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RINGING CURRENT DISTRIBUTING AND INTERRUPTING EQUIPMENT

Filed Dec. 10, 1925 2 Sheets-Sheet 1

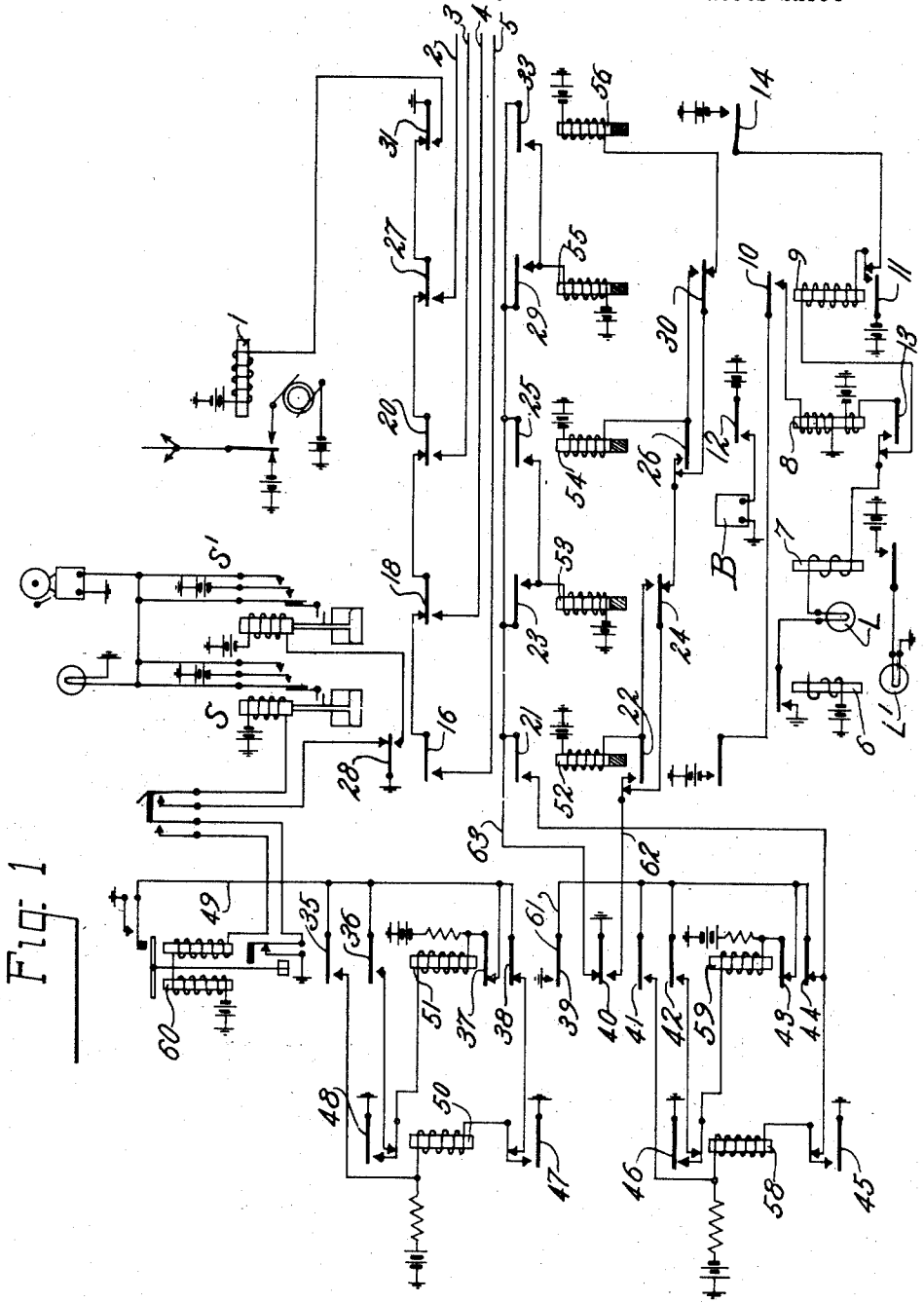

Fig. 1

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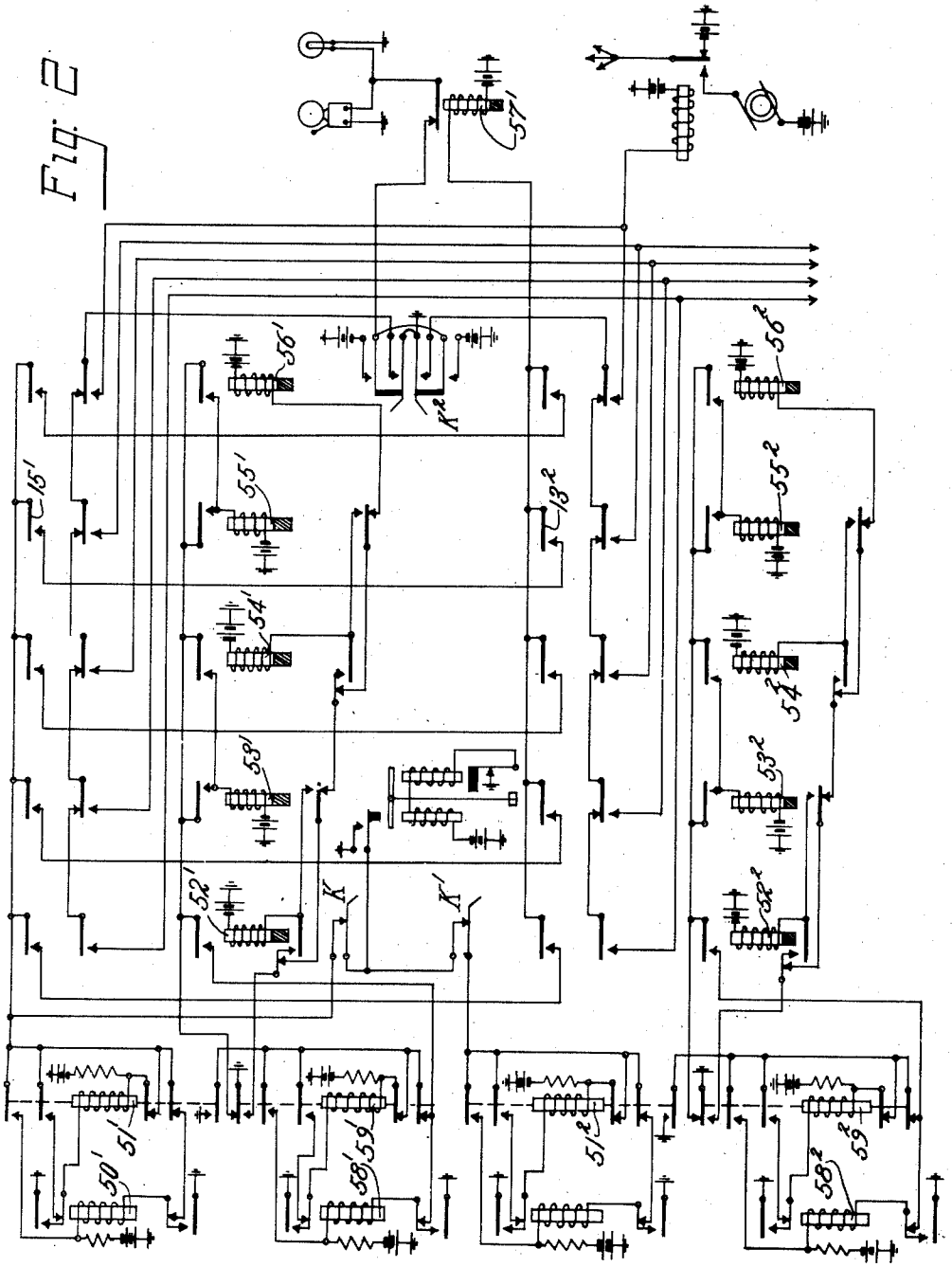
Fig. 2



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UNITED STATES PATENT OFFICE.

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RINGING CURRENT DISTRIBUTING AND INTERRUPTING EQUIPMENT.

Application filed December 10, 1925. Serial No. 74,459.

The present invention relates in general to ringing current distributing and interrupting equipment for use in connection with telephone systems, but is particularly concerned with the provision of equipment of this character which in one instance avoids the use of solenoid or dash pot relay equipment and which in another instance uses dash pot relay equipment for supervisory purposes only.

An object of the invention is to provide equipment of this character together with a novel means whereby the equipment in either instance may be controlled by ground impulses transmitted to perform functions not having to do with the application of ringing current, even though these impulses may originally be applied at a higher frequency than it would be practical to transmit ringing current.

Another object is to provide a new method of and means for controlling supervisory signals in connection with ringing current distributing systems.

There are other objects not specifically mentioned which will be brought out in the following description and appended claims.

The invention as disclosed comprises Figs. 1 and 2. Figure 1 discloses the invention as used in ordinary practice, while Fig. 2 shows the invention modified and in somewhat elaborated form for use in a system where it is to function as a master interrupter in a large system where maximum protection against failure of the equipment irrespective of cost is demanded.

The system as disclosed in Fig. 1 will first be described. In this disclosure it is assumed that the impulse mechanism available for controlling the ringing current distributing equipment comprises the busy interrupter 60, which applies ground to common conductor 49 one hundred and twenty times per minute, ground being applied for a period of one-fourth second followed by a like interruption. This is the interrupted ground ordinarily supplied through an induction coil for giving the busy tone to calling subscribers, who have set up connections to busy called lines.

In the application and distribution of ringing current in an automatic telephone system, it is the usual practice to apply the ringing current to five groups of connectors in sequence, the application of ringing current to one group being applied for a period of one second followed by a silent period of four seconds, during which time, each of the remaining four groups of connectors have ringing current applied to them in turn, after which the operation is repeated. From this it will be appreciated that each connector group has ringing current applied to it for a period of one second followed by a silent period of four seconds.

Since it has been assumed that an interrupter transmitting ground impulses at the rate of 120 per minute, or two per second, are to be used, it will be readily appreciated that some means must be provided for reducing the number of impulses transmitted to the ringing current distributing equipment. This is accomplished by the circuits controlled by the sets of relays 50—51 and 58—59, respectively. The manner in which these relays accomplish this result will now be explained.

It will be seen that a key is provided at the right side of the busy interrupter 60. The purpose of this key is to switch the equipment shown on circuit to start its operation. When the key is operated, ground will be connected to the windings of the interrupter 60, causing its energization. Upon operating, the interrupter 60 attracts its armature, thereby opening its own circuit, and closing its upper armature to transmit an impulse to common conductor 49. There is also a circuit closed, over the other contact of the key mentioned above for operating a solenoid S. The purpose and function of this solenoid will be explained subsequently.

Upon the first impulse being transmitted to common conductor 49 a circuit is completed for relay 50 via armature 38 and its resting contact and the springs controlled by armature 47. Relay 50 upon operating, at its armature 47 and its working contact, completes a locking circuit for itself independent of the ground applied over conductor 49, at

armature 48 completes a circuit for relay 51 and at springs controlled by this armature opens a point in a holding circuit of the relay 51. Although as stated, relay 51 has its circuit completed by armature 48, this relay cannot operate while the conductor 49 remains grounded due to this ground also extending by way of resting contact of armature 37. However, at the end of the one-fourth second impulse applied to conductor 49, relay 51 operates, at its armature 38 opens a point in the initial energizing circuit of relay 50, at its armature 37 disconnects conductor 49 from the lower terminal of relay 51, so that this relay cannot be again short circuited over this path, at armature 36 prepares a holding circuit for itself, and at armature 35 connects the conductor 49, to the upper terminal of the winding of relay 50. When another one-fourth second ground is again applied to conductor 49 relay 50 will be short circuited over this circuit. This relay accordingly restores to normal. When this occurs a point in its original operating circuit is closed at springs controlled by armature 47 and the ground on conductor 49 is supplied to the winding of relay 51 through the normal contacts controlled by armature 48 in substitution for the ground formerly supplied by this armature. At the termination of the third one-fourth second, ground is again removed from conductor 49 permitting relay 51 to restore.

It will be noted that in order to accomplish these operations ground was placed on conductor 49 and removed two times and during one half this period (one half second) relay 51 was operated and ground was accordingly applied to conductor 61 by armature 39 and its working contact for one-half second. The application of ground to conductor 61 causes the operation of relay 58 and upon removal of this ground the relay 59 operates, as did the relay 51, causing ground to be applied to conductor 62 by armature 40 in the same manner as ground was applied to conductor 61 by armature 39. From this it will be appreciated that the impulses transmitted to conductor 61 are at just one-half the rate and of twice the duration as those transmitted to conductor 49, and that the impulses transmitted to conductors 62 and 63 are at one-half the rate and twice the duration of those transmitted to conductor 61. Therefore, in the present case conductors 62 and 63 are grounded alternately for one second periods.

The effect on the ringing current distributing equipment by the periodic operation and release of armature 40 of relay 59 will now be explained. Upon the energization of relay 59 ground is applied to ringing relay 56 via armature 40 and its working contact, conductor 62, springs controlled by armature 22 of relay 52, armature 24 and its resting contact, springs controlled by armature 26, armature 30 and its resting contact and the winding of relay 56 to battery. Relay 56 operates, at its armature 33 prepares an operating circuit for relay 55, and at its armature 31 breaks a point in the circuit used in controlling the application of ringing current to the fifth, fourth, third and second connector groups, and at its working contact completes the circuit of ringing current control relay 1 to cause the application of ringing current to the No. 1 connector group.

At the end of the one second period relay 59 deenergizes, as previously described, and at its armature 40 and its resting contact completes a circuit for relay 55 via conductor 63 and armature 33 and its working contact. This circuit is completed before slow release relay 56 has had time to restore to normal. Relay 55 upon operating, at its armature 29 completes a locking circuit for itself independent of armature 33, at its armature 30 opens another point in the operating circuit of relay 56, at the front contact of this armature prepares a circuit for relay 54, at its armature 27 opens a point in a circuit for causing the application of ringing current to the connector groups 5, 4, and 3, and at its working contact completes a circuit for a relay similar to relay 1 for causing the application of ringing current. This circuit extends from ground by way of armature 31 and its resting contact. The application of generator in each instance is carried through break contacts such as 31 of the previously operated relay so as to guard against ringing current being applied to two connector groups at the same time.

As soon as relay 59 is again energized a circuit is completed from armature 40 and its working contact conductor 62, springs controlled by armature 22, armature 24 and its resting contact, springs controlled by armature 26, armature 30 and its working contact, and the winding of relay 54 to battery. This circuit is completed before the restoration of relay 55 following its circuit being opened as the result of the operation of relay 59. Relay 54 upon operating, at its armature 26 and its working contact completes a holding circuit for itself independent of armature 30, at its armature 25 prepares a circuit for relay 53, at its armature 20 opens a point in the circuit used in causing ringing current to be applied to the connector groups 5 and 4, and its working contact controls the application of ringing current to the third connector group.

Upon the next deenergization of relay 59 a circuit is completed for relay 53 by way of armature 25 and its working contact. Relay 53 operates, at its armature 23 completes a holding circuit for itself independent of armature 25, at its armature 18 breaks a point in the circuit for controlling the application

of ringing current to the connector group 5 and at its working contact controls the application of ringing current to the fourth group of connectors.

Upon the next energization of relay 59, relay 52 operates, at its armature 22 completes a holding circuit for itself independent of armature 24, at its armature 21 prepares a special circuit for relay 58 via springs controlled by armature 45, at armature 16 and its working contact controls the application of ringing current in the fifth group of connectors. The relay 52 also at its armature 28 breaks the circuit of the solenoid magnet S and at its working contact completes a circuit for solenoid magnet S'. This is done for a purpose which will be explained subsequently.

Upon the following deenergization of relay 59 a circuit is instantly completed for relay 58 via armature 40 and its resting contact, conductor 63, armature 21 and its working contact, springs controlled by armature 45 and the winding of relay 58 to battery. Relay 58 operates and at armature 46 again immediately completes the circuit of relay 59 causing the relay to operate as soon as relay 52 has restored and thereby removed the short-circuit from about relay 59. Relay 59 upon operating at its armature 40 and its working contact again completes a circuit for relay 56 following the restoration of relay 52 and the cycles of operation are once more completed in the previously described manner.

The supervision of the ringing control equipment will now be considered. As previously pointed out, armature 28 of relay 52 controls the operation of solenoids S and S'. The relay 52 like the other relays 53 to 56, inclusive, is deenergized for a four second period and is then energized for a one second period. The solenoid S is arranged to fully operate only if its circuit remains closed slightly over a four second interval, but will fully restore within a one second break in its circuit. The solenoid S' is adjusted just opposite to solenoid S and is, therefore, fully operative if its circuit is closed for over one second interval, but it will have four seconds to restore after its circuit has been broken. In view of the characteristics of these solenoids it will be appreciated that should any of the relays in the entire system fail either when relay 52 is energized or deenergized one or the other of the solenoids will become effective to operate the alarm lamp and bell associated therewith.

A further feature relating to supervision, but not previously mentioned, will now be described. It is the usual practice in automatic telephone systems to provide what is known as "release supervision", which consists of means for giving an alarm in case certain of the switches used fail to release when their release magnet circuit is closed. In the present case, the relays 7, 8, and 9 at the bottom of Fig. 1, are controlled by the relays 52 and 56 of the ringing interrupter equipment and co-operate with a supervisory relay 6 to operate an alarm when any switch of a group fails to release within a given period.

The relay 6 is the relay which usually supplies battery to release magnets of all switches of a group and corresponds to relay 41 of Fig. 1 of a Lomax Patent No. 1,611,655 of Dec. 21, 1926.

Since ringing interrupter relays 52 and 56 are the first and fifth relays of the ringing interrupter group, the time period between the operation of these relays is four seconds. Now, if release alarm relay 6 is operated at the time of operation of relay 56, a circuit will be completed from grounded working contact and armature of relay 6 through the lamp L, relay 7, springs controlled by armature 13, winding of relay 9, contacts controlled by armature 11, and the armature 14 and its working contact to battery. Due to the resistance of relay 9, the lamp L will not light and relay 7 will not be operated. Relay 9, however, operates, at its armature 11 completes a locking circuit for itself independent of armature 14, and at its armature 10 and its working contact closes a point in the operating circuit of relay 8. After a three-second interval, or the time required for relays 55, 54, and 53 to operate, relay 52 will operate and at its lowermost armature complete a circuit by way of armature 10 and its working contact for the upper winding of relay 8. This relay, upon operating, at its armature 13 completes a circuit for relay 7 and lamp L independent of relay 9 and cuts this latter relay out of the circuit entirely. Relay 7 now operates and completes a circuit for pilot lamp L', and, due to the low resistance of relay 8, lamp L will also light to notify the attendant of the particular shelf in which is located the switch which has failed to release. The relay 9 restores to normal as a result of its circuit being broken by the operation of relay 8. Relay 8, however, remains energized over its lower low resistance winding in series with the relay 7 and lamp L. Relay 8, in addition to bringing about the circuit changes just described, at its armature 12 and its working contact completes the circuit for the buzzer B to further assist in calling the attendant's attention to the trouble which has arisen.

In the example just described, it was assumed that the relay 6 was energized simultaneously with the ringing relay 56, under which condition the alarm was given within a three to four second period after the circuit of relay 6 was closed. In case the relay 6 is energized immediately following the operation of relay 56, it will be seen that the remaining interrupter relays 52–55, inclusive,

must be operated before relay 56 will be operated to prepare an alarm circuit and then 55, 54, and 53 must be operated again before relay 52 will be effective to complete the circuits prepared by relays 56 and 8. Under this condition the operation of the lamp L', lamp L and buzzer B will occur after the circuit for relay 6 has been completed a maximum period of substantially eight seconds.

When the ringing current distributing equipment is utilized in a very large system, it is desirable to take every possible precaution to insure against failure of the equipment used in applying ringing current to the connector groups regardless of the expense, and schemes using solenoids are sometimes objected to. To avoid the use of solenoids, applicant has elaborated on the scheme disclosed in Fig. 1 so that 100 per cent supervision is obtained by combining two such circuit arrangements, adding an extra pair of springs on each of the interrupter relays and omitting the solenoids.

In the normal operation of the system disclosed in Fig. 2, keys K and K', will be in normal position as shown, and the key K^2, will be operated so that either its upper or its lower pairs of springs are in engagement. Upon inspection of the drawing, it will be found that the relay groups are each like the relay groups shown in Fig. 1 with the ringing control interrupter leads connected together. The relay which is effective to cause the application of ringing current when any pair of relays such as 55', 55^2 are operated is dependent on the condition of key K^2. For instance if the upper springs of this key are closed 55' will be effective and relay 55^2 will serve only as a checking or supervisory relay. If the lower springs of key K^2 are closed relay 55' will function as a supervisory relay and 55^2 will be effective. These relays must both be operated at the same time to complete an operating circuit for relay 57' through series contacts of armature 15' and 13^2, and in case either of the relays fails, an alarm will be given due to the deenergization of relay 57'. The failure may be due to a relay being out of adjustment. For example, relay 59' may fail to operate in unison with 59^2 causing the corresponding relays of the two ringing interrupter relay groups to get out of step, in which case no further circuits for relay 57' would be completed and it would deenergize to give an alarm.

If any individual relay of either of the groups 52'–56' or 52^2–56^2 fails, relay 57' will only fail periodically to give an alarm. If the attendant desires to make adjustments on either group of relays this may be done by cutting out the group to be adjusted by operating the proper key K or K' and by placing key K^2 in proper position.

The feature of the invention relating to release supervision is fully disclosed in Fig. 1 and has been omitted in Fig. 2 merely to avoid unnecessarily complicating the drawing and description.

What is claimed is:

1. A chain of impulse generating mechanisms, means for transmitting impulses to the first impulse generator of the train, and means whereby each successive impulse generator of the train transmits impulses of double the length of those transmitted by the preceding impulse generator.

2. A chain of impulse generating mechanisms, means for transmitting impulses to the first impulse generator of the train, and means whereby each successive impulse generator of the train transmits impulses of double the length of those transmitted by the preceding impulse generator, the time lapse between impulses also being doubled in each instance.

3. In a ringing current distributing system, a plurality of branch circuits, a plurality of relays, means for transmitting current to operate one of said relays to cause the transmission of ringing current over one branch and to prepare a circuit for a second one of said relays, means for opening the circuit of the first operated relay and for closing the circuit of the second relay, and means for preventing the second relay from transmitting ringing current to a second branch until the said first relay has restored.

4. In a ringing current distributing system, a ringing current generator, a plurality of branch circuits, a plurality of relays, there being one for each branch, circuit arrangements for causing said relays to operate in sequence to cause ringing current to be applied to the various branches in sequence, and means for preventing the application of ringing current to two branches simultaneously.

5. In a ringing current distributing system, a plurality of branch circuits, a like plurality of relays for applying ringing current to their corresponding branches, a periodically applied source of current for causing the operation of said relays, another relay maintained energized continuously by said periodically applied current through contacts of one or another of said relays, and an alarm controlled by said relay in case one of said relays fails to operate.

6. In a ringing current distributing system, a plurality of branch circuits, a plurality of relays, there being one relay for controlling the application of ringing current to each respective branch, an alarm device, and means controlled by the failure of any of said relays to energize to cause the operation of said alarm.

7. In a ringing current distributing system, a source of periodically interrupted current, an impulse generator operated by current from said source, a plurality of branch

circuits, a plurality of relays, there being one for each branch, circuit arrangements for causing said relays to operate in sequence responsive to the generated impulses, and an alarm control relay under control of impulses of said source and said other relays.

8. In a ringing current distributing system, two like sets of relays, a source of current for operating said relays, circuit arrangements for normally operating the corresponding relays of the two sets in synchronism, an alarm device, a relay for causing the operation of said device, and circuits for causing the operation of said relay upon any relay of either set failing to operate properly.

9. In a ringing current distributing system, sets of relays, a source of current for operating said relays, circuit arrangements for normally operating pairs of said relays in synchronism, and means for operating an alarm should a relay of any pair get out of step with its associated relay.

10. A pair of relays, means for causing said relays to operate alternately, a third relay, a fourth relay operable by one of said pair of relays only when said third relay is in an operated condition, a signal, a fifth relay for operating said signal, and circuit arrangements including the second relay of the pair for operating said fifth relay only if said third and fourth relays have remained operated.

11. A supervisory signal, a relay operative periodically for preparing an operating circuit for said signal, a second relay operative periodically, a third relay operative each time the release circuit for an associated automatic switch is closed, and another relay operative to render said signal effective only if the said third relay has remained operated during the full time lapse between the operation of said periodically operated relays.

12. A group of ringing interrupter relays, a supervisory signal, a pair of relays for causing the operation of said signal if an automatic switch fails to release within a given period after its release magnet circuit is closed, a circuit for one of said relays closed by one of the interrupter relays only if a release magnet circuit is closed, and a circuit for the other relay of the pair closed by another of said interrupter relays only if the first relay is already in operated condition.

13. In a ringing current interrupter, and distributing system, a group of relays, one for each division or branch to which ringing current is to be supplied, means for closing a circuit for one of said relays for a desired ringing period, the particular relay responding causing the application of ringing current to its branch for a like period and also preparing an operating circuit for the relay for applying ringing current to the next branch, and contacts on said first relay preventing ringing current being applied to said second branch until ringing current has been cut off of the first branch.

14. In a ringing current interrupter and distributing system, a group of relays, one for each division or branch to which ringing current is to be supplied, means for closing a circuit for one of said relays for a desired ringing period, the particular relay responding causing the application of ringing current to its branch for a like period and also preparing an operating circuit for the relay for applying ringing current to the next branch, and contacts on said first relay preventing ringing current being applied to said second branch until ringing current has been cut off of the first branch, alarm equipment, and contacts on one of said relays effecting the operation of said alarm equipment if any relay of the group fails.

15. A circuit including a source of current, means for periodically closing and opening said circuit, and relays cooperating responsive to a successive plurality of said circuit closings and openings to close a second circuit for a period of time equal to one opening and one closing of the first circuit.

16. A circuit including a source of current, means for initially closing and thereafter periodically interrupting said circuit to transmit impulses, and relays cooperating responsive to a successive plurality of said impulses to transmit a new group of impulses in which each impulse is equal in length to two of the first impulses.

17. A circuit including a source of current, means for periodically closing and opening said circuit to transmit impulses, a pair of relays operative responsive to a plurality of impulses to generate impulses each of which is equal in length to two of said first impulses, and a second pair of relays operating responsive to a plurality of said second impulses to generate impulses each of which is equal in length to two of said second impulses or four of said first impulses.

In witness whereof, I hereunto subscribe my name this 5th day of December, A. D. 1925.

HERMAN H. HARBECKE.