Jan. 23, 1945. E. F. WATSON 2,367,910

START-STOP REGENERATIVE TELEGRAPH REPEATER

Filed July 19, 1941 2 Sheets-Sheet 1

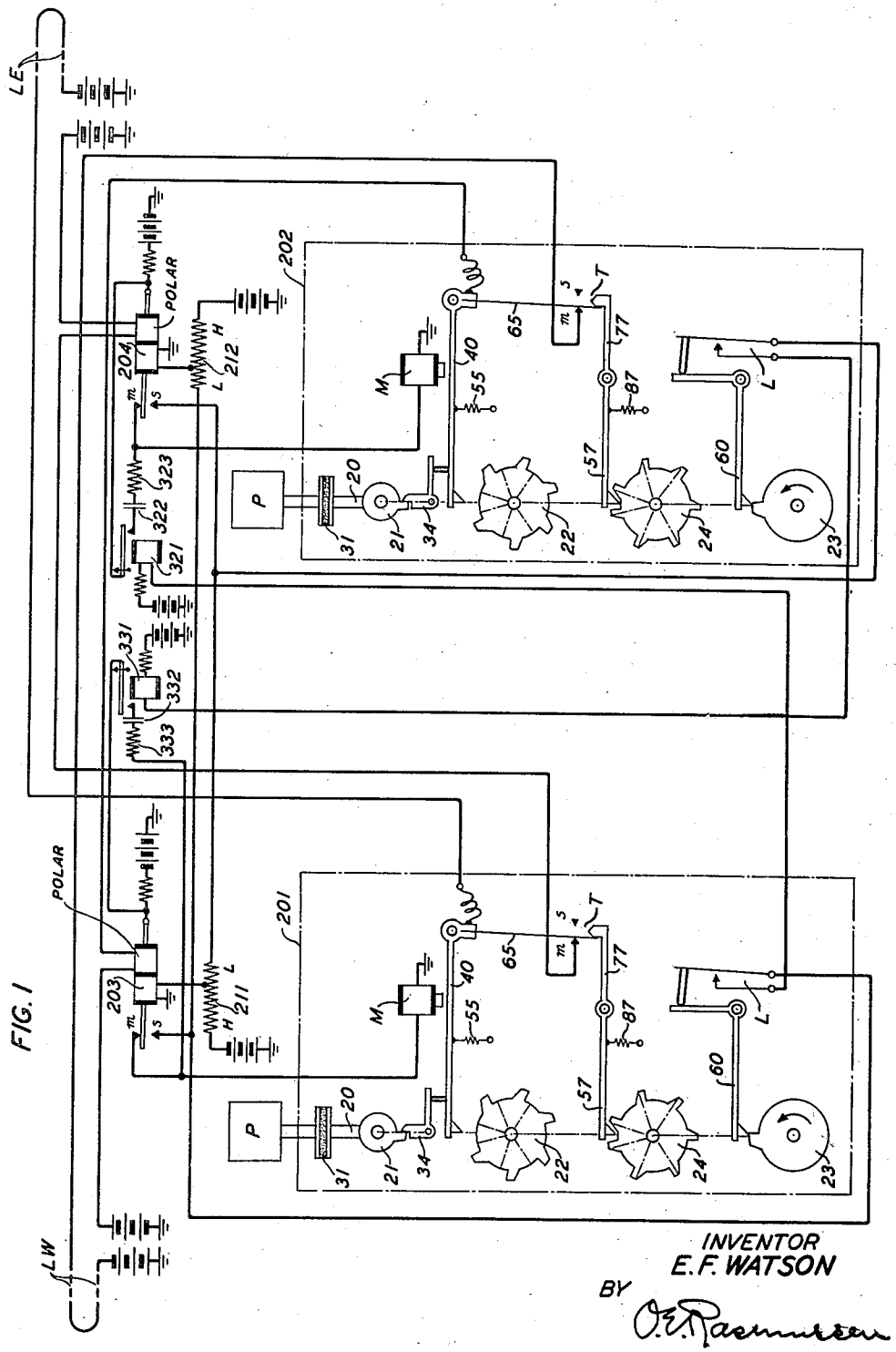

FIG. 1

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START-STOP REGENERATIVE TELEGRAPH REPEATER

Filed July 19, 1941 2 Sheets-Sheet 2

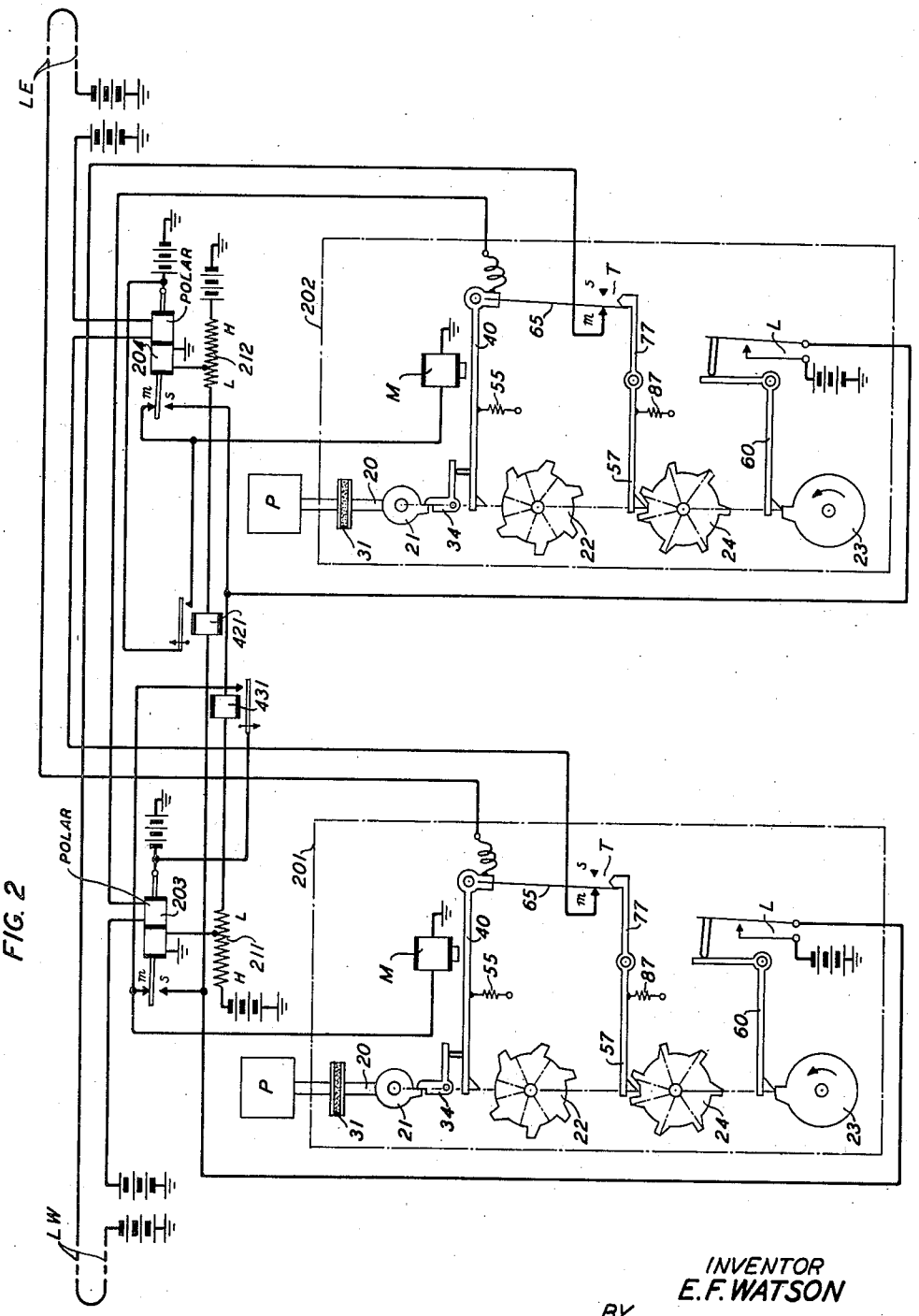

FIG. 2

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Patented Jan. 23, 1945

2,367,910

UNITED STATES PATENT OFFICE

2,367,910

START-STOP REGENERATIVE TELEGRAPH REPEATER

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Application July 19, 1941, Serial No. 403,082

12 Claims. (Cl. 178—71)

This invention relates to improvements in start-stop regenerative telegraph repeaters and more particularly to arrangements for improving the operation of said repeaters in the presence of interfering conditions in the line circuit.

A mechanical type of start-stop regenerator unit has been in extensive use for some time in half-duplex telegraph repeaters, particularly in teletypewriter service. Two such regenerator units are used in the repeater, one for transmission in one direction and the other for transmission in the opposite direction. When the repeater is arranged for half-duplex operation, that is, for operation in one direction at a time, provision is made for locking the inactive side in its stop position by means of off-normal contacts in the unit operating in the active side so that all impulses of a signal series representing a character will be sent before the other unit is permitted to operate.

A regenerator unit of the type referred to is disclosed in U. S. Patent 2,105,173, issued to Zenner et al. on January 11, 1938, and reference may be had to this disclosure for details of its mechanism and operation.

The unit comprises a receiving magnet, responsive to incoming signals, and transmitting contacts for reproducing the received signals and retransmitting them into the outgoing line circuit. An intervening cam mechanism, motor-driven through a friction clutch and stopped once after each revolution, controls a plurality of operating levers and the arrangement is such that the magnet determines whether the regenerator contacts should be in marking or in spacing position and the rotating mechanism determines at which time the contacts should be moved from one position to the other. In this manner the outgoing signals will have marking and spacing impulses in conformity with the incoming signals and the outgoing impulses will be timed to be of uniform length.

As is well known, the start-stop signals comprise a stop and a start impulse and five, or sometimes six, character impulses. The stop impulse usually is of marking and the start impulse of spacing characteristic.

For the purpose of maintaining successive outgoing signal series in isochronism with incoming signal series, the regenerator unit is equipped with a stop mechanism adapted to stop the cam mechanism during the stop impulse and to release it under control of the receiving magnet in response to the succeeding start impulse.

The two regenerator units operate between two sections of a single line circuit and each section may include a sensitive polar receiving relay for control of the associated receiving magnet. In a preferred form the locking arrangement referred to above is effective in preventing one receiving relay from starting its associated unit during the reception of a signal series by the other receiving relay and the locking circuit for the inactive relay includes the contacts of the active relay and the off-normal contacts of the active unit. These contacts cooperate in locking the inactive relay except for a portion of each stop impulse passing through the active side, thereby permitting the inactive side to respond to a signal, such as a break signal, from its line circuit during this unguarded period.

A circuit arrangement of this type has been disclosed in U. S. Patent No. 2,243,215 issued on May 27, 1941, to W. V. K. Large, and reference may be had particularly to Fig. 2 of that disclosure.

As is well known, interfering impulses, usually termed "hits," occur at varying intervals in telegraph circuits of this type and would be received as a spacing impulse. It is therefore general practice in commercial circuits to provide hit indicators that can be connected in each line section. These indicators may be of different types but have the common characteristics of responding separately to all pulses passing in each direction in the line circuit under observation and of giving an indication, which may be visual, for each response. Thus an observer will find one meter in the indicator actively responding to a message in a given direction and another associated meter remaining inactive during the transmission of the same message. Hits passing in the same direction as the message cannot be observed in this manner, whereas hits passing in the opposite direction will give readily observed indications on the inactive meter. In this manner too frequently occurring hits will be noted and it is possible to locate the line section on which they originate. Examples of hit indicator systems such as those just referred to are disclosed in U. S. Patents 1,861,553 issued to R. B. Shanck on June 7, 1932, and 1,982,022 issued to E. W. Reeve on November 27, 1934.

It has, however, been found that hits arriving at the repeater station in the same direction as the message and occurring during the unguarded portion of a stop impulse frequently give erroneous indications on the hit indicator. Such a hit may cause the inactive receiving relay in the repeater circuit to start the inactive unit which then would send a spacing impulse back into the

originating line circuit, thereby giving a false indication on the inactive hit meter. Thus the observer of the hit meters may be confused as to the origin of the hit.

Other provisions are made in the commercial circuits for supervision of long spacing conditions, such as break signals. For this purpose it is important that the open condition remain uninterrupted by the repeater circuit.

It is therefore an object of the invention to prevent the reflection into the originating line of hits arriving on that line by a start-stop regenerative repeater circuit, so that line trouble may more quickly be located.

It is a more specific object to guard the inactive side of a two-way repeater during the otherwise unguarded interval during the stop impulse to prevent false operation due to a hit.

It is another specific object to thus guard the inactive side substantially without interfering with the normal modes of operation of the regenerative repeater circuit.

An arrangement for the attainment of these objects has been disclosed in a copending application for U. S. Patent Serial No. 331,251, filed on April 23, 1940, by F. H. Fox which has issued as Patent No. 2,252,622, on Aug. 12, 1941. This arrangement includes certain contacts which for the purposes of Fox's invention were added to the cam mechanism of each regenerator unit of a repeater.

It is a further object of the invention to provide an arrangement for preventing the reflection of hits which will not require mechanical alteration of the regenerator units in the repeater.

In accordance with a feature of the invention the prevention of reflection is secured entirely by special control applied to the local timing circuits as distinguished from the signal carrying line circuits in the repeaters, namely, by control of the operation of the regenerator magnet to prevent untimely starting of the inactive unit during the unguarded period.

In accordance with a more specific feature the special control referred to is exerted by a delay circuit which is timed to bridge the usual unguarded period by preventing the inactive regenerator magnet from starting its unit in response to a false starting pulse in the outgoing line circuit produced by false operation of the active unit due to a hit in the incoming line circuit during the stop pulse. The arrangement of the delay circuit is, however, such that a long interruption, such as a break signal, in the outgoing line circuit will be retransmitted into the incoming line circuit after the active unit has completed its false operating cycle and reestablished the normal unguarded period for permitting the inactive unit to start.

In accordance with a still more specific feature the delay circuit for each unit includes a timed relay, such as a slow-release relay, which is adapted to extend the duration of the guard condition, established by the active side of the repeater during its operating cycle, to cover the duration of a normal stop impulse at the end of each signal series of impulses representing a character.

The invention will now be described more in detail as to its structure and operation as applied to two alternative preferred embodiments. The following description should be read in connection with the attached drawings which each shows a circuit diagram of a repeater station including two regenerator units of the general type, shown in the Zenner et al. patent referred to above. The regenerator units are shown in diagrammatic form with elements corresponding to those of the device disclosed by Zenner et al. and numbered to correspond to the numerals identifying the elements in the Zenner et al. patent.

It should, of course, be understood that whereas the embodiments shown in the drawings each includes mechanical regenerator units the invention may readily be adapted for operation with other types of start-stop regenerator units, such as the well-known type using segments and brush contacts. It should further be understood that whereas the disclosed embodiments each include a circuit arrangement similar to that of Fig. 2 in the copending application by Large, referred to above, other circuit arrangements, such as those shown in Fig. 1 or 3 of the Large disclosure, may be used for the purposes of the invention.

In the drawings Figs. 1 and 2 show the invention in two different embodiments, respectively, applied to identical repeater circuits of the type disclosed in the patent to Large, referred to above. In Fig. 1 the timed relay controls a circuit for producing a transient control current during the unguarded period, and in Fig. 2 the timed relay controls a simple direct current flow during the unguarded period.

The repeater circuits and their units being identical in Figs. 1 and 2 they will both be described together hereinafter, and corresponding reference numerals will be applied to corresponding parts. The specific circuit elements for carrying out the principles of the invention and their operation with the repeater circuits will thereafter be described separately with reference to the two embodiments, respectively, by means of separately assigned reference numerals for the corresponding parts.

Referring now to the repeater circuit diagram shown in the drawings the system comprises a repeating station with relay equipment for half-duplex operation between two line sections LW and LE which may terminate in subscribers' loop circuits including the usual receiving and transmitting equipment at each subscriber's station. The repeating station comprises two regenerator units **201** and **202**, one for each direction of transmission. Two polar relays **203** and **204** having operating and biasing windings are associated with the regenerator units **201** and **202**, respectively. The loop circuits will normally be closed and the normal line current will act to operate relays **203** and **204** to marking. A spacing signal is transmitted by opening either one of the loop circuits which causes the relays **203** or **204** to be operated to spacing by their biasing windings which are normally connected to a predetermined potential through potentiometers **211** and **212**, respectively.

Each regenerator unit will be assumed to be of the type disclosed in the patent to Zenner et al., referred to above, and comprises a receiving magnet M controlled by its associated receiving relay, transmitting contacts T controlled by the magnet M and the cam mechanism of the unit for operation into marking or spacing position, and off-normal or locking contacts L controlled by the cam mechanism.

The transmitting contacts T are included directly in the respective line circuits and thus repeat the signals directly into the subscribers' loops, the outgoing impulses passing through the

operating winding of the receiving relay in the outgoing circuit and tending to operate that relay. The polar relays are, however, prevented from responding to outgoing signals, except for short intervals during each stop condition, by the application of a locking potential to the potentiometer connected to the biasing winding of the relay, the locking potential being applied either from the spacing contact of the active polar relay or from the locking contact of the active regenerator unit or both; this locking potential is of a polarity opposite to that permanently applied to the other end of the potentiometer and causes the current to reverse in the biasing winding.

Referring now particularly to the details of each regenerator unit, the cams **21**, **22**, **23**, **24** are mounted on a common cam sleeve **20** intermittently driven through a friction clutch **31** by any suitable continuously rotating power supply P. The stop cam **21** cooperates with a stop latch **34** for stopping the cam sleeve in stop position; the stop latch **34** is in turn controlled by armature **40** of magnet M so that when the armature **40** is released by magnet M the latch **34** will permit the stop cam **21** and cam sleeve **20** to rotate.

The armature **40** has a spring **55** for retracting the armature and the magnet M is not of a sufficient strength during a marking impulse to attract the armature, but is of sufficient strength to hold the armature attracted during the marking impulses. The armature **40** cooperates with a flutter cam **22** with projections properly distributed about its periphery for raising the armature **40** against the spring **55** to present the armature to the magnet M. If at such a time magnet M is energized, as during a marking impulse, the armature **40** remains attracted. If, however, the magnet is deenergized, as during a spacing impulse, the armature will be retracted after the passing of the cam projection on cam **22**. The armature **40** also carries a contact operating member **65**, schematically shown as being flexible so that the member **65** may be locked against either the marking contact *m* or the spacing contact *s* by means of locking lever **77** while the armature **40** is in either position. Thus when the armature is attracted it will exert a force on the flexible arm **65** in the direction of the marking contact and when it is retracted it will exert a force on the arm **65** in the direction of the spacing contact. These forces exerted by the armature **40** will, however, not be effective until the arm **65** is released by the locking lever **77** which forms part of the lock arm **57**. The lock arm **57** is normally in engagement with a lock cam **24** by means of a spring **87** and during rotation of the cam sleeve will be raised at predetermined intervals by the projections on the lock cam **24**, thereby removing the locking lever **77** from engagement with the flexible contact arm **65** and permitting the latter to swing into engagement with either the marking or the spacing contact as determined by the position of the armature **40**. The distribution of the projections on the flutter cam **22** and lock cam **24** is such that for any particular impulse of a signal impulse series the armature **40** will first be presented to the magnet M and will be held or dropped by the magnet, as the case may be, whereupon the lock arm **57** will be operated to permit the flexible contact arm **65** to, if necessary, change from one position to the other.

An off-normal cam **23** has a single projection which in stop position operates the locking lever **60** against the tension of a contact spring to open the locking contacts L, thereby opening the holding circuit for the polar relay connected in the output circuit of the unit.

Assuming that a message is to be transmitted from the line West LW to the line East LE, a start impulse is received over the line circuit LW through the operating winding of relay **203** and over the closed contacts T of the regenerator unit **202**. Relay **203** responds by moving to spacing, thereby breaking the current in magnet M of the unit **201** and also applying negative potential to the low resistance end of the potentiometer **212**, the high resistance end of which is connected to positive potential, so that the current in the biasing winding of relay **204** will reverse and hold this relay in marking position. The unit **201** will be started by the release of armature **40** and immediately thereafter the locking contacts L will be operated to their alternate position thereby applying negative potential to the potentiometer **212** and thus preventing relay **204** and unit **202** from operating until unit **201** again reaches its stop position.

After a short interval the lock arm **57** is elevated by the first projection on cam **24** to unlock the flexible contact arm **65** which quickly moves to spacing position due to the stored-up tension produced by the armature when the latter was dropped. The transmitting contacts T thus will be opened and will transmit a spacing impulse into the loop LE without affecting relay **204**.

The circuit will remain in this condition until a marking impulse is received over loop LW which will operate relay **203** to marking thereby energizing magnet M of unit **201**. However, as the cam sleeve revolves the flutter cam **22** will raise the armature **40** once for each impulse period thereby presenting the armature to the magnet M for holding or dropping after each cam projection has passed. Cam **24** raises the lock arm **57** once for each impulse period shortly after the armature has been presented and has assumed its position in accordance with the characteristic of the pulse. Thus the transmitting contacts T are permitted to open or close the line circuit LE in accordance with the position of armature **40**, thereby transmitting impulses from LW into the outgoing circuit LE.

When the stop impulse arrives, relay **203** moves to marking thereby energizing magnet M of unit **201**. When the stop projection of cam **22** next presents the armature to the magnet the armature will be held attracted, thereby placing the stop latch **34** in the path of the cam **21** for stopping the unit. Shortly thereafter the stop projection on cam **24** releases the transmitting contacts T which then move to marking, or remain in marking as the case may be, for transmission of a stop impulse into the loop circuit LE. The contacts T will thereafter be locked while the unit moves to stop position and until the unit is again started, whereupon the start projection of cam **24** again will release the contacts T. The circuit is thus restored to normal condition as shown in the drawings.

It will be noted that the negative guard potential applied by relay **203** to potentiometer **212** is disconnected during the entire length of the incoming stop impulse and that the negative guard potential applied by locking contact L of unit **201** to the potentiometer **212** is disconnected by the off-normal cam **23** for an interval from shortly after the beginning of the outgoing stop impulse

until shortly after the next starting of the unit. Relay 204 therefore is permitted to operate to spacing the moment off-normal cam 23 opens the locking contacts L until the moment relay 203 operates to spacing in response to the next start impulse. This unguarded interval is provided to permit a break signal from line LE to start the regenerator unit 202 for placing a long opening on the line circuit LW, thereby notifying the transmitting subscriber that the other party wishes to cut in.

Referring now more particularly to Fig. 1 of the drawing, the system includes certain circuit details serving the purposes of the invention. Thus a slow releasing relay 321 has its winding included in the battery lead from negative battery to the locking contacts L of unit 201 and thus will be in operated condition while the contacts L are closed during each revolution of the unit. A similar relay 331 is included in the battery lead from positive battery to the contacts L of unit 202. Relay 321 when operated closes a circuit from plus battery through a condenser 322 and resistance 323 to the magnet M of unit 202. This condenser circuit is normally short-circuited over the marking contact *m* of relay 204. A similar condenser circuit including condenser 332 and resistance 333 is controlled by relay 331 and is short-circuited by relay 203 in marking position.

Under normal operating conditions of the regenerator unit relay 203 will operate magnet M to start the unit; shortly thereafter contacts L close to operate relay 321 through potentiometer 212. Wtih relay 204 in marking the operation of relay 321 has no effect. When unit 201 returns to normal, contacts L open the circuit for relay 321 which now will hold its contacts closed for an interval somewhat longer than a character length if contacts L remain open. If during this interval relay 204 should operate to spacing, under conditions which will be explained below, the uncharged condenser 322 will be included in the circuit from negative battery to magnet M of unit 202 and the resulting charging current to condenser 322 will temporarily energize magnet M sufficiently to delay the dropping of armature 40 and the starting of the unit 202 for somewhat longer than a normal length stop impulse. If relay 204 should return to marking soon enough, the normal energizing circuit for magnet M will be restored without starting of unit 202.

In the case of a break signal being transmitted from line East to the unit 202, relay 204 will operate to spacing at the beginning of the next unguarded period, and after condenser 322 has become charged through magnet M of unit 202 this unit will be started and will keep on rotating so long as the spacing condition of the break signal is maintained, thereby holding the line LW open for the duration of the break signal. Condenser 322 will be discharged again at the time normal transmission from line LW is resumed. During transmission from line LE condenser 322 will be disconnected when slow release relay 321 opens its contacts. As is well known, the break signal may be sent during transmission in the opposite direction as a request to the other station to stop sending, or a similar spacing signal may be sent through an idle line to call or start the other station.

When a hit occurs on line LW during transmission from line LW to line LE, as described above, a spacing condition will be imposed on the incoming end of the line circuit LW causing relay 203 to operate to spacing for the duration of the hit and the magnet M of the rotating unit 201 will drop the armature each time it is presented during the hit and will cause corresponding spacing impulses to be transmitted into the line LE. Such hits may interfere with the message in line LE but cannot be observed on the hit meters for either the active or inactive direction. A hit on the line LE occuring during transmission from line LW may also interfere with the reception of the message in line LE but can be properly observed on the inactive hit meter associated with the line circuit. If long enough, such a hit may start unit 202 in the manner of a break signal, as described above, in which case it could also be properly observed on the inactive hit meter associated with line LW.

A special condition arises, however, when a hit occurs on the incoming circuit during a stop pulse and particularly when the hit is present at the time the transmitting contacts T are unlocked for operation to marking in response to the stop impulse.

Relay 203 thus will be operated to spacing by the hit on line LW thereby causing the magnet M to drop armature 40 after it has been presented by the stop projection on cam 22 with the result that the transmitting contacts T, when released by locking cam 24 will move to spacing instead of moving to marking as in the case of an uninterrupted incoming stop impulse. The unit 201 will thus fail to stop and the contacts T will remain in spacing during the subsequent start impulse and at least until the armature 40 has been presented to magnet M by a projection on cam 22. If the hit be long enough to last into the incoming start impulse, the receiving relay 203 would remain in spacing and there would be no unguarded period for relay 204 which thereafter would remain locked by contacts L of unit 201 until the next stop impulse from line LW. However, when the hit ceases before the beginning of the next start impulse, the unguarded period for relay 204 may be as long as during normal operation.

In the absence of the condenser circuit 322, 323 provided in accordance with the invention and described above, the opening, due to the hit, of the line circuit LE by contacts T of unit 201 extending into the unguarded interval of the stop period, i. e., beyond the passing of the hit and the return of relay 203 to marking, would cause relay 204 to move to spacing and to start its associated regenerator unit 202. A guard potential would immediately be supplied to potentiometer 211 for locking relay 203 in marking position during a revolution of unit 202, and when the transmitting contacts of unit 202 were released by the start projection on cam 24 a spacing impulse would be transmitted into line circuit LW. Since transmission from line LW would continue the spacing pulse from unit 202 against the prevailing direction of transmission would be indicated on the hit indicator as a hit originating in line circuit LE, which would be erroneous.

With the condenser circuit 322, 323 provided in accordance with the invention, the starting of the unit 202 in response to a short operation of relay 204 to spacing is prevented, as described above, and the line circuit LW remains closed at the contacts T of unit 202. The erroneous hit indication under the special condition just described is thus prevented and the location of line faults is expedited.

Thus when a hit occurs on line LW and is

present when the transmitting contacts T of unit 201 are unlocked by the stop projection on cam 24 these contacts will be locked in spacing as described above, and the line circuit LE will be opened; with relay 203 still in spacing during the hit relay 204 is prevented from operating to spacing. However, when, after the passing of the hit, relay 203 returns to marking the unguarded period commences and relay 204 operates to spacing. As already described, the unit 202 is temporarily prevented from being started by the condenser circuit 322, 323. Unit 201 continues its rotation through its stop position and in running into its next rotation immediately closes its contacts L thereby applying the guard potential to potentiometer 212 and operating relay 204 back to marking and energizing relay 321 for discharge of condenser 322. With the proper timing constants of the circuit 322, 323 the unit 202 will be prevented from starting under these conditions before the return of relay 204 to marking. Thus the hit in line LW will not be reflected back into that line by the unit 202 and the inactive meter in the hit indicator will remain unaffected by the hit in the active direction. However, since armature 40 of unit 201 remains retracted due to the hit and the cam sleeve fails to stop, there may be some interference with the transmission of one or two characters into the loop circuit LE.

Referring more particularly to Fig. 2 of the drawings, the circuit elements for preventing reflection of hits includes slow release relays 421 and 431. In this arrangement the winding of relay 421 is connected directly in the lead to potentiometer 212 so that this relay will be operated when relay 203 goes to spacing in response to a start pulse and will remain operated over contacts L of unit 201 during the entire revolution of this unit. The contacts of relay 421 are connected to supply negative potential to magnet M of unit 202 and are normally short-circuited by the marking contacts of relay 204. Relay 431 is similarly connected for operation by relay 204 and unit 202 for control of magnet M of unit 201.

From the description given above in connection with Fig. 1 it will be immediately apparent that the presence of relays 421 and 431 will have no effect upon the operation of the repeater circuit except under the special condition, referred to above, when a hit occurs on the incoming circuit during a stop impulse and is present at the time the transmitting contacts T are unlocked for return to marking in response to the stop impulse, the hit passing before the end of the stop impulse, so that there will be an unguarded period.

Assuming such a hit to occur in line LW, relay 203 will be in spacing position when armature 40 of unit 201 passes off the stop projection on cam 22. The contacts T operate to spacing and open the line circuit LE. Relay 421 has been operated and relay 204 has been held in marking by the contacts L of unit 201 and are now also being held by relay 203 in spacing.

When the hit ceases relay 203 returns to marking and when the lever 60 is raised by the stop projection on cam 23 of unit 201 contacts L are opened. At such time relay 421 commences its slow release and relay 204 operates to spacing due to the open condition of line LE at contact T of unit 201. Without the relay 421 the operation of relay 204 to spacing would start the unit 202. However, with the relay 421 included in the circuit, the magnet M remains temporarily energized over the contacts of relay 421 after relay 204 has opened its marking contacts. Relay 421 is timed to open its contact after an interval somewhat longer than the duration of usual stop impulses. As the unit 201 continues its rotation into the next cycle, the contacts L will close and when the next start impulse arrives over the line LW the spacing contacts on relay 203 will also close thereby holding relay 421 energized. In this manner false starting of the inactive unit 202 and reflection into the incoming circuit of a hit in that circuit is prevented and erroneous indications on the hit indicator are prevented.

Inasmuch as the two regenerator units of the repeater station are similarly connected into the circuit, operation of the system during transmission from the line LE to the line LW will proceed in the same manner as described above for transmission in the opposite direction. Also the prevention of a false indication by the hit meters due to a hit on line LE during a stop impulse is accomplished in the same manner as described above for a similar hit on the line circuit LW.

Whereas the invention has been described above as being applied to a circuit arrangement in which the receiving relay in the inactive side is locked against operation except during the unguarded period, it should be understood that the invention is readily adaptable to a circuit arrangement in which the starting of the inactive unit is prevented, except during the unguarded period, by the application of a guard potential or other provision effective during the revolution of the active unit in locking the inactive magnet. Examples of such systems are shown in Figs. 1 and 3 in the patent to Large referred to above.

What is claimed is:

1. A two-way start-stop telegraph repeater system connected between two line circuits and comprising a west and an east regenerative repeater alternately active and inactive to, one at a time, repeat start-stop code impulses incoming from west and east into the east and west line circuits, respectively, each of said repeaters including receiving winding means, timed repeating contact means controlled as to code by said receiving winding means, guard contact means connected to lock the other of said repeaters against operation during the operating cycle of the active repeater except for an unguarded period during each stop impulse incoming to said active repeater, and circuit control means connected to control the starting of said other repeater and adapted to be operated into one of two conditions in response to the locking operation of said guard contact means and adjustable to automatically remain in said one condition for a predetermined time interval during said unguarded period to delay starting of said other repeater.

2. A two-way start-stop telegraph repeater system connected between two line circuits and comprising a west and an east regenerative repeater alternately active and inactive to, one at a time, repeat start-stop code impulses incoming from west and east into the east and west line circuits, respectively, each of said repeaters including receiving winding means, timed repeating contact means controlled as to code by said receiving winding means, guard contact means connected to lock the other of said repeaters against operation during the operating cycle of the active repeater except for an unguarded period during each stop impulse incoming to said

active repeater, and circuit control means connected to control the starting of said other repeater and adapted to be operated into one of two conditions by said guard contact means during locking of the other repeater and adjustable to temporarily remain in said one condition after the beginning of said unguarded period to delay starting of said other repeater by a start condition impressed upon said repeater system from either of said line circuits.

3. A two-way start-stop telegraph repeater system connected between two line circuits and comprising a west and an east regenerative repeater alternately active and inactive to, one at a time, repeat start-stop code impulses incoming from west and east into the east and west line circuits, respectively, each of said repeaters including receiving winding means, timed repeating contact means controlled as to code by said receiving winding means, guard contact means connected to lock the other of said repeaters against operation during the operating cycle of the active repeater except for an unguarded period during each stop impulse incoming to said active repeater, and circuit control means connected to control the starting of said other repeater and connected in a circuit to said guard contact means to be operated into one of two conditions in response to the locking operation of said guard contact means for in said one condition placing a supplementary guard condition on said other repeater, said circuit control means being timed to maintain said guard condition for the usual duration of the said unguarded period under normal transmission to prevent starting of said other repeater except during an unguarded period of greater than a predetermined duration.

4. A two-way start-stop telegraph repeater system connected between two line circuits and comprising a west and an east regenerative repeater alternately active and inactive to, one at a time, repeat start-stop code impulses incoming from west and east into the east and west line circuits, respectively, each of said repeaters including receiving winding means, timed repeater contact means controlled as to code by said receiving winding means, guard circuit means including contact means for locking the other of said repeaters against operation during the operating cycle of the active repeater except for an unguarded period during each stop impulse incoming to said active repeater, a supplementary guard circuit, and circuit control means including slow-acting relay means having contacts for control of the starting of said other repeater and being connected to operate in response to the locking operation of said guard circuit means for closing by its contacts said supplementary guard circuit for said other repeater during a complete operating cycle of said active repeater including said unguarded period of a predetermined maximum duration to prevent starting of said other repeater within said unguarded period.

5. A two-way start-stop telegraph repeater system in accordance with claim 4 in which said supplementary guard circuit is connected, when closed, to maintain said receiving winding means energized in said other repeater for said maximum duration of the unguarded period to prevent said starting in response to a start condition impressed upon said repeater system from either of said line circuits.

6. A two-way start-stop telegraph repeater system in accordance with claim 4 in which said supplementary guard circuit, when closed, includes capacitance means to establish a transient current for energization of said receiving winding means in said other repeater in response to a start condition impressed upon said repeater system from either of said line circuits during said unguarded period, said transient current being of sufficient strength for said maximum duration to prevent starting of said other repeater.

7. A two-way start-stop telegraph repeater system connected between two line circuits and comprising a west and an east regenerative repeater alternately active and inactive to, one at a time, repeat start-stop code impulses incoming from west and east into the east and west line circuits, respectively, each of said repeaters including a receiving line relay responsive to impulses in the associated line circuit, a rotary start-stop regenerator unit having mechanically timed repeating contacts for producing impulses in the associated line circuit and having a control magnet responsive to said line relay to start and stop said unit for each cycle of operation and to control said repeating contacts as to impulse characterization, locking circuit means including contacts on said line relay in start condition and including off-normal contacts on said unit and connected for locking of said line relay of the inactive repeater in its stop position during the operating cycle of the active repeater to prevent starting of said unit in the inactive repeater during said cycle except for an unguarded period during each stop impulse incoming to the active repeater, a supplementary guard circuit, and circuit control means including a slow-acting relay connected to operate in response to said locking by said locking circuit means and having contacts for closing said supplementary guard circuit for said control magnet in the inactive repeater continuously during the operating cycle of the inactive repeater and during said unguarded period of a predetermined maximum duration to prevent starting of the inactive unit by the inactive line relay in response to a start impulse condition in either of said line circuits during said unguarded period.

8. A two-way start-stop telegraph repeater system in accordance with claim 7 in which said guard circuit is connected to, when closed, maintain the inactive control magnet in stop condition independently of operations by the line relay in the inactive repeater during said unguarded period.

9. A two-way start-stop telegraph repeater system in accordance with claim 7 in which said guard circuit is connected to, when closed, maintain the inactive said control magnet energized for said maximum duration of the unguarded period to prevent starting of the inactive said unit in response to start operation by said line relay means in the inactive repeater, said slow-acting relay being timed to open said guard circuit at the end of said maximum duration.

10. A two-way start-stop telegraph repeater system in accordance with claim 7 in which said guard circuit, when closed, includes capacitance means to establish a transient energizing current for the inactive said magnet in response to a start operation by the inactive said line relay during the unguarded period, said energizing current being of sufficient strength for said maximum duration to prevent starting of the inactive said unit, and said slow-acting relay being timed

to open said guard circuit at the expiration of said maximum duration.

11. A two-way start-stop telegraph repeater system connected for repeating marking and spacing conditions of signals of a start-stop code between two line circuits and comprising a west and an east regenerative repeater alternately active and inactive to, one at a time, repeat said marking and spacing conditions of signals incoming from west and east into the east and west line circuits, respectively, each of said repeaters including receiving winding means, timed repeating contact means controlled as to code by said receiving winding means, locking circuit means connected to lock the other of said repeaters against operation during the operation of the active repeater, except for an unguarded period during marking condition of greater than a predetermined duration of signals incoming to said active repeater, said locking circuit means including guard circuit means connected to lock said other repeater during spacing condition in response to incoming signals and timed circuit control means connected to lock said other repeater for said predetermined duration under marking condition in response to the locking operation of said guard circuit means.

12. A two-way start-stop telegraph repeater system connected for repeating marking and spacing conditions of signals of a start-stop code between two line circuits and comprising a west and an east regenerative repeater alternately active and inactive to, one at a time, repeat said marking and spacing conditions of signals incoming from west and east into the east and west line circuits, respectively, each of said repeaters including receiving winding means, timed repeating contact means controlled as to code by said receiving winding means, guard contact means connected to lock the other of said repeaters against operation during the operation of the active repeater, except for an unguarded period during marking condition of signals incoming to said active repeater, and circuit control means connected to control the starting of said other repeater and adapted to be operated into one of two conditions in response to the locking operation of said guard contact means and adjustable to automatically remain in said one condition for a predetermined time interval during said unguarded period to delay starting of said other repeater.

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