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MULTIPLEX CHANNEL REPEATER SYSTEM

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MULTIPLEX-CHANNEL REPEATER SYSTEM.

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This invention relates to multiplex telegraph repeater systems and comprises means whereby telegraph messages received at a central station over a multiplex system may be automatically repeated to the branch office for which it was intended.

According to present practice the incoming telegraph business of a large city is received at a large central office from which it is distributed to various branch offices by means of Morse wires, telephone or pneumatic tubes. In each instance this involves a second handling of the messages thereby incurring added cost and introducing the possibility of error.

When the volume of business between a main office in one city and a branch office in another city is sufficient to warrant the expense, a multiplex system is installed. However, there are many instances where the volume of business is only sufficient to fill a single channel of the multiplex. In such cases it would be very desirable if the messages transmitted over one of the several channels joining the main offices in the two cities could be repeated automatically to the branch office, thus relieving the main office of the work and transferring it to the branch office which is its ultimate destination.

The object of our invention is to devise a system for carrying out the functions above mentioned by means of apparatus having a low initial cost and requiring a minimum of maintainance expense. This apparatus may be applied to any of the multiplex channels at either or both ends.

In the following description, we shall refer to the accompanying drawing in which it will be noted that two line wires are shown between the main and branch offices. It is evident, however, that a single duplexed line may be employed though for short distances it is more economical to use two wires, thereby avoiding the use of duplex balancing apparatus.

The drawing illustrates diagrammatically a multiplex system having three channels A, B and C. The five segments of channel B of the sending distributor SD at station A, are shown connected to the tongues of a transmitter T which may be of the well-known type disclosed in Benjamin Patent No. 1,298,440. The main line ML connecting the line relays LR at main stations is shown duplexed at either end. The signals transmitted from station A over channels A and C are recorded by the usual printers connected to the corresponding segments of the receiving distributer RD^2 at station B in accordance with the well known multiplex practice. The signals sent over the B channel are automatically repeated at station B and transmitted to the branch office where they are recorded by the printer PTR.

At station B, the segments of the B channel of the receiving distributer RD^2 are connected respectively to the five polarized relays PR, one terminal of each relay being connected to the middle point of a potentiometer *pt*. It is evident that any combination of signals sent out by the transmitter T over the B channel will be received on the segments of the B channel of the receiving distributer RD^2 at station B, and will be set up on the polar relays in an exact duplicate of the original transmitter combination. The tongues *t* of these five relays are connected respectively to five segments of a start-stop distributer S—SD whose solid sending ring is connected to the receiving line RL leading to the line relay LR^2 at the branch office.

Now assuming that the proper phase and speed relations exist between the multiplex and start-stop distributers, it is evident that as the brushes of the start-stop distributer pass over the segments, the combination stored in the bank of polar relays PR, will be retransmitted from the line battery LB, to the branch office where they are received on the segments of the receiving distributer RD^3 and transmitted to the selecting magnets of the printer PTR and thereby recorded.

In order that the tongues of the relays may operate and settle firmly on their contacts before the signals are repeated, the start-stop distributer brush is stopped on the rest segment R until the relays have received the signal impulses of the combination. Thereafter a brush b^2 on the multiplex distributer RD^2 closes a circuit through a segment s^2 on a local ring which actuates the start magnet SM, thus releasing the brush b^2 of the start-stop distributer S—SD. The speed of this brush must be greater than that of the multiplex brushes so that it will have passed off of the segment connected

to a relay before that relay is again operated. The phase relation between the multiplex and the start-stop apparatus is automatically established since the start-stop distributer is controlled by a local segment on the multiplex distributer. When the brush b^3 moves onto the sending segment S, an impulse is sent over the line RL, actuating the line relay LR^2 at the branch office and causing its armature to close a circuit from local battery through the brushes b^4 and segments R of the receiving distributer RD^3 to energize the start magnet SM^2. The brushes normally bear on the rest segments R when they are arrested by the armature-catch of the stop magnet. When the brush arm is released by the start magnet the brushes move over the segments in synchronism with the brushes on the start-stop distributer S—SD and thereby set up on the five selector magnets of the printer PTR, the combination which was locked up on the armatures of the magnets PR at station B. As the brushes pass over the last segment on the distributer RD^3 a circuit is closed from a local battery to energize the printer magnet PM, thereby recording the signal transmitted, from station A over the B channel of the multiplex between the main stations and automatically repeated from station B to the branch office by means of the start-stop distributers.

Messages may also be sent in the reverse direction from the branch office to main station A, being automatically repeated at main station B into the B channel of the multiplex between the main stations. The arrangement of the apparatus is diagrammatically shown in the lower part of the figure.

The transmitter T^2 at the branch office is connected to the sending segments of a start-stop distributer $S—SD^2$ the solid ring of which is directly connected to the branch office sending line SL. The brushes b^5 of the distributer rest upon the segments R when the brush arm has been arrested by the armature-hook of the start magnet SM^3. When the sending brushes b^5 are released the combination of signal impulses set up on the transmitter T^2 are transmitted over the branch line SL and are selected by the line relay LR^4 and the segments of the start-stop distributer $S—SD^3$ at the main station B and caused to operate a bank of polar relays PR^2, in the same manner as previously described for the transmission in the opposite direction.

The tongues t of these five polar relays PR^2 are connected to the five sending segments of the B channel of the multiplex distributer RD^4, so that as the brushes pass over these segments the combination of signal impulses sent from the branch office is sent over the multiplex line ML and received in the usual manner by the line relay LR, the tongue of which transmits the corresponding impulses from its local battery to the segments of the B channel of the receiving distributer RD, from whence the signals are set up on the selecting magnets of the B channel printer PTR as usual and as outlined above in describing the reception of signals at the branch office. In this manner the messages transmitted from the branch office are repeated at the main station B and sent over the B channel of the multiplex and recorded at station A on the printer of the B channel.

It is evident that some provision must be made for timing the motion of the tongues of the relay magnets PR^2 so that each combination of signal impulses will be set up before they are repeated into the multiplex B channel. This is accomplished by controlling the start of the sending brush b^5 at the branch office from a local segment on the multiplex distributer RD^4 at main station B in the same manner as previously described for the transmission in the opposite direction. It is obvious that it would be impractical to run a third line between main station B and the branch office for the sole purpose of furnishing this start impulse. We therefore provide means for transmitting this start impulse as an increment over the branch office sending line SL. A Morse relay MR at station B, actuated by the passing of a brush b^8 over a local segment on the multiplex distributer RD^4, short-circuits a resistance r in the branch office sending line, thus momentarily increasing the line current. A second Morse relay MR^2 located at the branch office is adjusted so that it is non-operative on the normal line current but responds to this increased value. When the latter relay operates by virtue of the increased increment of line current, it closes a circuit through the sending start magnet SM^3 which releases the sending brushes b^5. In this manner the start-stop system for the outgoing messages from the branch office is held in a definite fixed phase relation with respect to the multiplex system between the main stations. The repeating polar relays PR and PR^2 are designed to retain a small amount of residual magnetism and will bias with each received impulse to hold the tongues against the contacts without the aid of a locking circuit, the bias from an impulse being retained until a reverse impulse is received.

Operation of the start-stop system conforms in the main to other standard systems, but in our present system the receiving brush does not necessarily run faster than the sending brush. This is made possible by the fact that the sending brushes are stopped, which gives the receiving brush time to catch up with the sending brush while it is stopped. It will be noted from the theoretical circuits shown in the drawing that the receiving start

magnets can only be energized when a "marking" impulse is received with the receiving brushes in their rest position. When the sending brush b^3 stops, "spacing" polarity of battery LB is transmitted over the branch line RL, holding line relay LR^3 against its back contact, and consequently the receiving start magnet SM^2 is not energized, and the receiving brush b^4 of distributor RD^3 is stopped on the rest segment R. When the sending brush b^3 is released by start-magnet SM and passes onto the start segment S, a "marking" impulse is transmitted over branch line RL. This operates the line relay LR^2 at the other end of the start-stop system which closes a circuit from battery through its marking contact, the brushes of the receiving distributer and the start magnet SM^2, which withdraws its armature-hook from the brush-arm and permits the brushes to start.

The speeds of the two start-stop distributers S—SD and RD^3 are adjusted as closely as possible to the same value. The sending brush b^3 when released transmits a start pulse which releases the receiving brush b^4 at the other end. Both brushes then make one revolution and stop ready to be started again in the same way. This means that at the beginning of each revolution the sending brush and its corresponding receiving brush start in a true phase relation and even though the two speeds be somewhat at variance, they do not get far enough out of synchronism during one revolution to prevent proper operation.

We claim—

1. In a telegraph system, a plurality of stations, a multiplex synchronous system connecting two of said stations, a start-stop system extending from one of said stations to a distant station, said start-stop system embodying independently actuated rotary distributors designed to operate at substantially the same speed, means for transmitting code combinations of impulses over said multiplex system, means for automatically repeating said impulses from said multiplex system to said start-stop system, means controlled by the multiplex apparatus for releasing the start-stop distributor at the repeating station, and means controlled by said last-mentioned distributor for releasing the start-stop distributor at the distant station.

2. In a telegraph system, a plurality of stations, a multiplex synchronous system connecting two of said stations, a start-stop system extending from one of said stations to a distant station and embodying rotary distributors actuated independently of the signal impulses and operating in substantial synchronism, means for transmitting code combinations of signal impulses over said multiplex system, means for automatically repeating said impulses from said multiplex system to said start-stop system, means controlled by the multiplex apparatus at the repeating station for releasing the start-stop distributor at that station, and means controlled by said last-mentioned distributor for releasing the start-stop distributor at the distant station.

3. In a telegraph system, a plurality of stations, a multiplex synchronous system connecting two of said stations, a start-stop system extending from one of said stations to a distant station and embodying rotary distributors actuated independently of the signal impulses and operating in substantial synchronism, means for transmitting code combinations of signal impulses over said start-stop system, means for automatically repeating said code signal impulses from said start-stop system to said multiplex system, means controlled by the multiplex apparatus at the repeating station for releasing the start-stop distributor at the distant station, and means controlled by said last-mentioned distributor for releasing the start-stop distributor at the repeating station.

4. In a telegraph system as set forth in claim 3, said means for releasing the start-stop distributor at the distant station embodying means responsive only to an abnormal current.

5. In a telegraph system, a plurality of stations, a multiplex synchronous system connecting two of said stations, a start-stop system extending from one of said stations to a distant station, means for transmitting message impulses over said multiplex system, means for transmitting message impulses over said start-stop system, and means for simultaneously transferring message impulses from said multiplex system to said start-stop system and from said start-stop system to said multiplex system, each of said last two means embodying a set of polar relays for locking up the signal impulses between the multiplex and the start-stop system, said start-stop system embodying rotary distributors actuated independently of the signal impulses.

In testimony whereof we affix our signatures.

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