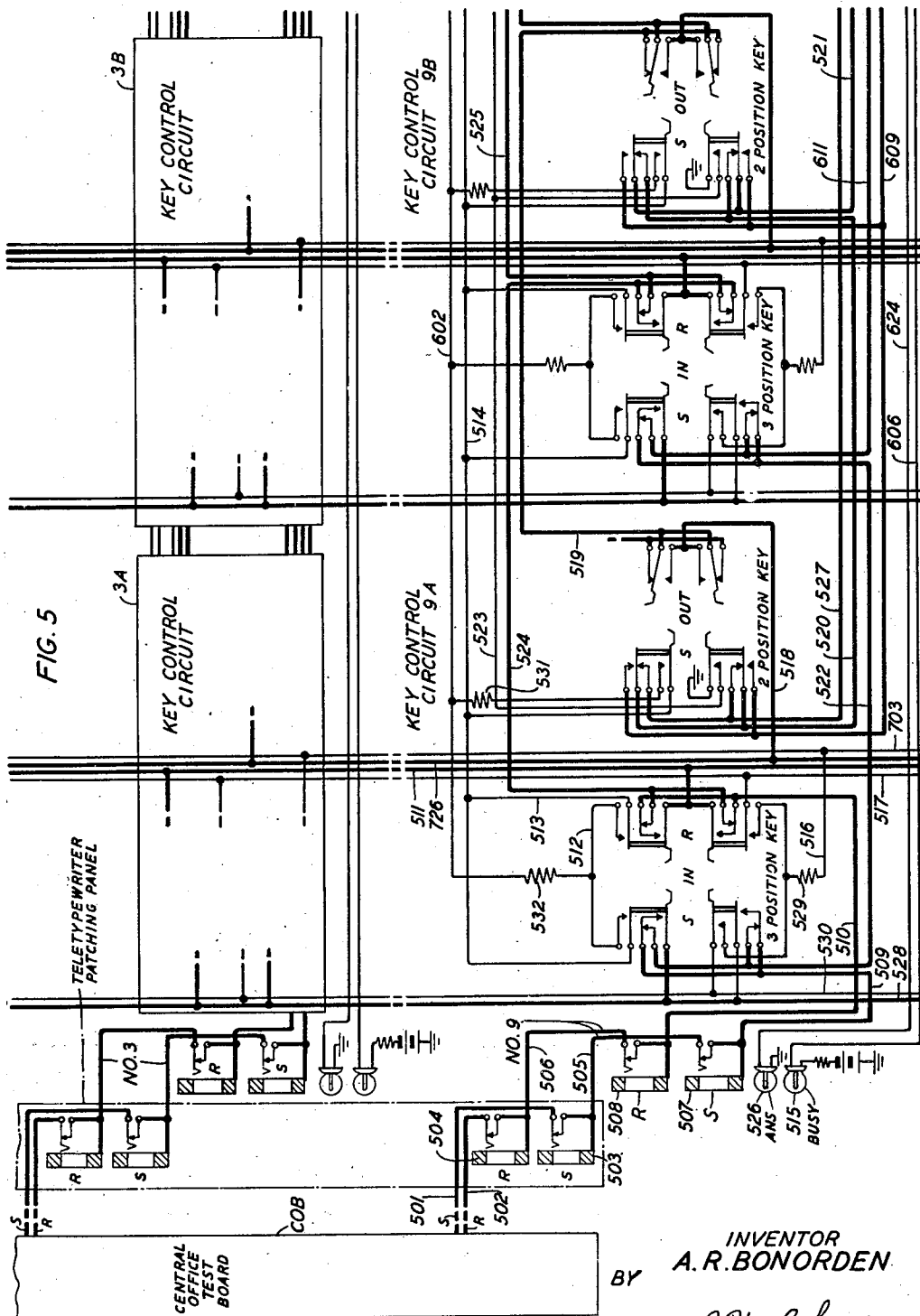
A. R. BONORDEN

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TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 29, 1939

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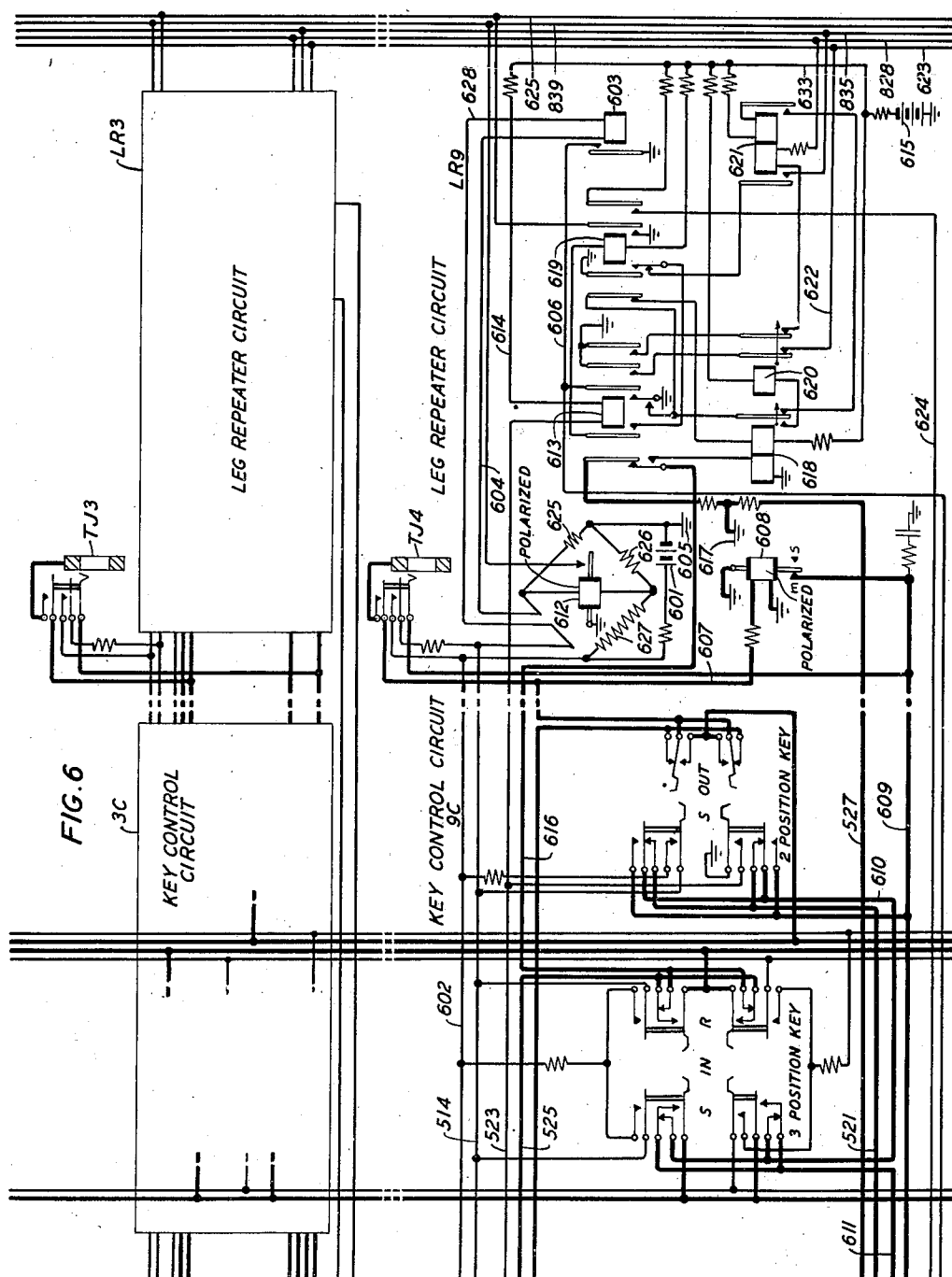
A. R. BONORDEN

2,255,596

TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 29, 1939

7 Sheets-Sheet 5



INVENTOR
A. R. BONORDEN
BY *JW Schmier*
ATTORNEY

Sept. 9, 1941.

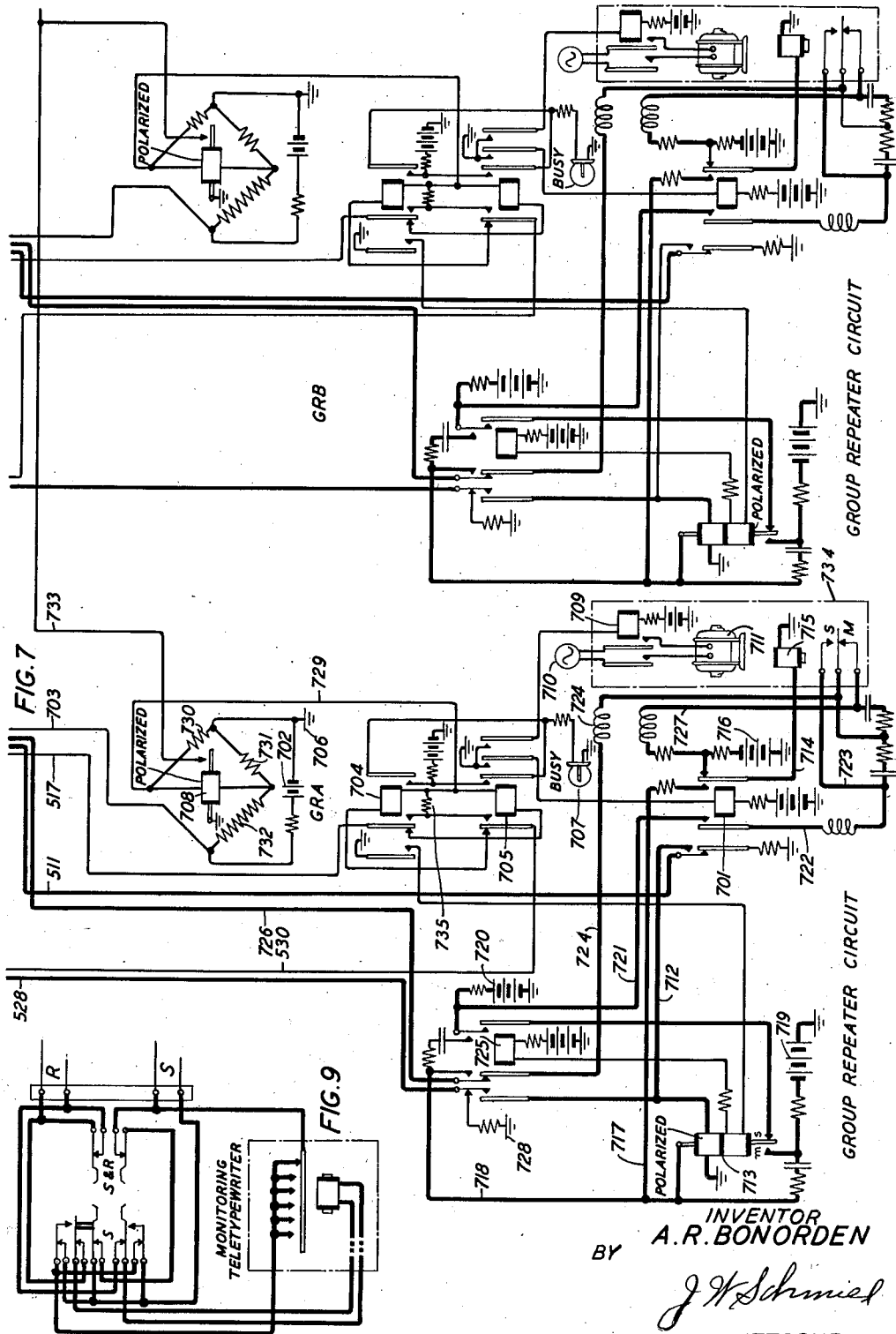
A. R. BONORDEN

2,255,596

TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 29, 1939

7 Sheets-Sheet 6



INVENTOR
A. R. BONORDEN
BY *J. H. Schmitt*
ATTORNEY

Sept. 9, 1941.

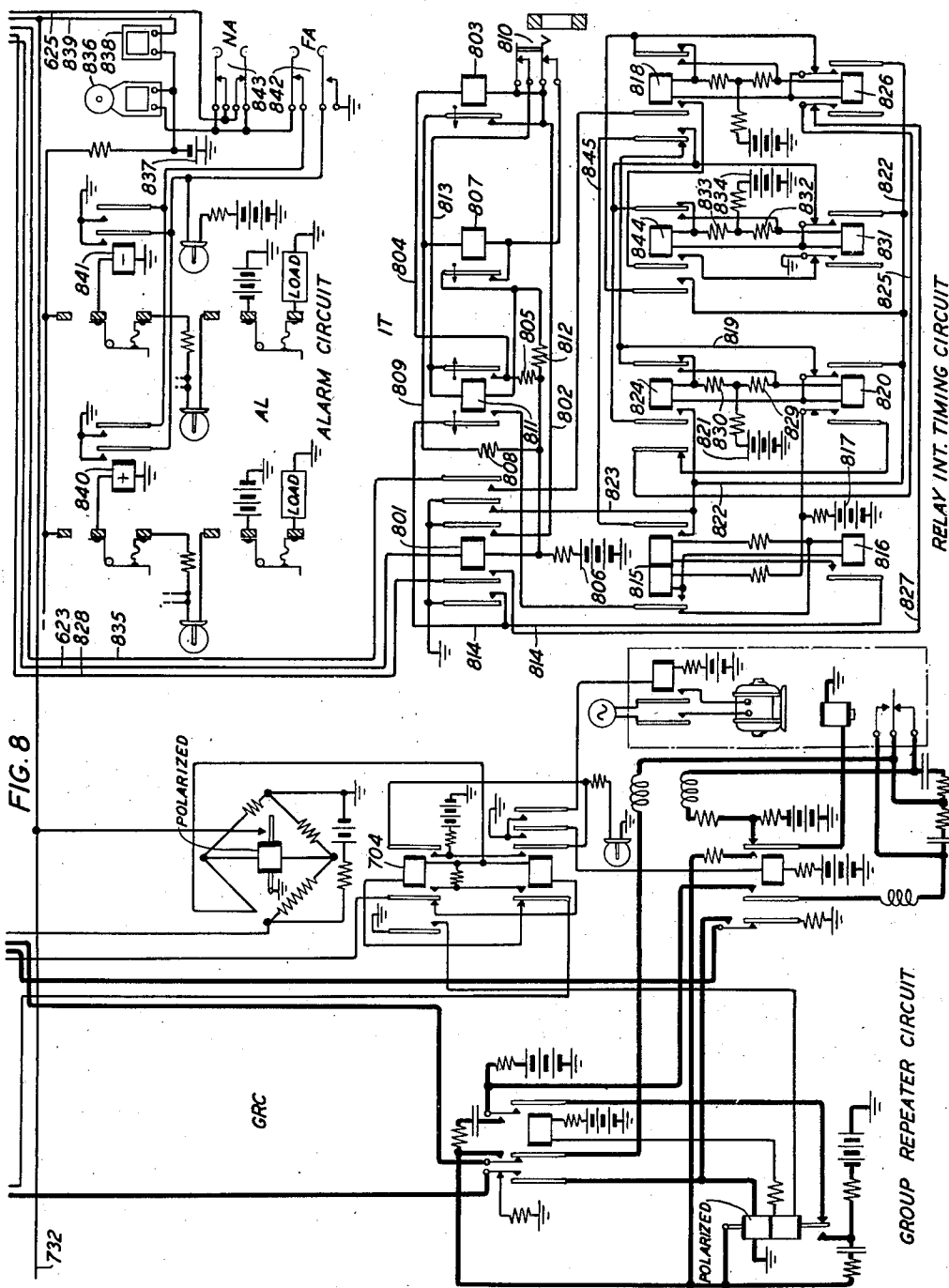
A. R. BONORDEN

2,255,596

TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 29, 1939

7 Sheets-Sheet 7



INVENTOR
A.R. BONORDEN
BY *J. H. Schmitt*
ATTORNEY

UNITED STATES PATENT OFFICE

2,255,596

TELETYPEWRITER SWITCHING SYSTEM

Allen R. Bonorden, Plainfield, N. J., assignor to
Bell Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

Application November 29, 1939, Serial No. 306,648

11 Claims. (Cl. 178—2)

This invention relates to teletypewriter switching systems and more particularly to those systems wherein teletypewriter loop circuits leased to a private company are adapted for connection with each other as desired by the lessee.

An object of the invention is to facilitate switching of any one of several loop circuits incoming at a lessee's premises into connection with one or more of the remaining loop circuits.

In information or news transmission systems employed by private establishments, such as press associations and other syndicates of this type, it is highly desirable that news flashes be broadcasted to various cities throughout the country most expeditiously. Switching centers located on the premises of these establishments in the larger cities are connected over leased lines or loops terminating at test boards located in local central, or exchange, offices of the telephone and telegraph operating companies so that should it be desired to send a news flash from one to another of the larger cities, the connection is established through test boards of one or more operating companies to the switching center at the distant city. When the information is received at the terminating switching center the connection may be extended on a broadcast basis to one or more other cities located in the area of the terminating switching center. For example, a switching center may be located in each of the following cities in the United States: New York, New York, representing the eastern States; Atlanta, Georgia, the southern States; Chicago, Illinois, the middle States; Denver, Colorado, the mountain States; and San Francisco, California, the western States. Therefore, a news flash being received from Chicago by New York, the switching center at New York, upon being advised of the importance of the message, may connect on a broadcast basis the loop connected through from Chicago, to other loops extending to Boston, Massachusetts; Pittsburgh, Pennsylvania; Washington, District of Columbia and other cities located in the eastern States area.

Hereinafter a private establishment which leases lines, or loops, from an operating company is referred to as the customer and the exchange office of the operating company is referred to as the central office. The leased lines extend from the test board at the local central office to the switching center of the customer, as loops, and these loops usually operate on a split loop basis, that is, one conductor of each loop operates as a "send leg" for transmitting from the switching center "neutral," or "open and close," signals to

the local central office, and the other operates as a "receive leg" for receiving at the switching center "polar signals" transmitted from the local central office. In this case the conductors of each loop respectively extend through series-connected jacks located in a patching panel board at the switching center, and patched to the jacks of each loop as required by traffic considerations are teletypewriters with keyboards or automatic tape transmitters for transmitting and "receive only" teletypewriters or receiving reperforators for receiving news flashes or messages. The teletypewriters are connected to continuously receive and transmit messages. The teletypewriters respectively connected to the "send legs" usually have an attendant for each machine but those connected to the "receive leg" are usually arranged in groups and each group is supervised by an attendant.

Although the present invention is based on the use of the "split loop" method of operation described in the preceding paragraph, it is within the scope of the invention that "send only" and "receive only" metallic loops might be used. In this case the "receive only" loop might be arranged for the transmission of either "polar signals" or "open and close" signals.

According to the present invention, the "send leg" or "receive leg" of each loop may be selectively connected separately to a "send leg" of any one of the remaining loops or, for broadcast purposes, to the "send legs" of one or more of the remaining loops simultaneously, the connection being established by means of operable keysets. One key of each set is of the three-position type and the other is of the two-position type. The keysets are arranged in groups, there being as many keysets in each group as there are loops and there are as many groups as the traffic warrants. Connected to each group of keysets is a common group repeater of the one-way type and connected to the corresponding keysets of such groups is a leg repeater also of the one-way type, that is, a leg repeater is connected to the first keysets of all groups, another is connected to the second keysets of all groups, and so on, there being as many leg repeaters as there are loops.

A feature of the invention resides in regenerating message signals incoming over the "receive leg" of a loop before repeating them over the "send leg" of one or more of the remaining loops to the central office.

Another feature consists of means for causing to be simply repeated, that is, without regenera-

tion, over the "send leg" of one or more loops to the central office, those message signals that originate at the local switching center and are transmitted over the "send leg" of another loop as a message incoming at the central office.

Still another feature is the provision at a customer's switching center, of keysets whereof the three-position key of any one of several sets may be operated either in one direction to connect the "receive leg" of its associated loop to the input side of a group repeater for regeneration of incoming signals or in the other direction to connect the "send leg" of such loop to the input side of a group repeater for repeating without regeneration the incoming signals.

Another feature resides in the keysets whereof the two-position key of any one of the several sets, when operated, may operatively connect the output side of the group repeater to the input side of a leg repeater associated with the loop over which the message is to be repeated and to connect the output side of such leg repeater to the "send leg" of the loop over which the message is to be repeated.

Another feature is the provision of teletypewriter monitoring on both the "send leg" and the "receive leg" of each loop and to permit a monitoring teletypewriter to transmit over the "send leg" of each loop.

Another feature resides in the method and means for receiving break signals.

Other features reside in the provision for giving alarm signals when the following attempts to repeat signals are made:

(a) Into one group repeater from more than one loop;

(b) Into one group repeater from one loop and to repeat simultaneously, the signals from the same group repeater into the same loop;

(c) Into one group repeater from one loop and to repeat signals from a second group repeater into this same loop;

(d) From more than one group repeater into one loop; and

(e) Into more than one group repeater from one loop.

The system shown herein is assumed to employ nine loops extending from a central office test board to a customer's switching center, and of the nine, loops 1, 2, 3 and 9 are shown. Also shown are three group repeaters so that a maximum of three simultaneous broadcasts may be cared for.

In the drawings:

Fig. 1 shows a diagrammatic arrangement of the system wherein four loop circuits of two conductors each extend from the central office test board through a single line two-spring jack (not shown) to the customer's switching center where the conductors of each loop are connected through individual jacks. The conductors of each loop are further extended through monitoring jacks, respectively, and then through a plurality of series-connected operable keysets to a leg repeater all of which are shown in each horizontal row on the drawings. The number of keysets in each row depends upon the requirements of traffic. The keysets are arranged in groups, the corresponding keysets connected to all the loops forming a vertical file or group. The keysets of each group are connected in series to a group repeater at one end and to test jacks at the other end. The leg repeaters are connected, in parallel, to a relay interrupter and timing circuit and also to an alarm circuit. The

group repeaters are likewise connected to the alarm circuit. A test jack is connected to each of the leg repeaters.

Fig. 2 shows the relative arrangement of Figs. 3 to 8, inclusive.

Figs. 3, 4, 5 and 6 show four loop circuits extending from a test board (in diagrammatic form) at a central office to a customer's switching center. Each of the loop circuits are shown connected, in series, through three keysets to a leg repeater circuit, the keysets and leg repeater connected in series in the lowest position, or to No. 9 loop, being shown in detail.

Fig. 7 shows two group repeater circuits respectively connected to the first and second keysets of each of the nine loops.

Fig. 8 shows a group repeater circuit connected to the third keyset of each of the nine loops. Also shown in Fig. 8 are the alarm circuit and the relay interrupter and timing circuit.

Fig. 9 shows the attendant's monitoring teletypewriter arranged for connection to both legs of any one of the loops.

Fig. 10 shows an attendant's series-connected teletypewriter arranged for connection at the patching panel and for transmitting or receiving messages or news flashes over the "send leg" or "receive leg" of any loop. Fig. 10 is also representative of other transmitting and receiving apparatus such as automatic tape transmitter and receiving reperforators which may be patched as traffic requires to the proper "leg." It is to be understood that instrumentalities connected to any "receive leg" is arranged for operation on "polar signals."

A test board shown diagrammatically and designated COB is located at the central office of the operating company. Loops Nos. 1 to 9 which correspond to customers' line circuits in the ordinary teletypewriter private wire system except that the loops operate on a split loop basis as hereinbefore described, terminate at their respective spring jacks (not shown) mounted in the test board at one end and at the other end, which is the customer's switching center, are respectively connected to pairs of single line two-spring jacks mounted at a teletypewriter patching panel. Each of the loops extend from its jacks in the teletypewriter patching panel through another pair of single line two-spring jacks and the terminals of a plurality of keysets, arranged in series connection, to terminate in a leg repeater, the jacks and keysets being mounted in a switching panel. Keysets 1A, 1B, 1C, etc. together with leg repeater LR1 are associated with loop No. 1; keysets 2A, 2B, 2C, etc. together with leg repeater LR2 are associated with loop No. 2; keysets 3A, 3B, 3C, etc. together with leg repeater LR3 are associated with loop No. 3; and keysets 9A, 9B, 9C, etc. together with leg repeater LR9 are associated with loop No. 9. Connected in common to keysets 1A, 2A, 3A and 9A is group repeater GRA; connected in common to keysets 1B, 2B, 3B and 9B is group repeater GRB, and connected in common with keys 1C, 2C, 3C and 9C is group repeater GRC. An alarm circuit AL is connected in common to each of the group repeaters and the leg repeaters, and connected in common with the leg repeaters only is a relay interrupter and timing circuit IT. The leg repeaters LR1, LR2, LR3 and LR9 are of the simple one-way type whereas the group repeaters GRA, GRB and GRC are of both the simple and the regenerative one-way

types. A group repeater acts as a simple repeater when repeating signals from the "send leg" of one loop to the "send leg" of one or more other loops and as a regenerative repeater when repeating signals from the "receive leg" of one loop to the "send leg" of one or more other loops.

For the purpose of illustration, keysets 9A, 9B, 9C, as well as the leg repeater LR9 which are associated with loop No. 9 are shown in detail whereas the keysets and leg repeaters connected to loops Nos. 1, 2 and 3, respectively, are shown in diagrammatic form, it being understood that each of the keysets and leg repeaters connected with loops Nos. 1, 2 and 3, respectively, are the same as the corresponding parts shown connected to loop No. 9.

A detailed description

A detailed description of the operation over loop No. 9 will now be given. Loop No. 9 consists of two conductors, namely, "send leg" 501 and "receive leg" 502 which respectively terminate in jacks 503 and 504 which are of the single line two-spring type and are mounted in the teletypewriter patching panel. During operation of the system, a teletypewriter or automatic tape transmitter may be patched to jack 503 or a "receiving only" teletypewriter or a reperforator may be patched to jack 504. In each case these instruments are connected in series with the respective legs. The teletypewriters connected to the "send legs" have individual operators in steady attendance whereas the teletypewriters, the tape transmitter and the tape reperforators connected to the "receive legs" may have one operator attending to a group of, say, four or five such machines. The teletypewriters adapted for connection to "send legs," such as conductor, 501, are of the type wherein the printer magnet and transmitting contacts are connected in series as shown in Fig. 10. The "receive only" teletypewriters and the receiving tape reperforators adapted for connection to "receive legs," such as conductor, 502, are provided with polar relays arranged for reception of polar signal over the "receive leg". The "send leg" 501 and "receive leg" 502 are extended through jacks 503 and 504, to the switching panel whereat they terminate at other single line two-spring jacks 507 and 508, respectively, which are provided for monitoring and administration purposes. The monitoring jacks 507 and 508 are adapted for the use of a monitoring teletypewriter of the type shown in Fig. 9. In the cord circuit for the monitoring teletypewriter shown in Fig. 9, there is provided a three-position key whereby the receiving element of the monitoring teletypewriter may be connected for operation with either the "send leg" 501 or the "receive leg" 502, it being assumed that the monitoring teletypewriter is equipped with key controlled means, well known in the art, whereby the receiving element may be conditioned for receiving on either a polar or a neutral signal basis. The monitoring key shown in Fig. 9 may be operated to the right or the left position depending upon whether it is desired to monitor on the "receive leg" 501 or the "send leg" 502. When the monitoring key is in either position the sending keyboard is connected to the "send leg," position, and signals may also be transmitted to the loop from the monitoring teletypewriter. In other words, when the monitoring key is in its normal position, the monitoring teletypewriter is shunted by paths across both the "send leg" and "receive leg" by the normally

closed contacts at the monitoring key; when the key is in its right-hand, or "send and receive leg," position the printer magnet of the monitoring teletypewriter is connected in series with the "receive leg" 502 and the transmitting contacts of the monitoring teletypewriter are connected in series with the "send leg" 501. Under this condition, the switching panel attendant may hold two-way communication over the loop with the distant city since his sending "copy" is retransmitted at the central office back over the "receive leg." When the monitoring key is in its left-hand, or "send leg" position, both the printing magnet and transmitting contacts are connected in series with the "send leg" 501 thereby permitting the monitoring of signals transmitted either from the teletypewriter patched into jack 503 in "send leg" 501 of loop No. 9 or from the leg repeater when the "send leg" 501 is connected to the output side of a group repeater as hereinafter described.

The sleeves of "send leg" jack 507 and "receive leg" jack 508 for the monitoring teletypewriters are respectively connected to conductors 509 and 510. These conductors, like the corresponding conductors of loops 1, 2 and 3, terminate at a multiple switching panel (not shown) consisting of switching keysets, busy lamps, testing and optional monitoring facilities. The switching keysets provide a means for connecting separately or simultaneously any number of combinations of loops that are associated with the arrangement. The busy lamps indicate which of the various telegraph legs, leg repeaters and group repeater circuits are engaged in connection in the system. The monitoring facilities already described provide means for monitoring on the telegraph legs and the testing facilities provide means for checking the operation of the leg repeaters and group repeaters including the associated regenerative elements.

The keysets on the switching panel consist of two keys each, one a three-position key located on the left of the set and the other a two-position key on the right. Three-position keys may be operated from normal to either their left, that is, "send leg in" position, or their right, that is, "receive leg in" position, depending on whether it is desired to connect the teletypewriter connected at the patching panel to the jack terminating the "send leg" 501 for originating messages at the local switching center, to the input side of a group repeater for broadcasting said messages over a "send leg" of one or more of the remaining loops, or to connect the teletypewriter connected at the patching panel to the jack terminating the "receive leg" 502 for receiving messages incoming at the switching center, to the input side of a group repeater for broadcasting said messages over a "send leg" of one or more of the remaining loops, the said group repeater being the particular group repeater associated with the particular key that is operated. Each of the group repeaters is common to a group, or vertical file, of those of the three-position keys which are in the same corresponding position, such as the first, second, and so forth, keysets to which the loops are respectively extended. Each group repeater is caused to repeat the signals with or without regeneration when any of the associated three-position keysets is operated to its "receive leg in" or "send leg in" position. The two-position keys may be operated from their normal, or right-hand, positions to the left-hand, or "send leg out," posi-

tions. Each of the two-position keys when operated to its left-hand position is effective to connect the output side of a group repeater to the input side of the leg repeater associated with the "send leg" of the loop with which the operated two-position key is associated, and in establishing such connection also connects the output side of the leg repeater to the "send leg" which serves to route the message to a distant city. Hereinafter the three-position keys and the two-position keys will be referred to as "in" and "out" keys, respectively.

Method of operation

When a news flash is received over the "receive leg" 502 and recorded at the teletypewriter patched to jack 504 and the news is of such importance that it is desired to broadcast it to other cities over several of the other loops, the attendant in charge of the group of teletypewriters to which the teletypewriter recording the news is assigned, operates first the "in" key of keyset 9A associated with the loop over which the news is received, to its right-hand, or "receive leg in" position and then one or more of the "out" keys of the sets associated with the remaining loops, provided they are idle, to their respective "send leg out" positions, it being understood that only one "in" key in any row and group may be operated, and that no "out" key may be operated in the same row containing an operated "in" key in establishing either an individual or a broadcast connection.

The circuit of the "receive leg" when the "in" key of set 9A is operated to its right, or "receive leg in" position, completes the circuit which includes the teletypewriter patched in at jack 504, conductor 506, "receive" monitor jack 508, and conductor 510, and which extends over the inner upper and lower operated right-hand spring members, in parallel, and associated contacts on the "in" key of set 9A, conductor 511, contact and outer left armature of relay 701, to ground, grounded battery (not shown) for the circuit being furnished at the central office. At the outer upper operated right-hand spring member and associated contact of the "in" key of set 9A a circuit is closed extending from grounded battery 601, conductor 602, resistance 532, conductor 512, contact and outer upper operated right-hand spring member of the "in" key of set 9A, conductors 513, 514 and 628, through the winding of busy relay 603, conductor 604, resistance 625, to ground connection 605. Busy relay 603 operates and closes at its armature and contact a circuit extending from ground, conductor 606, busy lamp 515 to grounded battery. Lamp 515 lights to indicate that a keyset in loop No. 9 is operated. Polarized relay 612 which is included in a bridge of a Wheatstone bridge arrangement comprising, as one arm, conductor 602, resistance 532, conductors 512, 513, 514 and 628 and winding of relay 603, and as the remaining arms, the respective resistances 625, 626 and 627, does not operate at this time.

At the outer lower operated right-hand spring member of the "in" key of set 9A, a circuit is closed extending from grounded battery 702, conductors 703 and 516, resistance 529, operated outer lower right-hand spring member of the "in" key of keyset 9A, conductor 517, inner left armature and back contact of relay 704, through the winding of relay 705, conductor 729, resistance 730 to ground connection 706. Relay 705

operates and at its left armature and back contact opens the operating circuit for relay 704. At its innermost right armature and contact relay 705, upon operating, closes an obvious operating circuit for busy lamp 707 which lights indicating that group repeater GRA which is associated with the first keysets 1A, 2A and 3A, is busy, and that no other "in" keys of the first keysets, that is, those designated 1A, 2A and 3A, should be operated at this time. Polarized relay 708, however, does not operate at this time inasmuch as it forms a part of a balanced Wheatstone bridge. Polarized relay 708 in this respect is like polarized relay 612 hereinbefore described. The Wheatstone bridge arrangement comprises, one arm, conductors 703 and 516, resistance 529, conductor 517, inner left armature and back contact of relay 704, the winding of relay 705 when the "in" key of set 9A is in its right-hand position, or the winding of relay 704 when the "in" key is in its left-hand position, and as the remaining arms, the respective resistances 730, 731 and 732. Relay 708 does not operate at this time.

Relay 705, upon operating, closes another obvious circuit which operates relay 701. Relay 701, upon operating, transfers conductor 511 which is the previously traced extension of the "receive leg" 502, from ground at its outer left armature to conductor 712, through the upper winding of polarized relay 713 to ground. Relay 701, upon operating, also transfers at its right armature, conductor 714 from the back contact to the front contact of the armature whereby one side of the operating circuit of regenerative repeater magnet 715 including grounded positive battery 719 is extended over conductors 717 and 718 to the armature of polarized receive relay 713. Relay 705, upon operating, as hereinbefore described, closes still another obvious circuit for operating motor start relay 709 which operates. Relay 709, upon operating, connects source 710 of alternating current to start motor 711 whereby the regenerative repeater element 734 in group repeater GRA is started.

The basic principle of all telegraph regenerative repeaters is to utilize only a small part of the middle portion of each received impulse to determine the nature of the outgoing pulses and to control the timing of these outgoing pulses accurately by local means. In the regenerative repeater employed in the system herein described, but not shown in mechanical detail, the synchronous motor drives two sets of cams, the first set being used to pick out the mid-portions of each incoming pulse and the second set to control the timing of the outgoing pulses. A complete disclosure of this type of repeater may be found in U. S. Patent 2,105,173 granted to W. J. Zenner et al. on January 11, 1938.

The transfer of conductor 511 to conductor 712 includes receive relay 713 in the "receive leg" of loop No. 9 whereby relay 713 being polarized, now follows the signals of positive and negative polarities as they are received in their attenuated condition. Relay 713 will repeat these attenuated signals as impulses of "current" and "no current" over a circuit extending from grounded battery 719 or no battery, left-hand, or marking, or right-hand, or spacing contact and armature of relay 713, conductors 718 and 717, front contact and right armature of relay 701, conductor 714, through the winding of repeater magnet 715 to ground. The regenerative element 734 of group repeater

GRA will regenerate signals similar in magnitude, shape, duration and polarity as those originally transmitted from the point of origin and when one or more loops are selected for the broadcast these regenerated polar signals will be repeated as "current" and "no current" signal at the leg repeater of each of the selected loops for transmission over the "send legs" of the selected loops. The circuit for transmitting the regenerated signals to the leg repeaters is not completed until the attendant operates the "out" keys of the selected loops over which the outgoing signals are to be transmitted. It is at this time partly completed over two paths, one from the positive pole of grounded battery and the other from the negative pole. The path from the positive pole begins at grounded battery 720 and extends over conductor 721, contact and inner left armature of relay 701, conductors 722 and 723, to the upper contact and armature of magnet 715; and the path from the negative pole begins at grounded battery 716, and extends over conductor 727 to the lower contact and armature of magnet 715. Both paths converge and extend as one path over conductor 724, inner left armature and back contact of relay 725, conductor 726, to the open contacts of the "out" keys of each of keysets 9A, 3A, 2A and 1A in their normal, or right-hand, positions, the path to keyset 9A extending over conductor 518.

Inasmuch as the signals are incoming over the "receive leg" of loop No. 9 and the "in" key associated with that loop is operated, the "out" key associated with one or more of the remaining loops and the group repeater GRA, should be operated to transmit the regenerated signals to their respective destinations over the "send legs" of those of the remaining loops that are selected to be included in the broadcast. Keysets 3A, 2A and 1A are shown in block form but a description of the operation of the "out" key of set 9A which is shown in detail, will suffice for the corresponding keys in sets 3A, 2A and 1A. Therefore, for the purpose of illustration, assume that the "out" key of set 9A is operated, the circuit path hereinbefore traced to conductors 726 and 518 is extended over the inner contacts and spring members of the "out" key of set 9A, now closed since the key is operated to its left-hand position, conductor 519, outer contacts and right-hand spring members of the "out" key of sets 9B and 9C in the positions shown, conductor 607, through the winding of polarized relay 608 to ground. Relay 608 will follow the regenerated signals and repeat them over the "send leg" of loop No. 9 which in this case is assumed to be one of the selected loops over which the broadcast is being made. This condition in actual practice would be undesirable in that the news flash would be retransmitted to a place from which it had been received. However, for the purpose of the description herein this assumption is made.

The circuit to the "send leg" of loop No. 9 may be traced from ground, armature and marking, or left, contact of relay 608, conductor 609, make contacts and outer left-hand spring members of the "out" key of set 9A, conductor 520, break contacts and outer left-hand spring members of the "out" key of set 9B, conductor 521, break contacts and outer left-hand spring members of "out" key of set 9C, conductor 619, left-hand make-before-break contacts of the "in" key of set 9C, conductor 611, left-hand make-before-break contacts of the "in" key of set 9B,

conductor 522, left-hand make-before-break contacts of the "in" key of set 9A (which contacts would be closed if loop No. 9 were actually selected for an outgoing message), conductor 509, monitoring jack 507, conductor 505, patching jack 503 to "send leg" 501 to which grounded battery is connected at the central office. The operation of the "out" key of set 9A to its "send leg out," or left-hand position also closes a circuit for operating busy relay 603 which in operating lights busy lamp 515. (Busy relay 603 was hereinbefore described as being operated to indicate that loop No. 9 contained an operated key due to an incoming message. Now it is assumed to be again operated because of loop No. 9 is herein assumed to be selected for an outgoing message.) The circuit for operating busy relay 603 is substantially the same as hereinbefore described except that it is now closed at the make contact and inner upper left-hand spring member of the "out" key of set 9A and includes resistance 531 instead of resistance 528. Polarized relay 612 which is in a path parallel to the operating circuit for busy lamp 603, does not operate at this time. Another circuit is closed by the operation of the "out" key of set 9A, which is traceable from ground, inner lower left-hand spring member and make contact of the operated key, conductor 523, through the winding of relay 613, conductor 614 to grounded battery 615. Relay 613 operates and transfers the "receive leg" 502—which is normally extended through the patching jack 504, monitoring jack 506, normally closed make-before-break contacts on the right-hand side of the "in" key of set 9A (in normal position), conductor 524, normally closed make-before-break contacts on the right-hand side of the "in" key of set 9B, conductor 525, normally closed make-before-break contacts of the right-hand side of the "in" key of set 9C and conductor 616 to the back contact and the outer left armature of relay 613—from a ground connection 617 to a path traceable to ground through the left-hand winding of the slow-to-release relay 618. The circuit just traced exists only when the "in" key of set 9A is in a normal position in which it is assumed to be at the present time and it is further assumed, at this time, that the "out" key only of set 9A is operated for sending a message out over loop No. 9.

Receiving break signal

The purpose of the "receive leg" of the loop being terminated at the winding of relay 618 in the manner described in the preceding paragraph is to provide for the reception of a break signal originated at the station to which the message is being transmitted. When the "out" key of set 9A was operated to its left-hand position in order to engage the "send leg" of loop No. 9 for sending a message to a distant city, relay 613 operated as hereinbefore described. Relay 613, upon operating, closes at its left-hand make-before-break contacts a circuit extending through the primary, or left-hand, winding of relay 618, to ground. Marking current in the "receive leg" causes relay 618 to operate. When relay 613 operated, current aiding the effect of the marking current in the "receive leg" flows through the secondary, or right-hand, winding of relay 618. Relay 618, upon operating, closes at its armature and front contact an operating circuit for relay 620 and relay 620 operates. Relay 620, upon operating, opens at its inner right armature and contact the operating circuit for

start relay 801 and at its outer right-hand armature and contact opens the circuit including the primary winding of relay 621. Relay 618 being of the slow-to-release type may or may not follow telegraph signals in the "receive leg." Relay 620 being also of the slow-to-release type will remain operated under normal signaling conditions. However, if a spacing signal exceeding the normal duration is received, relay 618 releases and its continued release causes relay 620 to release. The release of relay 620 applies ground at the middle right armature and contact of relay 613 to the inner right armature and back contact of relay 620, conductors 622 and 623, through the winding of start relay 801, to grounded positive battery. Start relay 801 operates to start the interrupter and timing circuit IT. Relay 801, upon operating, closes at its innermost right armature and contact a circuit traceable from ground over conductor 802 through the winding of slow-to-release relay 803, conductor 804, resistance 805, to grounded battery 806. Relay 803 operates and at its armature and contact removes direct ground from a path which is parallel with the operating circuit of relay 807. Relay 807 which is of the slow-release type now operates in a circuit traceable from grounded battery 806, resistance 808, conductor 809, through the winding of relay 807, contact normally closed at the lower spring of jack 810, conductor 802, contact and innermost right-hand armature of relay 801 to ground. Relay 807, upon operating, removes at its armature and contact a ground connection from a path which is parallel to the operating circuit of relay 811. Relay 811 operates in a circuit traceable from grounded battery 806, resistance 812 through the winding of relay 811, conductor 813, normally closed contact at the upper spring member of jack 810, conductor 802, contact and innermost right-hand armature of relay 801 to ground. Relay 811, upon operating, closes at its contact and right-hand armature a path to ground which shunts the winding of relay 803 and relay 803 releases. Relay 803 upon releasing, closes at its armature and contact a path for shunting the winding of relay 807 and relay 807 releases. Relay 807, upon releasing, closes at its armature and contact a path for shunting the winding of relay 811 and relay 811 releases. Therefore, as long as start relay 801 is operated the armature and contact of relay 811 closes and opens automatically at a frequency determined by the operating time of each of relays 803, 807 and 811. This frequency is at the rate of 120 interruptions per minute, approximately. The first closure of the armature and contact of relay 811 causes to be closed a circuit traceable from ground, outer left armature and contact of relay 801, conductor 814, left-hand armature and contact of relay 811, left-hand armature and back contact of relay 815, through the winding of relay 816, through the left-hand winding of relay 815, to grounded positive battery 817. Relay 816 operates but relay 815 does not operate at this time because the current through the left-hand, or secondary, winding of relay 815 is insufficient to operate it. However, the first release of relay 811 and the operation of relay 816 transfers the ground connection from the left-hand armature of relay 811 to the armature and contact of relay 816 whereby a circuit is closed extending through the right-hand, or primary, winding of relay 815, the winding of relay 816 and the secondary winding of relay 815, all

in series, to grounded battery 817. Relay 815 operates. Relays 816 and 815 are now both operated and the contacts of relay 811 have closed and opened once. A second closure of the contacts of relay 811, after relays 816 and 815 have become operated, closes a path from ground, outer left armature and contact of relay 801, conductor 814, left-hand armature and contact of relay 811, left-hand armature and front contact of relay 815, through the secondary winding of relay 815 to grounded battery 817 thereby shunting the winding of relay 816. Relay 816 releases but relay 815 is held operated. The second opening of the left-hand armature and contact of relay 811 causes relay 815 to release. The left-hand armature and contact of relay 811 have now closed and opened twice and the left-hand armature and front contact of relay 815 have closed and opened once. Therefore, left-hand armature and front contact of relay 815 close and open at the rate of approximately 60 interruptions per minute as long as start relay 801 remains operated. Relay 815, upon operating, closes at its right armature and contacts a circuit traceable from ground, middle right-hand armature and contact of relay 801, contact and right-hand armature of relay 815, conductor 845, outer left armature and back contact of relay 818, conductor 819, right-hand normally closed contact of relay 820, through the winding of relay 820, to grounded positive battery 821. Relay 820 operates and locks up in a circuit traceable from grounded positive battery 821, through the winding of relay 820, contact and right-hand armature of relay 820, conductors 822 and 823, back to ground on the contact and middle right-hand armature of relay 801. Relay 820, upon operating, applies grounded positive battery 817 to the contacts and left-hand armature of relay 820, contact and outer left-hand armature of relay 824, conductor 825, left-hand normally closed contact of relay 826, conductor 827, contact and inner left armature of start relay 801, conductor 828, through the left-hand winding of relay 621, contact and outer right armature of relay 620, contact and outermost right-hand armature of relay 613 to ground. The operating circuit for relay 820 which extends from grounded positive battery 821 through the resistance 829 and the winding of relay 820 has a parallel path which extends from the same battery source through the resistance 830, back contact and right-hand armature of relay 824 to the same ground used for the operating circuit. The first opening of the contacts of relay 815 removes the ground at the middle right-hand armature of start relay 801 from the parallel paths and thereby permits relay 824 to operate in a circuit traceable from grounded positive battery 821, resistance 830, through the winding of relay 824, front contact and right armature of relay 820, conductors 822 and 823, over the contact and middle right armature of relay 801, to ground. Relay 824, upon operating, opens at its outer left-hand armature and contact the positive potential supply from grounded battery 817 and thereby removes battery from conductor 828 which extends through the left-hand winding of relay 621 as hereinbefore described. Relay 824, upon operating, closes at its inner left-hand armature and contact a circuit traceable from ground at the middle right-hand armature and contact of start relay 801, right-hand normally closed contact of relay 831, through the winding of relay 831, resistance 832

to grounded positive battery 834. The operating circuit for relay 831 likewise has a parallel path extending from grounded battery 834 through resistance 833, back contact and right-hand armature of relay 844 to ground at the middle right armature and contact of start relay 801. The second closure of the right-hand armature and contact of relay 815 applies ground to a path which shunts the winding of relay 820 causing it to release. The second opening of the right-hand armature and contact of relay 815 causes relay 824 to release. The release of relay 824 removes the shunt around relay 844 which operates. Relay 844 upon operating causes relay 826 to operate and lock to the ground on conductor 822. The third closing of the contacts of relay 815 causes the relay 820 to operate again, and a third opening of the contacts of relay 815 causes relay 824 to operate again as described above. This second closure of the contacts of relay 824 causes relay 831 to release. The fourth closure of relay 815 contacts causes relay 820 to release as previously described. The fourth opening of the contacts of relay 815 causes relay 824 to release and the release of relay 824 causes the release of relay 844. The release of relay 844 causes the operation of relay 818 which now transfers conductor 845 from relay 820 to relay 831. Hence, the fifth closure of relay 815 contacts causes the relay 831 to operate. The fifth opening of the contacts of relay 815 causes relay 844 to operate again. This operation of relay 844 causes relay 826 to release. The sixth closure of the contacts of relay 815 causes the release of relay 831 which, upon releasing, applies ground at its left-hand normally closed contacts to a circuit traceable over contact and inner left armature of relay 844, contact and inner left armature of relay 818, contact and outermost right-hand armature of relay 801, conductor 835, contact and left-hand armature of relay 621, normally closed contacts of relay 619, contacts of inner left armature of relay 613, through the winding of relay 619 to grounded battery 615. The sixth opening of the contacts of relay 815 causes the release of relay 844, the release of which causes relay 818 to release and also removes ground from conductor 835. The cycle described in the foregoing repeats about every six seconds, applying first a battery pulse on conductor 828 of about one-half second duration and then a ground pulse on conductor 835 of about one-half second duration. The ground pulse follows the battery pulse at about four and one-half seconds interval. The sequence of operation as just described is based on a continuous break signal received on the "receive leg" of loop No. 9 when it is assumed that loop No. 9 is being utilized at the customer's switching center for an outgoing message. If the break signal ceases before a battery pulse followed by a ground pulse is applied to conductors 828 and 835, respectively, the appearance of these pulses on these conductors which is essential for the operation of the break signal, is prevented. Assuming that the break signal is sufficient to cause the appearance of battery and ground pulses on conductors 828 and 835, these pulses cause the break signal to operate as described in the following description.

The battery pulse on conductor 828 causes the operation of relay 621 in a circuit hereinbefore described. Relay 621, upon operating, closes at its right-hand armature and contact a locking circuit extending from grounded battery 615, conductor 633, through the right-hand winding and

over the right-hand armature and contact of relay 621, back contact and right-hand armature of relay 618 to ground at the innermost right-hand contact of relay 613. Relay 621 locks up in an operated condition. The next or following ground pulse on conductor 835 causes the operation of relay 619 by means of a circuit hereinbefore described. Relay 619, upon operating, closes a locking circuit for itself which is traceable from ground at the inner left armature and front contact of relay 619, front contact and inner left armature of relay 613 through the winding of relay 619 to grounded battery 615. Relay 619 locks itself in an operated condition. Relay 619, upon operating, closes a circuit traceable from grounded battery 615, outer right armature and contact of relay 619, conductor 624, through the answering lamp 526 to ground. Lamp 526 lights to indicate to the attendant at the switching center that the party at the opposite end of loop No. 9 wishes to interrupt the message. Relay 619, upon operating, completes another circuit which is traceable from ground at the contact and inner right-hand armature of relay 619, conductor 625, through the normally closed contacts of night alarm key 843, signal bell 836 to grounded battery 837. The bell operates providing an audible alarm operating in conjunction with answering lamp 526 to indicate to the attendant at the switching center that a party normally receiving a broadcasted message desires to send a message back to the switching center. Relay 619, upon operating, opens at its outer left armature and contact the circuit extending through the secondary, or right-hand, winding of relay 618 thereby permitting relay 618 to operate under the influence of the current flowing in the primary, or left-hand, winding at the end of the break signal. Relay 618, upon operating, opens at its back contact and armature the locking circuit for relay 621 and at its front contact and armature closes an obvious circuit for operating relay 620. Relay 621 releases. Relay 620 operates to thereby open at its inner right armature and contact the operating circuit for start relay 801, and at its outer right-hand armature and contact the circuit including battery pulse conductor 828. The relay interrupter and timing circuit, shown in Fig. 8, is now disassociated from the leg repeater circuit LR9, associated with loop No. 9 over which the first break signal was received. It still might be in operation, however, in connection with a break signal received on another of the remaining loop circuits. Normally, a break signal of about five seconds in duration should operate the audible signal. However, if two break signals are received nearly simultaneously, a break signal of about ten seconds in duration may be required on the second circuit to operate the lamp and audible signal. The break signals and break circuits are restored by operating to its normal, or the right-hand, position the two-position key of set 9A which is assumed to be associated with loop No. 9 on which the break occurs. The attendant at the switching panel answers the lighted lamp signal 526 by plugging the monitoring teletypewriter cord shown in Fig. 9 into monitoring jacks 508 and 507, operating the cord key to the right, or "send and receive leg," position. He then restores to normal the operated "out" key, thus restoring loop No. 9 to its former condition. All operated relays in the leg repeater LR9 restore to normal, relay 619, on restoring, causing lamp 526 to be extinguished and the bell 836 to be silenced. Two-way teletypewriter communica-

tion is now established between the monitoring teletypewriter and the distant station where the break signal originated.

Transmitting from a teletypewriter connected to a jack at the patching panel, over a "send leg" of one loop to a "send leg" of one or more of the remaining loops

Assume that it is desired to originate a news flash or message at the customer's switching center for transmission over one or more of the remaining loops and that the teletypewriter connected to loop No. 9 is selected. The teletypewriter connected at "send leg" 501 to jack 503 which is mounted in the patching panel is employed for this purpose. The attendant assigned to this teletypewriter throws the "in," or three-position, key of set 9A at the switching panel to its "send in," or left-hand, position and then throws an "out," or two-position, key of the keyset for each of the remaining loops over which the news flash or message is to be transmitted, to its respective "send out," or left-hand, position. Inasmuch as the switching circuit for loop No. 9 is the only one that is shown in detail, it will be assumed hereinafter for the purpose of the description of the invention that loop No. 9 is also selected as one of the remaining loops over which the news flash is to be transmitted.

The operation of the "in" key of set 9A to its "send in," or left-hand, position transfers the "send leg" 501,—which normally extends through the teletypewriter at jack 503 in the patching panel, over conductor 505, through the monitoring jack 507, over conductor 509, normally closed contacts on the left side of the "in" keys of sets 9A, 9B and 9C, in series, back over the normally closed contacts on the left side of the "out" keys of sets 9C, 9B and 9A, in series, conductor 527 to ground connection 617,—to conductor 528, normally closed contacts of relay 725 to ground connection 728.

Grounded battery 601 is connected over conductor 602, resistance 532, contacts and outer upper spring member on the left side of the "in" key of set 9A, conductor 514, through the winding of busy relay 603, to ground 605. Busy relay 603 operates but relay 612, which is in the bridge of the Wheatstone bridge arrangement, does not operate at this time. Relay 603, upon operating, causes busy lamp 515 to light indicating to the attendant at the switching center that a keyset in loop No. 9 is operated. The "in" key of set 9A upon being operated to its "send leg in," or left-hand, position closes a circuit extending from grounded battery 702, conductors 703 and 516, resistance 529, contact and inner lower left-hand spring member of the "in" key of set 9A, conductor 530, left-hand armature and back contact of relay 705, through the winding of relay 704, conductor 729, resistance 730, to ground connection 706. Relay 704 operates but polarized relay 708, which is in the bridge of a Wheatstone bridge arrangement included in the circuit just traced, does not operate. Relay 704, upon operating, connects at its outer left armature and contact ground to the lower, or biasing, winding of polarized relay 713, through the winding of relay 725 to grounded battery. The circuit just traced, applies biasing current to relay 713 and operates relay 725. Relay 704, upon operating, closes at its right armature and contact a circuit for operating busy lamp 707 indicating that a group repeater GRA is busy. Also, relay 704, upon operating, opens

at its inner left-hand armature and back contact the operating circuit for relay 705 so as to prevent any possibility of the regenerative element of group repeater GRA operating at this time. Relay 725, upon operating, transfers conductor 528 from ground connection 728 to the grounded operating, or upper, winding of polarized relay 713 and at its right-hand armature and contacts connects grounded positive battery 720 to the spacing contacts of relay 713, grounded negative battery 719 being connected to the marking contacts of relay 713. Relay 713 now follows the signals transmitted by the teletypewriter connected to jack 503 which is connected in the "send leg" of loop No. 9.

Assume for the purpose of illustration that loop No. 9 is idle and that it is one over which the signals are to be transmitted to a distant station. The "out" key of set 9A is then operated to its "send leg out," or left-hand, position. Relay 725, upon operating as described in the previous paragraph, closes at its inner left make-before-break contacts a circuit extending from the armature of relay 713, conductors 718, 726 and 518, inner make contacts and right-hand spring members of the "out" key of set 9A and over conductor 519 as hereinbefore traced to operate polarized relay 608 of the leg repeater LR9 associated with loop No. 9. Polarized relay 608 follows the signals repeated by relay 713 and repeats them out over the "send leg" of loop No. 9 as hereinbefore described for outgoing messages. One or more of the remaining loops may also be employed for repeating the outgoing message by operating the "out" key of the corresponding keyset associated with each of the other remaining loops, the leg repeater associated with each of the other remaining loops being connected in parallel with leg repeater LR9 to repeat the signals from relay 713 over the "send legs" of their respectively associated loops.

Alarm for operating errors

An audible alarm in the form of buzzer 838 is caused to operate whenever an operating error is made. An operating error may consist of:

(a) Associating more than one loop with the input side of repeater;

(b) Associating the same loop with both the input and output sides of one group. (This function was assumed in the foregoing description for the purpose of illustration only);

(c) Associating the same loop with the input side of one group repeater and the output side of a second group repeater;

(d) Associating the same loop with the output side of more than one group repeater;

(e) Associating the same loop with the input side of more than one group repeater.

The foregoing errors would occur when more than one key is operated in any horizontal or vertical row except that any number of "out" keys in one vertical may be operated. The buzzer 838 is operated by the operation of either of the polarized relays 612 or 708.

As hereinbefore described, the windings of polarized relays 612 and 708 each comprise the "bridge" element of a Wheatstone bridge resistance network. It is a well-known characteristic of such a network that values of resistances may be selected for any three arms so that the current in the bridge element may be reversed by varying the value of the fourth resistance arm. Resistances 625, 626 and 627 comprise three arms

and polarized relay 612 the "bridge" of such a network. The fourth arm is normally open, i. e., of infinite resistance. When an "in" or "out" key is operated, a resistance, such as 538 or 531 in series with relay 603, becomes the fourth arm as previously described. The resistance value of relay 603 is small compared to that of resistances 532 or 531. In both cases the current in polar relay 612 is in such a direction as to hold the relay non-operated. When a second key in the same horizontal row is operated, a second resistance, such as 532 or 531, is connected in parallel so that the resistance value of the fourth arm is almost halved, resulting in a reversal of current in the polar relay 612 which operates. Resistances 730, 731 and 732 comprise three arms, and polarized relay 708 is the "bridge" of a similar network which is associated with group repeater GRA. The fourth arm in this network, as hereinbefore described, consists of a resistance such as 529 in series with either relay 704 or relay 705, the resistance of the relay winding being low compared with that of resistance 529. When either relay operates it substitutes resistance 735 of equal value for the winding of the other relay.

When a second "in" key is operated to the same position as the first "in" key a second resistance, such as 529, is connected in parallel with the first, reducing the resistance value of the fourth arm almost by half. If the second "in" key is operated to the opposite position to that of the first "in" key, a second resistance such as 529 in series with resistance 735 is connected in parallel with the first resistance and the relay 704 or 705 so that the value of the fourth arm is halved. In either case the reduction in the value of resistance of this fourth arm results in a reversal of current in polar relay 708. Relay 708, upon operating, closes a circuit from ground, armature and contact of relay 708, conductors 733 and 839 through buzzer 838 to grounded battery 837 and the buzzer operates to give an audible signal that an error has been made in operating the switching keys. In a similar manner relay 612 upon operating closes a circuit from ground, armature and contact of relay 612, conductor 839, through the winding of buzzer 838 to grounded battery 837, the buzzer operates to indicate that an error has been made in operating the switching keys.

A blown fuse applies grounded battery to the back bus-bar causing the fuse panel lamp to light and the fuse alarm plus relay 840 or the fuse alarm minus relay 841 to operate. The operation of either of these relays causes the alarm bell 836 to operate until restored by the replacement or removal of the defective fuse or until shut off by the operation of key 842. Night alarm key 843 is provided to cut the bell off the break circuit when an audible signal is not desired. The fuse alarm plus and fuse alarm minus relays 840 and 841 are protected by fuses which also operate the alarm when the respective fuses are blown.

Testing

A testing loop (not shown) is provided between the central office and the switching panel equipment at the switching center. This test loop extends from the test board at the central office and terminates in two single line jacks connected in series and mounted in the switching panel. An idle pulsing relay such as relay 713 in group

repeater GRA or an idle pulsing relay such as relay 608 in leg repeater LR9 or an idle regenerative repeater element taken in conjunction with its associated pulsing relay such as relay 713 of group repeater GRA may be tested by making suitable patch connections at the switching panel. At the switching panel are mounted for each group repeater a pair of test jacks. Test jacks TJA representing those assigned to group repeater GRA, test jack TJB represents those assigned to group repeater GRB, test jacks TJC represents those assigned to group repeater GRC, etc. Test jacks TJ1, TJ2, TJ3 and TJ9 represent those assigned to leg repeaters LR1, LR2, LR3 and LR3, respectively, for testing the pulsing relay in each repeater such as relay 608 assigned to leg repeater LR9. When a patching cord is connected to test pulsing relay 713, one end of the cord is inserted in jack A1 of TJA and the other end of the cord is inserted in either of the two jacks terminating the test loop, the relays of group repeater GRA becoming operated as the result of connected patching cords in a manner as hereinbefore described when an end key "in" was operated to the send, or left-hand, position. The polar test signals of known bias sent from the central office over the ring of the test loop are repeated by relay 713 and sent back as open and close signals to the central office on the tip side of the test loop. In a similar manner, an idle regenerative repeater element and its associated receiving relay, such as relay 713 of group repeater GRA, may be tested except that one end of the patching cord is connected to jack A2 of TJA and the other end is connected to either of the test trunk loop jacks. The receiving relays of each of the leg repeaters may be tested, for example, relay 606 of leg repeater LR9 by patching a test loop jack to jack TJ9. Or again, the overall transmission of the combination of any one group repeater with any one leg repeater may be tested by operating the "out" key common to that combination and employing two patching cords, one of which is inserted at one end to A1, assuming that group repeater GRA is engaged in the test, and the other end of the patching cord is inserted in the first of the two test loop jacks, and the other patching cord has one of its ends inserted in jack TJ9 of the leg repeater LR9 and the other end of the patching cord is connected to the second of the two jacks terminating the test loop. The particular "send leg out" key is operated, which associates leg repeater LR9 with group repeater GRA. In this way the relays of a group repeater and a leg repeater are operated as in the manner hereinbefore described when an "in" key associated with one of the loops was operated through its receive, or right-hand, positions and an "out" key associated with one of the other loops was operated to its send, or left-hand, position. In this way routine testing of the pulsing relays of any of the groups or leg repeaters may be made at the central office under the control of an attendant at the switching center without interfering with traffic on the subscribers' regular loops.

What is claimed is:

1. A signaling system comprising two or more transmission circuits each having two conductors, a plurality of switching means connected to each of said transmission circuits, each of said means having two operable elements, circuit means responsive to the operation, in either of two directions, of one of said elements of one of

said switching means and other circuit means responsive to the operation in one direction only of the other element of one or more of the other of said switching means for interconnecting for signaling purposes one conductor of one of said transmission circuits and the other conductor of one or more of the other of said transmission circuits.

2. A signaling system comprising two or more transmission circuits, each having two conductors respectively arranged to transmit signals in opposite directions, a plurality of switching means connected in series to each of said transmission circuits, each of said means having two operable elements, a plurality of devices each having a simple and a regenerative repeater connectable to all of said transmission circuits, other repeating devices respectively connectable to each of said plurality of switching means, circuit means responsive to the operation in either of two directions, of one of said elements of one of said switching means, and other circuit means responsive to the operation, in one direction only, of the other element of one or more of the other of said switching means for interconnecting, through the simple and the regenerative repeater of one of said devices and one or more of said other repeating devices, a conductor of the transmission circuit connected to the switching means of which one of said elements is operated in said one direction and the other conductor of one or more of the other transmission circuits.

3. A signaling system according to claim 2 wherein said circuit means comprise electromagnetic devices responsive when said one element is operated in either of two directions, other electromagnetic devices responsive when said other element is operated in one direction only and a circuit network arrangement provided for each of the first and the second-mentioned electromagnetic devices, said circuit network arrangements serving to cause the operation of an audible alarm when any conflicting operation of said switching means is made.

4. A telegraph system comprising two or more loop circuits each having two conductors, a plurality of switching means connected to each of said loop circuits, each of said switching means having two operable elements, circuit means responsive to the operation, in either of two directions, of one of said elements of one of said switching means and responsive to the operation of the other element of any number of the other of said switching means for interconnecting for transmission purposes one conductor of one of said loop circuits and the other conductors of a corresponding number of the other of said loop circuits and means connected to each of said one conductors of said other of said loop circuits for operating a distinctive visual and an audible alarm when a "break" signal is received from the distant end of any one of said loop circuits.

5. A telegraph system according to claim 4 wherein said means for operating the distinctive visual and the audible signal comprises an interrupter and timing circuit responsive to signals of a duration longer than the telegraph message signals.

6. A telegraph signaling system comprising a plurality of at least three telegraph lines each having two conductors, the second of said conductors each having terminating repeating means, a plurality of combined simple and regenerative repeating means each common to said

lines, and key operative means for selectively connecting one of said combined simple and regenerative repeating means operatively to one of the conductors of a calling one of said lines and one or more of said terminating repeating means operatively to the said second conductor of a corresponding one or more of the remaining lines.

7. A telegraph signaling system according to claim 6 wherein the key operative means comprises a plurality of parts, one part having circuit closing instruments arranged, first, when said part is operated in one direction to connect the simple repeating means of said combined repeating means to one of the conductors of a calling one of said lines, and secondly, when said part is operated in the other direction to connect said combined repeating means to the other of said conductors of the calling one of said lines, and another part having other circuit closing instruments arranged when said other part is operated to operatively connect one of said terminating repeating means to said second one of the conductors of one of the remaining lines and to said simple repeating means or to said combined repeating means as determined by the direction of operation of the first-mentioned part of said key operative means.

8. A telegraph signaling system comprising a telegraph line having one way terminating repeating means, a plurality of other lines each having one way terminating repeating means, a plurality of one-way regenerative repeating means each common to said lines, key operative means for selectively connecting said telegraph line through any one of said regenerative repeating means to the terminating repeating means of one or more of said plurality of lines for one-way transmission.

9. A telegraph switching system adapted for broadcast purposes, comprising a central office, a switching center, a plurality of line circuits interconnecting said central office and said switching center, each of said line circuits having a send conductor arranged for transmission in one direction and a receive conductor arranged for transmission in the other direction, a plurality of key-controlled circuits normally connected in series to each of said line circuits at said switching center, a line circuit repeater connected to the last one of one of said key-controlled circuits and a plurality of group repeater circuits each connected to those of said key-controlled circuits that are connected to different line circuits.

10. A telegraph switching system adapted for broadcast purposes and comprising a central office, a switching center, a plurality of line circuits interconnecting said central office and said switching center and each of said line circuits comprising a send conductor arranged for transmission in one direction and a receive conductor arranged for transmission in the other direction, a plurality of key-controlled connections normally connected in series to each of said line circuits at said switching center, devices at said switching center each having a transmitting and a receiving means, connectable means connected to each conductor of said line circuits at said switching center whereby said transmitting and receiving means may be included in said send and said receive conductors, respectively, said transmitting and receiving means connected in any one of said send conductors and arranged through the operation of said key-controlled con-

nections to transmit to one or more send conductors of the remaining line circuits, a line circuit repeater for each of said line circuits and connectable through two or more of said key-controlled connections while repeating signals from one of said transmitting and receiving means to one or more send conductors of the remaining line circuits, a plurality of group regenerative repeaters common to said line circuits, each of said group repeaters being connectable through two or more key-controlled connections for regenerating signals incoming over said received conductor and for transmitting said regenerated signals over one or more send conductors of the remaining line circuits.

11. A telegraph system adapted for broadcast purposes and comprising a central office, a switching center, a plurality of line circuits interconnecting said central office and said switch-

ing center, each of said line circuits including a send conductor arranged for transmission in one direction and a receive conductor arranged for transmission in the other direction, a plurality of key-controlled circuits normally connected, in series, to each of said line circuits at said switching center, a line repeater connected to the last one of said key-controlled circuits connected in series, a plurality of group regenerative repeaters, circuits of each of said pluralities, means included in each of said key-controlled circuits of each of said pluralities for connecting a different one of said group repeaters to one of said line circuits and other means included in each of said key-controlled circuits for connecting any one of said group repeaters to one or more of said line repeaters for transmission over one or more of the remaining line circuits.

ALLEN R. BONORDEN.