

April 26, 1927.

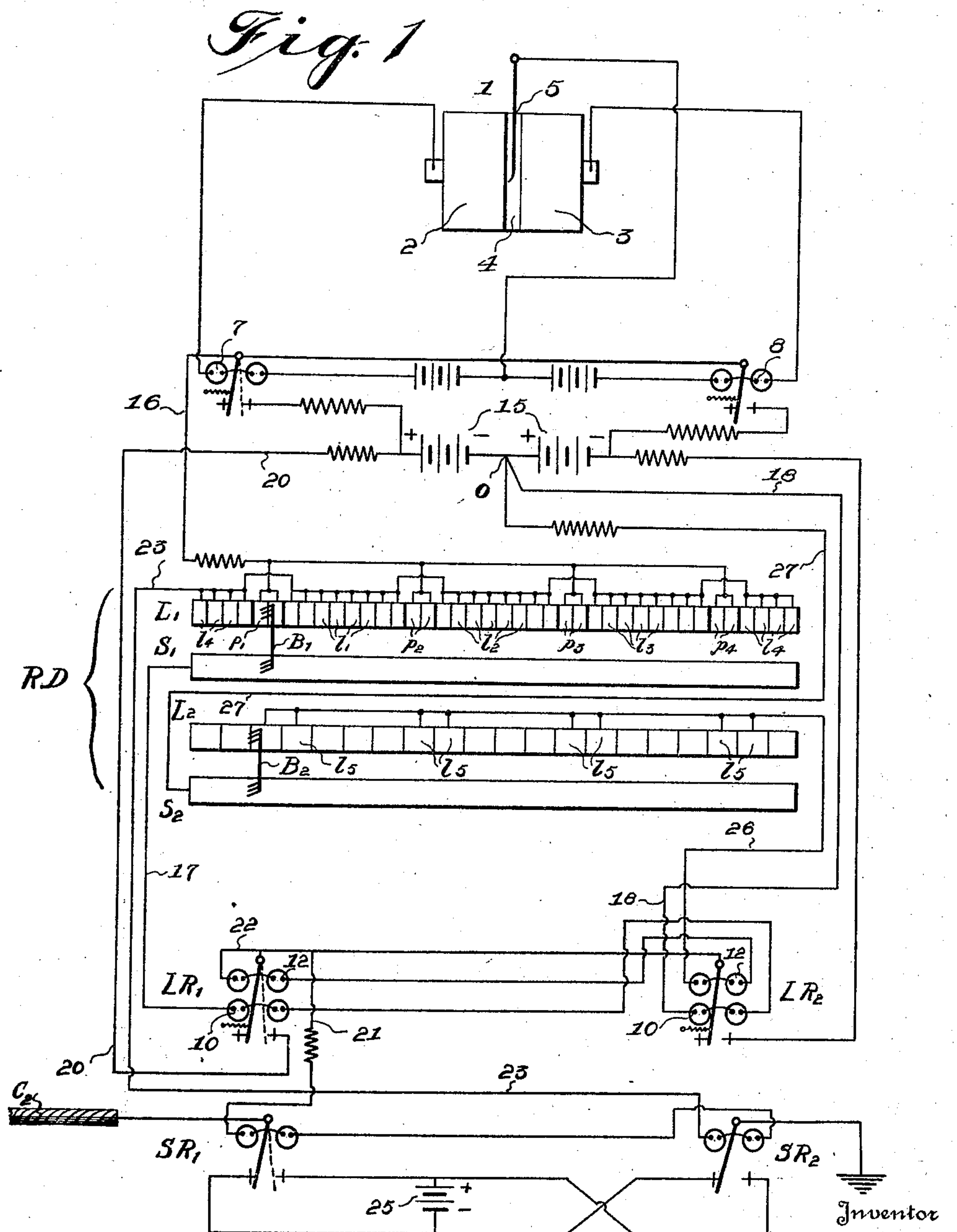
A. H. HOWARD

1,626,534

REGENERATIVE ROTARY REPEATER

Filed Aug. 14, 1925

2 Sheets-Sheet 1



Albert H. Howard

By

Eugene C. Brown,
Attorney

April 26, 1927.

A. H. HOWARD

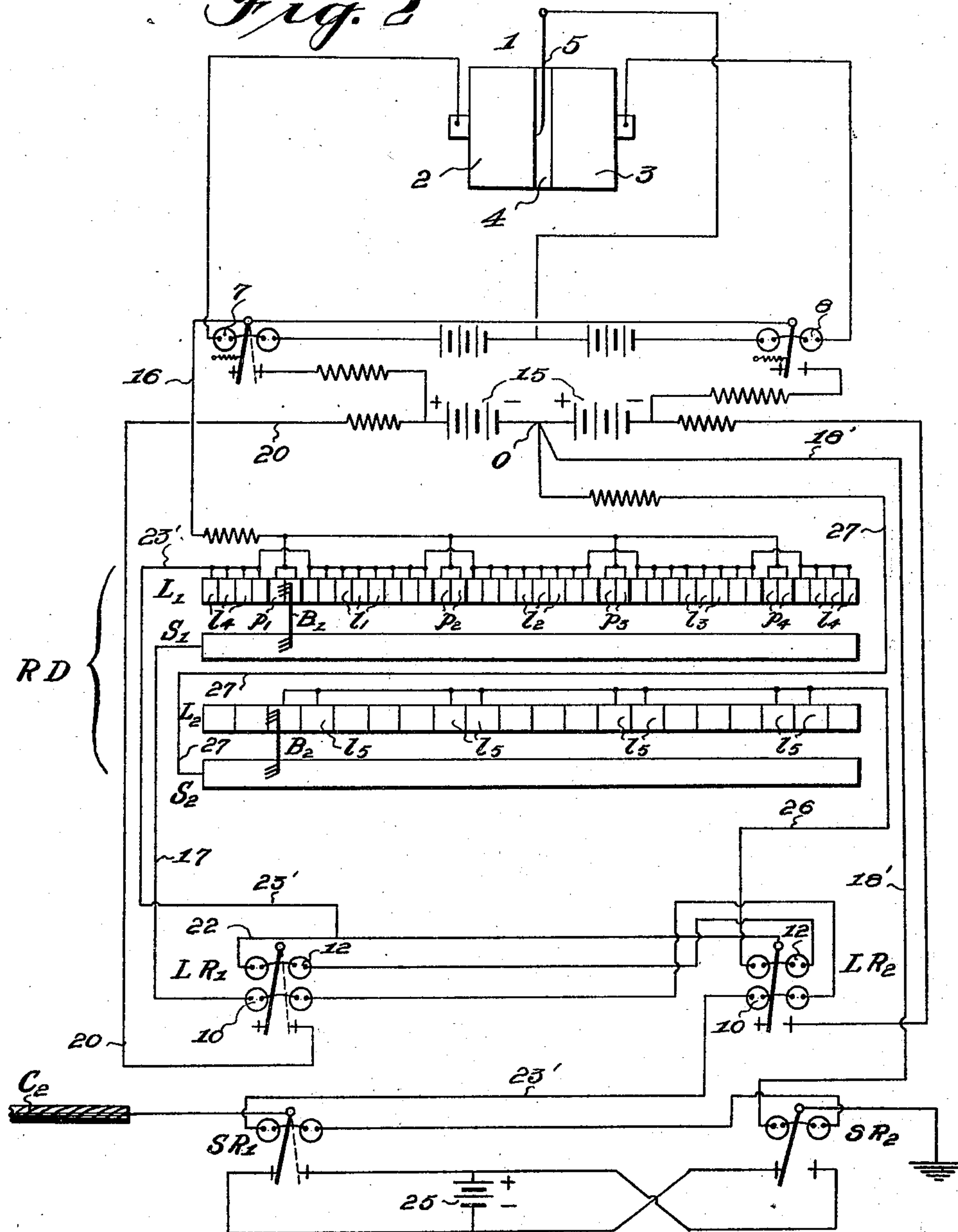
1,626,534

REGENERATIVE ROTARY REPEATER

Filed Aug. 14, 1925

2 Sheets-Sheet 2

Fig. 2



Inventor

Albert H Howard

By

Engene C. Brown

Attorney

Patented Apr. 26, 1927.

1,626,534

UNITED STATES PATENT OFFICE.

ALBERT H. HOWARD, OF BAY ROBERTS, NEWFOUNDLAND, ASSIGNOR TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

REGENERATIVE ROTARY REPEATER.

Application filed August 14, 1925, Serial No. 50,206, and in Canada August 5, 1925.

This invention relates to telegraph systems employing synchronized transmitters and receivers and particularly to regenerating means for receiving or retransmitting telegraph signals.

The principal object of my invention is to ensure the retransmission of all signal impulses received, especially when the incoming signals are weak or of short duration and to this end I provide means for actuating a relay the instant the incoming signal impulse is received and for locking or maintaining said relay energized until the signal has been retransmitted to the next line section or to a recorder.

My invention relates to synchronous telegraph repeating systems in which the retransmitted signals are reformed and regenerated and have a predetermined duration independent of the length of the incoming signals. In such systems as heretofore devised, the rotary distributor of the repeater is so synchronized with the distributor at the distant sending station that the brush of the receiving ring of the repeating distributor normally passes over the pick-up segments at the instant the incoming signals have reached their mid-point. As is well known this is done to ensure the reception at the most stable part of the current impulse. In said prior systems the relays of the repeater are not connected to the locking or holding circuits until the brushes have moved from the pick-up segments onto the locking or holding segments. If for any reason, due to some electrical disturbance, the received signal is weak or is out of proper phase, and ceases before the brush has passed off of the pick-up segment onto the holding or locking segments, the impulse would be lost because the locking relay tongue or armature would have moved away from its marking contact before the brush reached the first locking segment.

It is to overcome this defect in prior systems that I have devised the organization disclosed herein. The method involved in my present invention provides an additional locking or holding circuit which comes into operation in advance of the usual locking circuit and hence bridges over the interval in which the previous failures have occurred and thus eliminates the danger of losing an out-of-phase or weak signal.

In the following detailed description, I shall refer to the accompanying drawings in which Figures 1 and 2 are diagrams of circuit arrangements embodying my invention.

Figure 1 represents one organization of circuits which may be used at a repeater station. The signals transmitted over a cable or line section are received as usual by a drum relay 1 having the conducting cylinders 2 and 3, separated by an insulating section 4, upon which the needle or tongue 5 rests when no impulses are being received. When the needle 5 swings to the left a circuit is closed from the local battery to energize the local dot relay 7, and likewise when the needle swings to the right the local dash relay 8 is actuated.

For the purpose of carrying out my improvement I provide the rotary distributor RD with an auxiliary locking ring L_2 in addition to the receiving and locking ring L_1 heretofore employed in regenerative repeating apparatus such as disclosed in U. S. application of Peterman, Serial No. 557,048, filed April 28, 1922. The locking relays LR_1 and LR_2 are provided with energizing coils 10 connected with the ring L_1 through ring S_1 and brush B_1 and with other coils 12 connected to ring L_2 .

The operation of the apparatus above described is as follows:—

Assume that a signal impulse transmitted from the distant station is received at the repeating station and causes the needle 5 of the drum relay to swing over to the cylinder 2 thereby causing the tongue of the dot relay 7 to move over against its marking contact, as indicated in dotted lines. A circuit is thereby closed from the plus pole of battery 15, through the tongue of dot relay 7, conductor 16, pick-up segments p_1 of receiving and locking the ring L_1 , brush B_1 , solid ring S_1 , conductor 17, coils 10 of both locking relays LR_1 and LR_2 , conductor 18, to the split or neutral point O of the battery. The tongue of locking relay LR_1 moves over against its right hand contact, as indicated in dotted lines.

If the incoming signal impulse holds the tongue of the dot relay 7 against its marking contact until the brush B_1 moves from the pick-up segments p_1 onto the adjacent set of locking segments l_1 of ring L_1 , the tongue of locking relay LR_1 will be held against its

right-hand contact by a circuit from the plus pole of battery 15, through conductor 20, tongue of relay LR_1 , conductor 21, coils of sending-on or retransmitting relays SR_1 and SR_2 , conductor 23, locking segments l_1 or segmented ring L_1 , brush B_1 , solid ring S_1 , conductor 17, coils 10 of relays LR_1 and LR_2 , and conductor 18 to the split of the battery. The coils 10 of locking relays LR_1 and LR_2 will thus be maintained in energized condition and simultaneously the tongue of sending-on relay SR_1 will be moved against its right-hand or marking contact, thus connecting the plus pole of battery 25 with the cable C_2 . This positive impulse will be transmitted to cable C_2 while the brush B_1 is passing over the segments l_1 which are connected together. The method just described for repeating a signal impulse received from a distant station upon the drum relay, reforming it to predetermined length, regenerating it through the cable battery 25 and transmitting it to the next line section or cable C_2 , is disclosed in said Peterman application.

As previously pointed out, in the repeating arrangement devised by Peterman, if the incoming signal should cease before the brush B_1 passes from the pick-up segments p_1 onto the holding or locking segments l_1 there will be no current available to hold the tongue of relay LR_1 against its right hand contact and hence there will be no circuit through the sending-on relays SR_1 and SR_2 . Consequently no corresponding signal impulse will be sent into cable C_2 . It is to provide against this contingency that I devised the new organization disclosed herein. To this end, I provide an auxiliary pair of rings L_2 , S_2 , on the rotary distributor which are arranged to energize the locking relays LR_1 and LR_2 through coils 12 while the brush B_1 is still on the pick-up segments p_1 , so that the tongue of either the dot locking relay LR_1 or the dash locking relay LR_2 will be locked or held over against its right-hand or marking contact before the brush B_1 passes onto the locking segment l_1 .

Assuming as before, that an incoming signal impulse causes the needle 5 of the cable drum relay 1 to swing over on the cylinder part 2 thereby energizing the local dot relay 7 and moving its tongue into marking position indicated in dotted lines. When the brushes B_1 pass over any of the pick-up segments of the receiving and locking ring L_1 , a circuit is closed from battery 15 through the coils 10 of locking relays LR_1 and LR_2 over the circuit previously traced. For the purpose of holding the tongue of relay LR_1 against its marking contact, I provide the auxiliary relay coils 12 and the auxiliary rings L_2 , S_2 , and brush B_2 . As soon as the tongue of relay LR_1 touches its right hand or marking contact, an auxiliary hold-

ing or locking circuit is closed from the plus pole of battery 15, through conductor 20, tongue of relay LR_1 , conductor 22, coils 12 of relays LR_1 and LR_2 , conductor 26, pairs of segments l_5 of the auxiliary segmental ring L_2 , brush B_2 , solid ring S_2 and conductor 27 to the split O of battery 15. The brush B_2 is so positioned that it moves onto segments l_5 before brush B_1 has passed off of the pick-up segments p_1 of ring L_1 . A sufficient number of segments l_5 of ring L_2 are connected together and connected to conductor 26 to ensure a circuit through coils 12 until after the brush B_1 has passed onto the locking segments l_1 of ring L_1 which establishes a locking circuit through the coils 10, thus providing an overlap between the two holding or locking circuits for the relays LR_1 and LR_2 . It is evident, therefore, that even though the current should cease through the pick-up segments p_1 before the brush passed therefrom, the relays LR_1 and LR_2 would remain energized through the auxiliary circuit including the auxiliary rings L_2 , S_2 , brush B_2 , and coils 12, thus eliminating the previous danger of losing a signal impulse.

It will be observed that if the brush B_2 should pass onto the segments l_5 before the brush B_1 has moved off of a group of locking segments l_1 , l_2 , l_3 , or l_4 , for a previous signal, a circuit would be closed through brush B_2 , and coils 12 which would again lock up said previous signal so that it would not cease when the brush B_1 passed off of the last segment of a group of locking segments. To avoid such an occurrence, the brush B_2 is staggered behind the brush B_1 to ensure the breaking of the circuit of the preceding signal before the brush B_1 receives the succeeding signal impulse in passing onto the next pick-up segments. In other words, the brush B_2 does not pass onto a segment l_5 of ring L_2 until just after the brush B_1 has moved onto a receiving or a pick-up segment of ring L_1 .

Although the coils 10 and 12 of the locking relays LR_1 and LR_2 are energized and the tongue of one or the other relay is moved against its marking contact, depending upon whether the signal impulse is of positive or of negative polarity, yet a circuit is not closed through the coils of the sending-on relays SR_1 and SR_2 until the brush B_1 passes off of the pick-up segments and onto the first of one of the connected groups of locking segments, l_1 , l_2 , l_3 , or l_4 , and the circuit through the sending-on relays is broken as the brush B_1 passes off of the last segment of said group. Thus, the signal impulse repeated into the succeeding line or cable section C_2 has a definite length or period depending upon the number of segments joined or connected together in the groups of the ring L_1 and hence as previously stated, the

duration of the repeated signal is absolutely independent of the duration of the incoming signal.

In the arrangement shown in Figure 1, the duration of the signal impulses repeated into cable C_2 is necessarily less than the unit time allotted to a signal impulse since the signal is not transmitted by the sending-on relays until the brush B_1 has moved upon the first segment of one of the connected groups of the locking segments. It is sometimes desirable that the repeated signals should extend over the full unit period and for this purpose I have devised the arrangement shown in Figure 2.

Referring to Figure 2, the various elements which are identical with the corresponding elements in Figure 1 are designated by the same reference characters. As previously pointed out, while the locking relays LR_1 and LR_2 in the arrangement of Figure 1 are energized as soon as the brush B_1 moves onto a pick-up segment p_1, p_2, p_3 , or p_4 , yet no circuit is completed through the sending-on relays SR_1 and SR_2 until the brush B_1 moves onto a locking segment l_1, l_2, l_3 or l_4 . On the other hand, in the arrangement of Fig. 2, the sending-on relays SR_1 and SR_2 are energized as soon as the brush B_1 moves onto one of the pick-up segments and consequently the signal impulses are repeated into the cable C_2 . While an impulse repeated into cable C_2 may be initiated at any instant during the time the brush B_1 is passing over the pick-up segments, so that the beginning of the signal impulse is more or less indeterminate, its termination is fixed by the passing of the brush B_1 off of the last of a group of locking segments.

The operation of the arrangement shown in Figure 2 will be evident from the previous description of Figure 1. Thus if a positive signal impulse is received on the cable drum relay 1, causing the local dot relay 7 to connect the pick-up segments p_1 with the plus terminal of battery 15, while the brush B_1 is passing over said pick-up segments, a circuit will be closed from the plus terminal of battery 15, through the tongue of dot relay 7, conductor 16, pick-up segments p_1 of segmented ring L_1 , brush B_1 , solid ring S_1 , conductor 17, coils 10 of locking relays LR_1 and LR_2 , conductor 23' coils of sending-on relays SR_1 and SR_2 and conductor 18' to the neutral point O of battery 15. The sending-on relays SR_1 and SR_2 are therefore energized simultaneously with the locking relays LR_1 and LR_2 and at the instant the impulse is received upon the pick-up segments of the ring L_1 . Hence the impulse, regenerated by the battery 25, is repeated into the cable C_2 , the instant the incoming signal is received on the pick-up segments p_1, p_2, p_3 , or p_4 . Before the brush B_1 leaves the pick-up segments, the brush B_2

passes onto the locking segments l_5 of the auxiliary locking ring L_2 and thereby closes a circuit from the plus terminal of battery 15, through conductor 20, tongue of relay LR_1 , conductor 22, coils 12 of relays LR_1 and LR_2 , conductor 26, locking segments l_5 of auxiliary locking ring L_2 , brush B_2 , solid ring S_2 , conductor 27 to the neutral point O of the battery. The relays are thus maintained in energized condition by the coils 12 until the brush B_1 passes over a predetermined number of the connected locking segments l_1 of segmented ring L_1 . As the brush B_1 passes over the connected segments l_1 , the relays are held by the coils 10, which are then energized over a circuit from the plus terminal of battery 15, through conductor 20, tongue of relay LR_1 , conductor 23', locking segments l_1 of receiving and locking ring L_1 , brush B_1 , solid ring S_1 , conductor 17, coils 10 of locking relays LR_1 and LR_2 , conductor 23', coils of sending-on relays SR_1 and SR_2 , and conductor 18', to the neutral point O of the battery. The impulse repeated into cable C_2 will cease as the brush B_1 moves off of the last segment of the group of connected segments l_1 . Since the full unit period allotted to a signal impulse is the time required for the brush B_1 to move over one set of pick-up segments and the succeeding connected group of locking segments, it is evident that if a signal impulse is received just as the brush B_1 moves onto the first pick-up segment, the impulse repeated into cable C_2 will have a duration equal to the full unit period allotted to a signal.

I claim:—

1. In a synchronous telegraph system, means for receiving or retransmitting the signals, comprising a rotary distributor operating synchronously with the received signal impulses, and three pairs of normally biased oppositely-poled polar relays operatively associated therewith, the first pair of said relays acting to receive another pair, to store and the third pair to retransmit the signal impulses, said distributor operating to cause the impulses to be stored during the reception of the impulses and to be retransmitted for a period ending at a predetermined time, the storing relay being maintained in energized condition throughout the reception and retransmission periods.

2. In a synchronous telegraph system as set forth in claim 1, said distributor having means for causing the impulses stored during the reception of the impulses to be retransmitted subsequently for a predetermined period.

3. In a synchronous telegraph system, means for receiving or retransmitting the signals, comprising a rotary distributor operating synchronously with the received signal impulses, and three pairs of normally

biased oppositely-poled polar plurality of relays operatively associated therewith, the first pair of said relays acting to receive another pair, to store and the third pair to retransmit the signal impulses, said distributor operating to cause the impulses to be stored during the reception of the impulses and to be retransmitted for a period ending at a predetermined time, said distributor being provided with means for causing a storing relay to store the impulse simultaneously with its operation, to be held in actuated condition independently of the receiving relay and to actuate a retransmitting relay while maintaining said storing relay in said condition during the retransmission period.

4. In a synchronous telegraph system, means for receiving or retransmitting the signals, comprising a rotary distributor operating synchronously with the received signal impulses, and three pairs of normally biased oppositely-poled polar relays operatively associated therewith, the first pair of said relays acting to receive another pair, to store and the third pair to retransmit the signal impulses, said distributor operating to cause the impulses to be stored during the reception of the impulses and to be subsequently retransmitted for a predetermined period, said distributor being provided with means for causing a storing relay to store the impulse simultaneously with its operation, to be held in actuated condition independently of the receiving relay and thereafter to actuate a retransmitting relay while maintaining said storing relay in said condition during the retransmission period.

5. In a synchronous telegraph system, the combination with a plurality of line sections, of a relaying equipment comprising a source of current, a rotary distributor having a plurality of segmented rings including a pick-up and locking ring, and an overlap ring, three pairs of normally biased oppositely poled polar relays, the first pair operating to receive the signals, the second pair to store them and the third pair to retransmit or send-on the signals, said receiving relays being connected to a plurality of pick-up segments spaced at equal intervals in said pick-up and locking ring, said storing relays having coils arranged to be connected to said current source through said pick-up segments, and other coils arranged to be connected to a plurality of segments spaced at equal intervals in said overlap ring, said retransmitting or sending-on relays having their coils operatively connected

to said locking segments through the tongues of said storing relays when in marking position.

6. In a synchronous telegraph system, the combination with a plurality of line sections, of a relaying equipment comprising a source of current, a rotary distributor having a plurality of segmented rings including a pick-up and locking ring, and an overlap ring, three pairs of normally biased oppositely poled relays, the first pair operating to receive the signals, the second pair to store them and the third pair to retransmit or send-on the signals, said receiving relays being connected to a plurality of pick-up segments spaced at equal intervals in said pick-up and locking ring, said storing relays having coils arranged to be connected to said current source through said pick-up segments, and other coils arranged to be connected to groups of connected segments in said overlap ring, said retransmitting or sending-on relays having their coils operatively connected to said locking segments through the tongues of said storing relays when in marking position.

7. In a synchronous telegraph system, the combination with a plurality of line or cable sections, of a relaying equipment comprising a source of current, a rotary distributor having a plurality of segmented rings including a pick-up and locking ring, and an overlap ring, three pairs of normally biased oppositely poled polar relays, the first pair operating to receive the signals, the second pair to store them and the third pair to retransmit or send-on the signals, said receiving relays being connected to a plurality of pick-up segments spaced at equal intervals on said pick-up and locking ring, said storing relays having coils arranged to be connected to said current source alternately through said pick-up segments and through groups of connected locking segments in said pick-up and locking ring, and other coils connected to segments in said overlap ring, said last named segments overlapping said pick-up segments and part of said locking segments in said pick-up and locking ring, said retransmitting or sending-on relays having coils operatively connected to the said locking segments through the tongues of said storing relays when in marking position.

In testimony whereof I affix my signature.

ALBERT H. HOWARD.