April 21, 1931. R. F. DIRKES ET AL 1,802,240

OPERATING SIMPLEX PRINTERS IN A MULTIPLEX SYSTEM

Filed Aug. 18, 1928 3 Sheets-Sheet 1

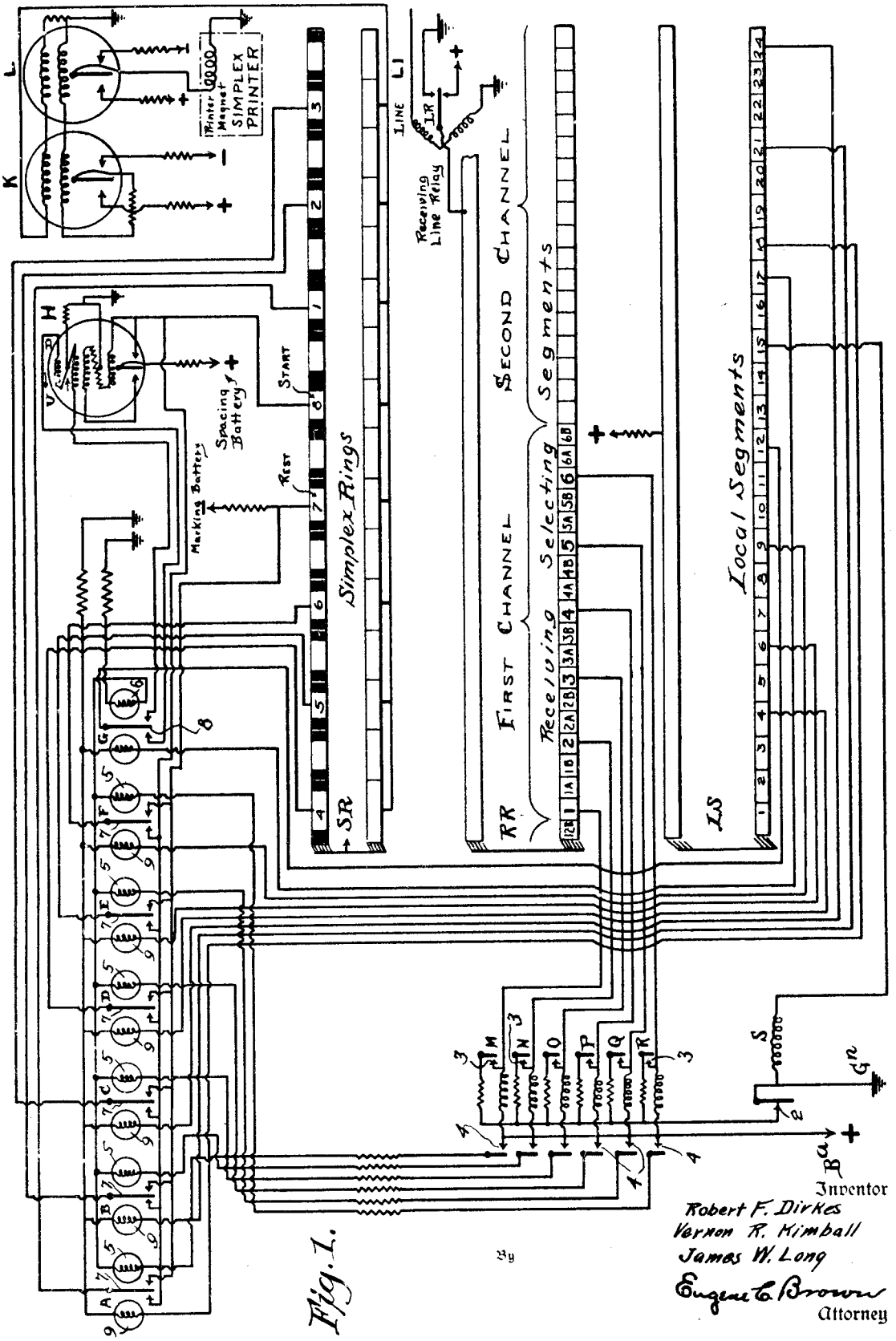

Fig. 1.

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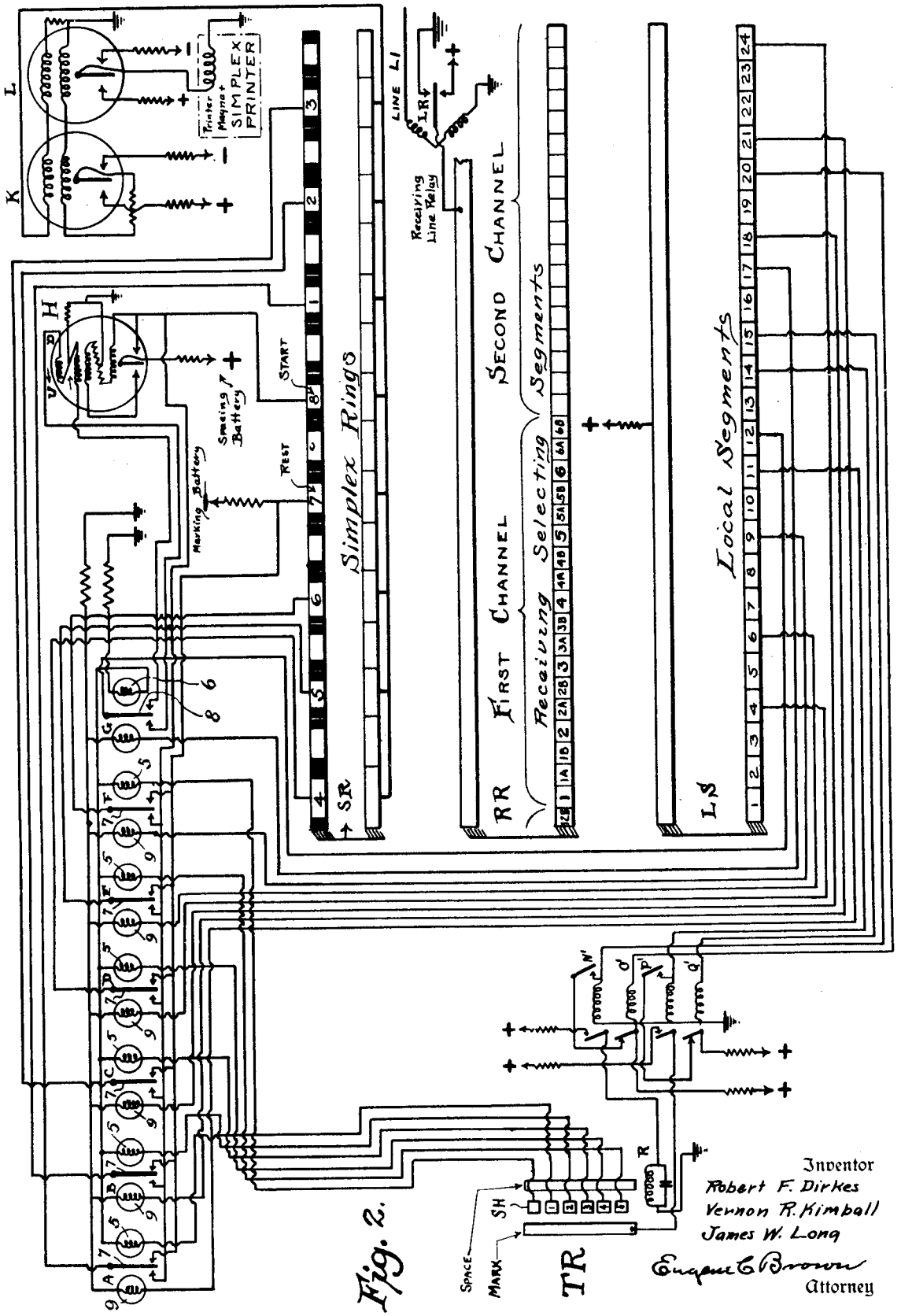

Fig. 2.

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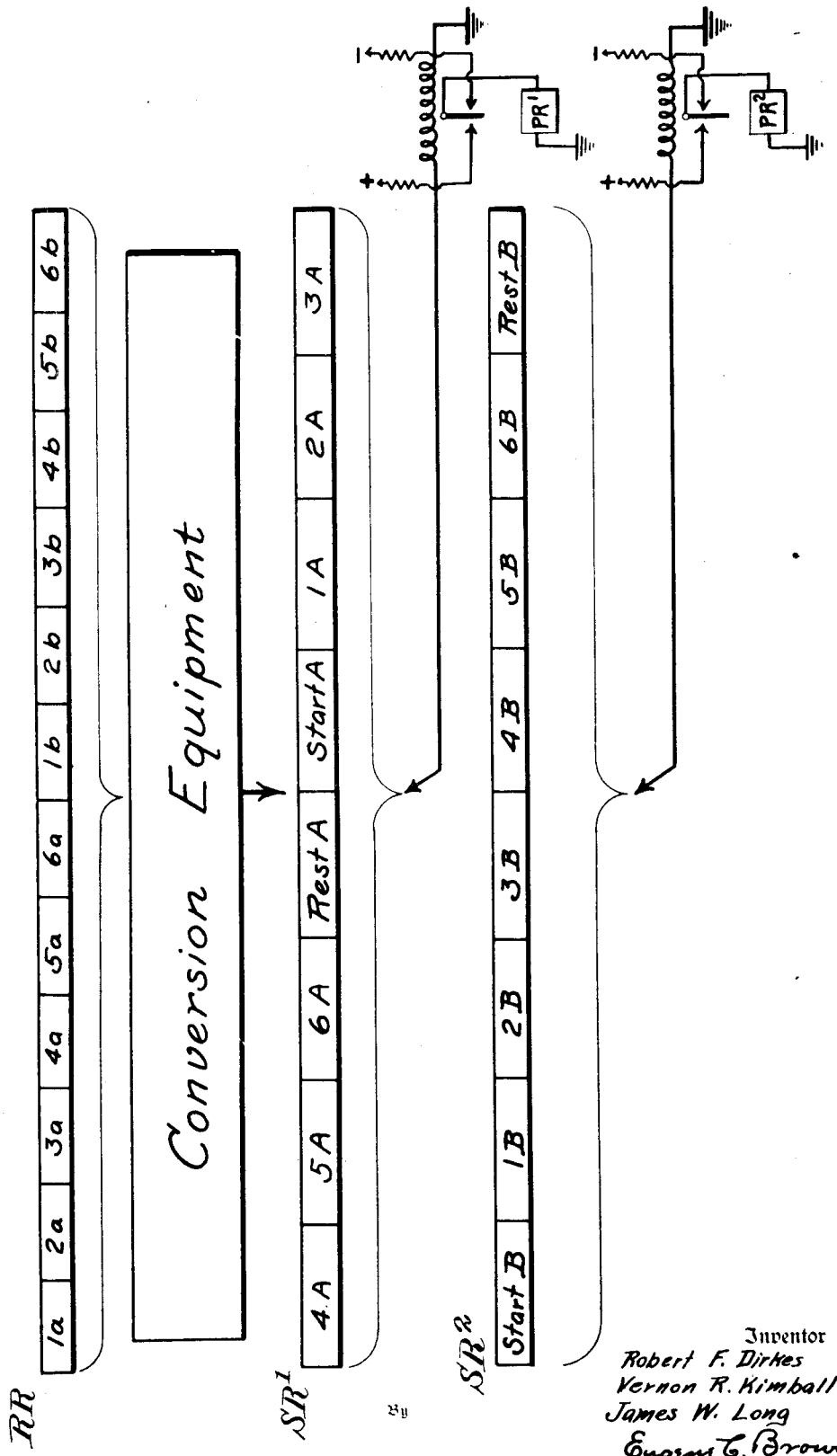
Fig. 3.



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UNITED STATES PATENT OFFICE

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OPERATING SIMPLEX PRINTERS IN A MULTIPLEX SYSTEM

Application filed August 18, 1928. Serial No. 300,570.

This invention relates to a multiplex telegraph system and in particular to a multiplex system in which simplex printers are operated from a multiplex circuit.

An object of this invention is to devise a system whereby simplex printers may be employed for receiving signals on the separate channels of a multiplex transmission circuit.

It is a further object of this invention to devise an arrangement wherein the signals for each channel of the multiplex circuit are stored and are retransmitted to simplex transmitters so that the transmission of each character in each channel occupies the whole time of one complete revolution of the multiplex distributor.

Multiplex telegraph signals are usually made up of six-unit code impulses comprising each character. The simplex printer requires, in addition to the character impulses, a start and a rest impulse. It is, therefore, an object of this invention to devise means for introducing the start and the rest impulses locally at the receiving station.

A further object of this invention is to provide means whereby the local start impulse will not be transmitted to the printer in case no signal is received over the line for that channel.

A further object is to devise means whereby the simplex printer is supplied with steady marking current so long as no signal is being received for the channel in which the printer is located.

It is a further object of this invention to provide means wherein intelligence signals originating in a transmitter unit of transmitting apparatus may be employed to regulate the polarity of the start signal of a start-stop system to make possible the sending of simplex signals from a transmitting apparatus employing a commutator or distributing device which is kept constantly rotating. This makes possible the sending of simplex signals from a phonic wheel distributor or other synchronous device, eliminating the slip clutch system now employed and the governed motor necessary with the clutch and thus providing constant speed of transmission.

Our invention is illustrated in the accompanying drawing in which—

Figure 1 is a circuit diagram of the invention applied to a six-unit multiplex telegraph system;

Figure 2 is a circuit diagram of the invention applied to a six-unit transmitting set; and

Figure 3 is a diagram illustrating the operation of the invention.

Referring to Fig. 1, L1 indicates a telegraph line from which mutiplex signals are received by a receiving relay LR. The tongue of the line relay is connected to the solid ring of a set of receiving rings RR on a multiplex distributor head, which also carries simplex rings SR and local segment rings LS. The upper and lower contacts of the receiving relay LR are connected respectively to ground and to positive battery. Segments 1 to 6 of the receiving rings RR are connected respectively through neutral relays M, N, O, P, Q and R to positive battery at B_a. Each of the neutral relays is provided with a contact 3 which closes a holding circuit for the relay from the positive battery at B_a, through the winding of the relay, through the contact 3, through a cooling resistance, through contact 2 of a release magnet S, to ground at G_n. This magnet S is also grounded at G_n and connected at the other terminal to segment 15 on the local segment rings LS. Neutral relays M to R are provided with additional contacts 4 which complete circuits respectively from the positive battery at B_a to the right-hand operating coils 5 of polar relays A, B, C, D, E and F. The remaining terminals of the right-hand operating coils 5 are connected together and are connected through a common circuit including the right-hand operating coil 6 of polar relay G to ground. One terminal of each of the left-hand operating windings of polar relays A to G is connected to ground, and the remaining terminals of these coils are connected respectively to segments 18, 21, 24, 4, 6, 9 and 17 of local segment rings LS. The solid ring of local segment rings LS is connected to positive battery as shown. The tongue 8 of polar relay G is connected to segment 12 of local segment rings LS. The

tongues 7 of polar relays A, B, C, D, E and F, are connected respectively to segments 1, 2, 3, 4, 5 and 6 of simplex rings SR. Alternate segments of the remaining ring of the simplex rings are connected by a common circuit through the operating winding of a relay K, and through the operating windings of a relay L to ground. The relay L is connected to the simplex printer PR. The right and left-hand contacts of polar relay G are connected respectively to the right and left-hand operating windings of a cut-off relay H. The right-hand contacts of polar relays A to F are connected together and are connected to rest segment 7 of simplex rings SR, which is also connected to minus battery. The left-hand contact of polar relays A to F are connected together and to the start segment 8 of simplex rings SR, which is also connected to the marking contact of cut-off relay H. The tongue of cut-off relay H is connected to positive battery.

The neutral relays M, N, O, P, Q and R serve to relay the signals received on the receiving rings RR to the polar relays A to F. The polar relays A to F serve to store the received signal impulses and retransmit them through the simplex rings SR to the simplex printer PR in such a manner that the time interval for sending one character is spread over the time of one complete revolution of the brushes. Relays G and H serve to determine or control the polarity of the start impulse supplied to the printer by simplex ring SR. Relays K and L are arranged to operate from the simplex rings in accordance with the signals furnished to them by polar relays A to F. Relay L is a sending-on relay from which the impulses are transmitted to the simplex printer PR. Relay K is a locking relay which serves to hold the relay tongue on the side on which it was thrown by the received impulse from its own channel while the brush on the simplex ring is passing over the segments of the remaining channels. Local segment rings LS serve to restore the neutral and polar relays to normal condition after each character.

Operation of Figure 1 is as follows:

The receiving relay LR is operated by incoming signals and thereby causes the tongue of the relay to supply impulses to the receiving segments corresponding to the signals being received. Due to the particular connection of the tongue of relay LR, it will be appreciated that line impulses are repeated by the line relay to the solid ring of the receiving rings RR. As is well understood by those skilled in the art, the signals are transferred from the solid ring to the receiving segments by the rotating brush associated with the receiving ring. It will also be understood that the brushes of the distributor head are rotated in synchronism with the transmitter at the transmitting station by means well known in the art.

Assume that the rotating brushes on the distributor head are at the left-hand end of the rings and are moving towards the right-hand end, and assume, further, that the character Y is being received from the line. Since Y is composed of alternate marking and spacing impulses, as the brush passes over the distributor head, receiving segments 1, 3 and 5 will receive marking impulses, and neutral relays M, O and Q will be operated to complete circuits respectively through the operating windings 5 of polar relays A, C, and E. At the same time, neutral relays M, O and Q will complete holding circuit through contacts 3 and battery B_a as described above, and will remain energized until release relay S is energized. The armatures 7 of polar relays A, C and E will be operated to the right-hand position, thereby impressing marking battery upon segments 1, 3 and 5 of simplex rings SR. The tongue of polar relay G is also operated to the right-hand position, since the operating coil 6 is connected in series with polar relays A to F, and is operated when one or all of these relays is energized. Relay G therefore actuates the tongue of cut-off relay H to the right-hand position when the brush of the local segment rings LS passes over segment 12, thereby placing positive battery upon the start segment 8 of simplex rings SR. As the brush of the simplex rings SR passes over the start segment 8, a positive or spacing impulse is transmitted to the printer PR through relays K and L to start the printer operating. Upon further rotation of the distributor brushes, the brush associated with local segment rings LS impresses a positive impulse upon segment 15, thereby operating release relay S and opening the holding circuits of neutral relays M, O and Q at contact 2. Upon further rotation of the brushes, marking impulses are transmitted to the printer PR as the brush associated with the simplex rings passes over contacts 1, 3 and 5. As the brush passes over the rest contact 7, a negative impulse is transmitted to the simplex printer to phase the printer mechanism as known by those versed in the art.

As soon as the marking impulse is transmitted to the printer from segment 1 of the simplex rings SR, the brush on the local rings LS makes contact with segment 18 to impress positive battery upon the left-hand winding 9 of polar relay A, thereby operating the tongue of relay A to the left-hand position. In a like manner, segments 21, 24, 4, 6 and 9 are connected to operate the tongues of polar relays B, C, D, E and F respectively to the left-hand position immediately after the transmission of impulses from segments 2, 3, 4, 5 and 6 of the simplex rings SR. Also, segment 17 is provided for returning

relay G to its spacing position after the start pulse has been transmitted. It is necessary that the return pulses for all the relays A to G actuate the relays as soon as possible after the associated signal is transmitted, and this is especially so in the case of relay G, as this relay armature must again be ready to travel to the right, should a marking impulse be received on the receiving segment 1.

Assume that no marking signal is received from line L1 for any of the six receiving segments. In this case it is necessary to eliminate the start pulse, and to provide for steady marking current in the printer line to keep the printer at rest. The latter condition is not always absolutely necessary, but most of the simplex printer systems used in this country rest on marking battery and start on spacing battery, thus making the inclusion of this feature desirable. As assumed above, if no marking signals are received on any of the six segments, neutral relays M to R will not be operated, and polar relays A to F in turn will receive no current and will remain in their spacing position. For the same reason, the relay G will remain on its left-hand contact, and the local impulse from segment 12 of the local rings LS will operate the cut-off relay H to the left or spacing position, thereby depriving the start segment 8 of simplex rings SR and the left-hand contacts of relays A, B, C, D, E and F of spacing battery. Thus, the tongues of relays A to F having no battery on them, and the right-hand contact of cut-off relay H being also deprived of spacing battery, the only available battery on the simplex segments is that on the seventh or rest segment, which supplies marking battery. The impulse supplied by this segment will throw the armatures of relays K and L to the right or marking positions, and inasmuch as no other impulse is left, and by virtue of relays K and L being polar relays and being locked-in by the tongue and right-hand contact of relay K, these relays will remain on the right-hand or marking contact until they receive a spacing impulse. Thus, a steady marking battery, which is the same as a rest battery, is sent through the printer magnet by relay L, and the printer remains at rest until a start or spacing impulse is again received by the magnet. As soon as one or more marking impulses are again received over the line L1 through any or all of receiving segments 1 to 6, one or more of relays A to F are again operated to the marking position, and the armature 8 of relay G will again be thrown to the right, after which the impulse from segment 12 of local rings LS actuates cut-off relay H to the right-hand position and again impresses spacing battery upon the left-hand contacts of relays A to F and upon the start segment 8 of the simplex rings SR. The start impulse transmitted by segment 8 will, therefore, set the printer into operation.

In Figure 1, we have shown only the circuit arrangements for operating one printer from one channel of the multiplex circuit. The second incoming channel will operate on the last group of segments on the receiving rings RR, and has corresponding spaced segments on the local rings LS and on the simplex rings SR. All the relays shown in connection with the first channel are duplicated for the second channel. The relay L of the second channel transmits to a separate printing mechanism over a different line from the one shown for channel one.

The time cycle of operation of the two channels is shown in Figure 3. In this figure RR indicates the receiving segment ring on the distributor head, and SR^1 and SR^2 indicate the simplex rings on the distributor head corresponding to channels A and B respectively. PR^1 and PR^2 indicate the printers associated with the two channels. From this figure, it will be seen that the signal transmitted over the channel A is stored in the conversion equipment during the first half revolution of the distributor head, and the signal transmitted over channel B is stored in the conversion equipment during the second half revolution. The stored signal from channel A is then transmitted from the conversion equipment to the printer associated with this channel during a complete revolution of the distributor head beginning immediately after the first half revolution. The stored signal from channel B is transmitted from the conversion equipment to the printer corresponding to this channel during a complete revolution of the distributor head beginning after the first complete revolution. It will be apparent to one skilled in the art that our invention may be applied to a multiplex system having more than two channels.

In Figure 2 we have shown our system applied to a six-unit transmitting set. In this arrangement, we have shown the transmitter TR as controlled by the contacts of a tape transmitter, but obviously the system could be applied to any of the standard and known forms of telegraph transmission. As in Figure 1, there is provided a set of polar relays A to G, and a control cut-off relay H, with a locking relay K, and a printer relay L. In addition, there is shown break and locking relays N', O', P', and Q' associated with the transmitter TR. The means of distribution of the signals and local impulses is again a distributor face-plate supplied with simplex rings and local segment rings as shown in Fig. 1. In this case, however, the receiving rings are not used inasmuch as the source of the signals is not in the line but in the transmitter TR.

Operation of Figure 2 is as follows:

Supposing the contacts SH 1, 2, 3, 4 and 5 to be controlled by a perforated tape or any

other of the known methods of control, and that selection is made by having these contacts travel to the left or marking side, and non-selection by having the contacts remain on the right or spacing side, we have on the selection of an impulse the connection through the tongues SH 1, 2, 3, 4 and 5, from the right-hand coils of polar relays A, B, C, D, E and F to the marking bus-bar. Let us suppose that the selection Y is to be sent. Tongues SH 2 and 4 remain on the right-hand or spacing bus-bar, while tongues 1, 3 and 5 move to the left-hand or marking bus-bar. This prepares a circuit from the contact of make-relay P′ through the marking bus-bar to the right-hand coils of relays A, C and E, and also through the right-hand coil of relay G as shown. Tongues SH 2 and 4, by virtue of being on the spacing side, make no circuit to the right-hand coils of their associated relays, namely, B, D and F and so relays B, D, and F are directly under control of their left-hand coils through the local segments as to be explained later. When the brushes pass over segment 11 of the local ring, relay P′ is energized and furnishes battery for all tongues on the marking bus-bar.

By virtue of the Y selection set-up as before explained, relays A, C and E, and also relay G, are actuated and their tongues travel to the right or marking side. Relay G as before explained, prepares, through its marking contact and tongue, a circuit to the right-hand coil of cut-off relay H. In this manner simplex ring segments 1, 3 and 5 are furnished with negative or marking battery, and a circuit is prepared so that on the passage of the local brush over segment 12, relays B, D and F will be furnished with positive or spacing battery, and start segment 8 will be furnished with battery of the same polarity. On the passage of the local brushes over a segment following 11, in this case shown as segment 14, relay Q′ is operated, which relay breaks the locking current on make-relay P′, which removes the battery from the marking bus-bar of the transmitter.

The tape transmitter is now ready to receive the following selection by advancing the perforated tape to the next character selection. As the brush passes over local ring segment 15, make-relay N′ closes a circuit which energizes transmitter magnet R, and steps the perforated tape to the next selection. Relay N′, being held energized long enough for the magnet R to be completely built up, is de-energized by the removal of the impressed locking current through relay O′, when the brush passes over local segment 20. In the manner before described, relays A, B, C, D, E, F and G are returned to their spacing side by reason of the local brush passing over segments 18, 21, 24, 4, 6, 9 and 17. The relays are again ready for operation and actuation of their tongues in accordance with the ensuing selection. As before, should the next selection sent through the tape transmitter be all spacing, that is, with no marking signals, it will of course be necessary to stop the actuation of the simplex printer. In this case all the tongues 7 of relays A to G will be on the left-hand or spacing side, and the impulse from local segment 12 now being sent through the left-hand contact of relay G, and through coil D—U, throws the tongue of cut-off relay H to the left, in which position the battery is removed from all left-hand contacts of relays A to F and from start segment 8. Thus, the only segment which can govern relays K and L by virtue of its being the only segment furnished with battery, is segment 7 or the rest segment. Inasmuch as this is minus or marking battery, we have again made a condition under which the printers will idle without actuation.

From the foregoing, it will be apparent that we have devised an arrangement in which the start impulse for the simplex printer is converted automatically from actuating polarity to non-actuating polarity or vice versa, depending upon the combination of signal impulses which are to be transmitted following the starting impulse. It will further be observed that we have developed a system in which the receiving arrangement is operated from a transmitting system of totally different synchronous characteristics, that is, a system in which a receiver of the type maintained in synchronism by start and rest pulses is operated from a transmitting system of the type in which synchronism is maintained by polarity changes of the signal pulses.

Referring again to Figures 1 and 2 it is obvious that the application of this invention to any of the so-called start-stop distributors would be simple.

Referring to Figure 1 let us suppose that in place of returning the signals through the simplex rings of the continuously rotating distributor face plate it would be desirable for some reason to relay these signals to the sending segments of a start-stoped distributor and from there to a line. It is obvious then that the only change neecssary to actuate this combination would be to connect the right hand contact of relay G to the start magnet of the start-stop distributor to ground and thus prepare a path for the surge from segment 12.

Upon the operation of the start magnet as above explained the distributor brushes would be allowed to rotate. This action would be repeated until it was desired to send no intelligence impulses to the receiving printers, when by the method before explained relay G would rest on its left-hand contact and no path would be made from

segment 12 to the start magnet and consequently, the start magnet receiving no impulse, the brushes will come to rest on the rest segment and the receiving printers cease actuation.

Referring to Figure 2 let us suppose that it is desired from some reason to send signals from an automatically operated transmitter using a start-stop distributor in place of the constantly rotating distributor as explained in the above text. In this case it is obvious to those versed in this art, that the pulse from segment 11 as shown in Figure 2 could be utilized to set up the relay G on or about the time the brushes pass over the rest segment, and that then a circuit from battery through the tongue and right hand contact of relay G could operate the start magnet on the start-stop distributor and thus approximate the action as explained above.

It is obvious, however, that neither of these two latter explained methods is as good as the methods previously described, due of course to the varying brush speed which is characteristic of this type of mechanism.

While we have shown our invention as applied to a multiplex system employing a six-unit code, it is obvious that it may as easily be applied to any form of synchronous reception, and the six-unit multiplex system has been shown for the purpose of illustration only.

We claim:

1. In a telegraph system, the combination of a multiplex transmission circuit, a continuously operating distributor for separating the signals into separate channels, means in each channel for storing the received signal, a simplex printer for each channel and means operated by said distributor for supplying the stored signals to the printers during a complete revolution of the distributor.

2. In a telegraph system the combination of a multiplex transmission circuit, a rotary distributor for separating the signals into separate channels, means in each channel for storing the received signal, a simplex printer in each channel, means operated by said distributor for producing start and rest impulses for the printer, and means associated with said distributor for supplying the stored signals to the printer during a complete revolution of the distributor.

3. In a telegraph system, a multiplex transmission circuit in which the signals transmitted comprise equal-impulse code combinations, a distributor for separating the successive combinations into separate channels, means in each channel for storing the received combinations, a simplex printer for each channel, means controlled by the distributor for producing start impulses for the printers after each combination stored, means associated with the distributor for supplying the stored combinations to the printers, and means controlled by the distributor for transmitting a rest impulse to each printer after the transmission of each combination.

4. In a telegraph system, a multiplex transmission circuit in which signals for the different channels are transmitted in rotation, a receiving distributor for separating the signals into separate channels, means in each channel for storing the received signal, a simplex printer for each channel, means including said distributor for transmitting a start impulse to each printer after a signal is stored, and means including said storing means for preventing the transmission of the starting impulse when no signal is received.

5. In a telegraph system, a multiplex transmission circuit in which the signals transmitted comprise equal-impulse code combinations, a distributor for separating the successive combinations into separate channels, means in each channel for storing the received combinations, a simplex printer for each channel, means controlled by the distributor for producing start impulses for the printers after each combination stored, means associated with the distributor for supplying the stored combinations in each channel to the respective printers during one complete revolution of the distributor, and means controlled by the distributor for transmitting a rest impulse to each printer after the transmission of each combination.

6. In a telegraph system, a multiplex transmission circuit in which signals for the different channels are transmitted in rotation, a receiving distributor for separating the signals into separate channels, means in each channel for storing the received signal, a simplex printer for each channel, means including said distributor for transmitting a start impulse to each printer after a signal is stored, means in each channel and controlled by said distributor for supplying the stored signal to the printer over a complete revolution of the distributor, and means including said storing means for preventing the transmission of the starting impulse when no signal is received.

7. In a telegraph system, a multiplex transmission circuit in which the signals transmitted comprise equal-impulse code combinations, a receiving distributor for separating the successive combinations into separate channels, a smplex printer for each channel, and local means including said distributor for generating start and rest impulses for each printer.

8. In a telegraph system, a multiplex transmission circuit in which the signals transmitted comprise equal-impulse code combinations, a distributor for separating the successive combinations into separate channels, means in each channel for storing the received combinations, a simplex printer

for each channel, means controlled by the distributor for producing start impulses for the printers after each combination stored, means associated with the distributor for supplying the stored combinations in each channel to the respective printers during one complete revolution of the distributor, means controlled by the distributor for transmitting a rest impulse to each printer after the transmission of each combination, and means in each channel controlled by said storing means for preventing the transmission of the start impulse when no combination is stored.

9. The method of controlling a start-stop printing receiver or simplex printer from a continuously rotating commutator or distributing device, which consists in controlling the polarity of the start impulse through the medium of the code selections.

10. The method of operating a start-stop system employing a continuously rotating sending distributor device, which consists in controlling the start pulse by the character of the selected intelligence impulses about to be transmitted.

11. The method of operating a start-stop printing mechanism from a synchronous or other constant speed distributor or commutator employing a constantly rotating element which consists in controlling the operation of the receiving start-stop element from the code transmitting element of the distributor.

12. In a telegraph system, the combination of a constant speed distributor having a constantly rotating element, a start-stop printing receiver having a start-stop element, and means operated by said distributor for controlling the operation of said start-stop element.

13. In a telegraph system, the combination of a constant speed distributor having a constantly rotating element, a start-stop printing receiver having a start-stop element, and means associated with the distributor and controlled by the intelligence portion of the signal selections for determining the operation of said start-stop element.

14. In a start-stop telegraph system, means for actuating a simplex printer from an automatically controlled transmitting unit and means for arresting the action of the transmitter so as to send rest impulses to the printer when no "intelligence" impulses are to be transmitted.

15. In a telegraph system, the combination of a multiplex transmission circuit, a rotary distributor for separating the signals into separate channels, means for storing said impulses for each channel, a start-stop distributor for each channel, the starting of said start-stop distributor being controlled by the intelligence portion of signal selections and a simplex printer for each channel operated from said start-stop distributor.

16. In a start-stop telegraph system, a plurality of contacts adapted to be positioned in accordance with a predetermined coding, a continuously operating rotary distributor for transmitting impulses over a line in accordance with the positions of said contacts, means for extending a start impulse to the start segment of said distributor when one or more of the contacts are actuated and means for preventing a start impulse from being transmitted by the rotary distributor in the event that none of the contacts are actuated.

17. In a start-stop telegraph system, a plurality of tape controlled elements adapted to occupy one position or another depending upon perforations in a tape, a rotary distributor for transmitting impulses over a line in accordance with the positions of the said elements, means for extendng a start impulse to the start segment of said distributor when one or more perforations appear in the tape at its operative position, and means for preventing a start impulse from being transmitted by the rotary distributor in the event that no perforations appear in the tape at its operative position.

18. In a start-stop telegraph system, a plurality of tape controlled elements adapted to occupy one or another position in accordance with perforations in a tape, a rotary distributor for transmitting impulses over a line in accordance with the positions of the tape-controlled elements and means controlled in accordance with the condition of the tape for controlling the transmission of a start impulse by the rotary distributor.

In testimony whereof, we affix our signatures.

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JAMES W. LONG.