

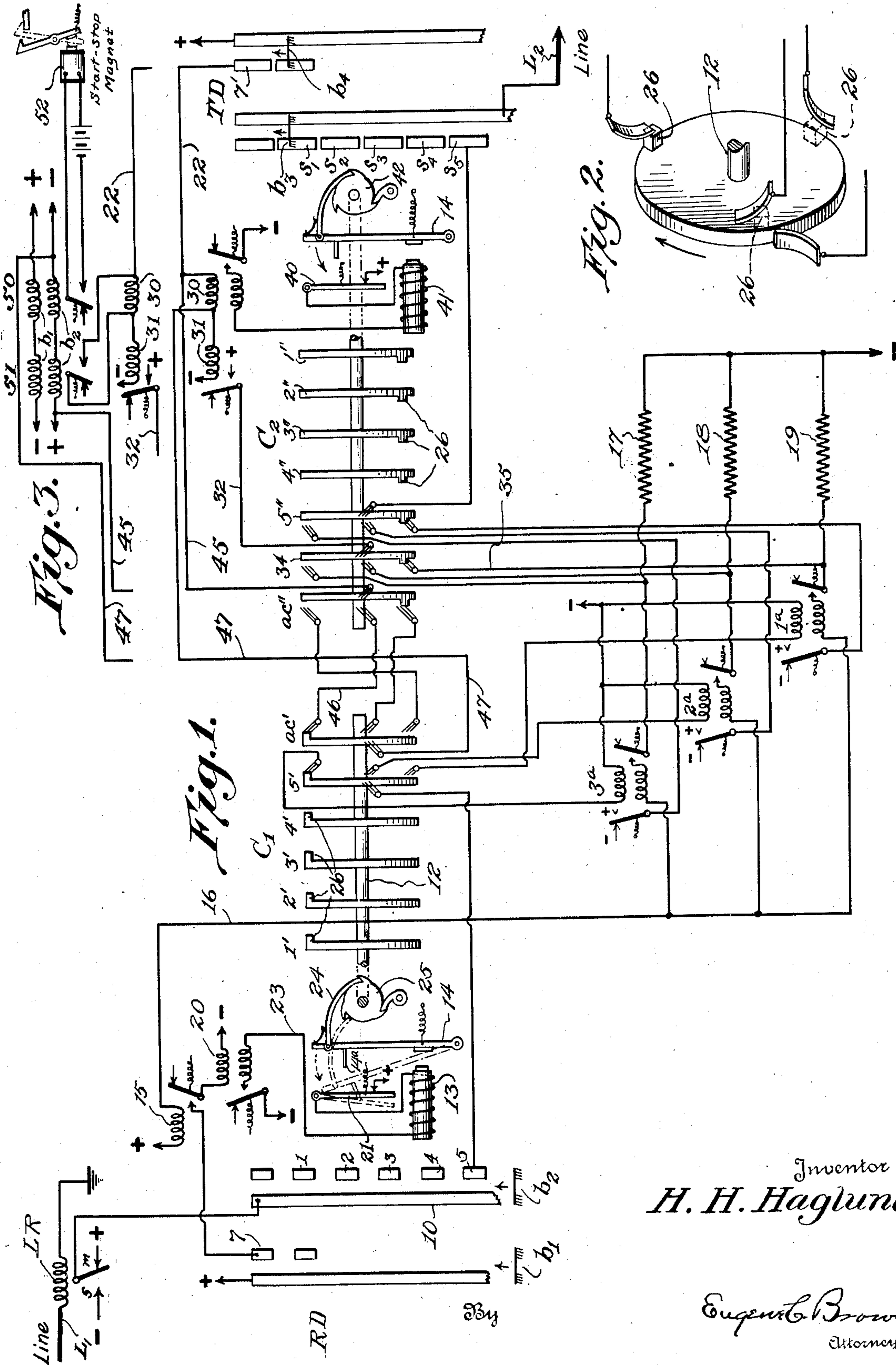
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CHANNEL REPEATER FOR TELEGRAPH SYSTEMS

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CHANNEL REPEATER FOR TELEGRAPH SYSTEMS

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This invention relates to automatic telegraph systems and particularly to means for automatically repeating messages from a channel or channels of a multiplex circuit or similar system into a channel or channels of another circuit without the necessity of maintaining the distributors of said circuits in synchronism.

The object of the invention is to provide a repeating mechanism which will receive the code messages from the receiving distributor, store them momentarily and transfer them to a sending-on transmitting distributor which may operate at a different speed from that of the receiving distributor.

Since this mechanism is concerned only with each individual channel, it may be used to repeat one channel of a three-channel circuit into one channel of a four-channel circuit or any other similar combination. It may be used to repeat a channel from a multiplex circuit into a start-stop system or vice versa. It is therefore suitable for extending one channel of a multiplex circuit which interconnects two cities, such as New York and Chicago, into a private office where this channel may be operated as a private wire, permitting the remaining channels on the New York-Chicago circuit to be operated for general business; or said other channels may be repeated by means of channel repeaters into other private offices or perhaps into another multiplex line as from Chicago to San Francisco.

Besides the flexibility gained through the use of this repeater, gain in speed on long circuits is also possible by means of such a repeater; for example, New York-San Francisco circuits working synchronously through eleven universal or duplex repeaters and one rotary repeater, work at a frequency of about twenty-two cycles. New York-Kansas City and Kansas City-San Francisco circuits, which are approximately half as long as the direct New York-San Francisco circuit, work at almost twice the frequency of the long circuit. This is primarily due to the fact that the distortion is added up in the long circuit and although it is partially compensated for by rotary repeaters, enough rotary repeaters cannot be conveniently installed to offset this loss. If, instead of working New York to San Francisco direct with synchronous repeaters, the circuit is broken at Kansas City and repeated through channel repeaters, thus cutting the distance over which synchronism must be maintained in half, a considerable increase in speed may be obtained.

In the following description I shall refer to the

accompanying drawing, in which Figure 1 is a schematic illustration of one arrangement embodying my invention;

Figure 2 is a fragmentary perspective view of commutator disk and associated brushes of the repeater; and

Figure 3 is a fragmentary diagram showing a modification showing a start-stop arrangement applied to the repeating or sending distributor.

On the left hand side of Figure 1 are shown the receiving and local rings of a receiving multiplex distributor RD and on the right hand side the sending and local rings of a multiplex transmitting distributor TD. Between the distributors is shown the commutating mechanism and associated storage relays which serve as the intermediary between the non-synchronous distributors.

The incoming main line L_1 terminates in the polar line relay LR. The tongue of the relay is connected to the solid receiving ring 10 of the distributor RD.

The left hand or receiving portion of the commutating mechanism RC comprises five selecting commutators and auto-stop control commutator carried by a shaft 12 which is actuated by a stepping device under the control of a stepper magnet 13. The right hand or sending portion of the commutating mechanism comprises five transmitting commutators, one resetting commutator and one auto-stop control commutator. I have only shown one receiving and one sending commutator connected to the distributors and to the cooperating selecting storing relays, but it will be understood that the four left-hand commutators on the receiving device and the four right hand commutators on the sending device are connected in the same manner to corresponding sets of selecting storing relays.

The operation is as follows:—Assume that the brushes b_1 , b_2 are moving upward over the rings of the receiving distributor RD. When the receiving brush b_2 contacts with segment 5, a circuit is closed from plus battery through the tongue of receiving line relay LR, solid ring 10, brush b_2 , segment 5, selecting commutator 5', selecting relay 3^a to negative battery. The operation of relay 3^a closes a circuit from plus battery, through the winding of sixth pulse relay 15, conductor 16, the locking winding and right hand tongue of relay 3^a, and high resistance 17 to negative battery. Operation of sixth pulse relay 15 connects segment 7 of the local distributor ring to negative battery through the tongue of relay 15. As the distributor brushes

continue over the receiving segments 4, 3, 2, 1, the selecting relays associated with the corresponding commutators 4', 3', 2', 1', (not shown) are selected in the same manner. When the brushes have passed over the five selecting segments of the distributor ring, the local brush b_1 contacts with local segment 7, thereby closing a circuit through the main winding of the stepper relay 20. The operation of relay 20 closes a circuit from plus battery through the contact and lever 21, winding of stepper magnet 13, conductor 23, locking winding and tongue of stepper relay 20 to negative battery. As the armature 14 of stepper magnet 13 completes its stroke, the lug 14^a engages the lever 21 and brakes the circuit which releases the stepper magnet 13 and stepper relay 20. As the armature 14 is retracted by its spring, the pawl 24 engages a tooth on the ratchet wheel 25, thereby turning the shaft 12 and rotating the receiving commutators through one-third of a revolution, thus causing the contact lugs 26 on each commutator to move from the upper brush and to engage the bottom brush of each set as indicated in Fig. 2.

During the time the brush b_2 is rotating over the five selecting segments of the receiving distributor RD, the sending brush b_3 is moving upward over the corresponding segments of the transmitting ring of the transmitting or sending distributor TD. The sending brush b_3 is assumed to be almost two revolutions behind the receiving brush b_2 of the receiving distributor RD. When the brush b_3 passed over the segment S_5 a pulse of negative polarity was transmitted from the left hand tongue of selecting relay 1^a through transmitting commutator 5'' to the line L_2 . Impulses were likewise transmitted to line L_2 from the corresponding sending commutators as the brush b_3 passed over segments 4'', 3'', 2'' and 1''.

When the local sending brush b_4 contacts with local segment 7', a circuit is established from plus battery, through solid sending local ring, brush b_4 , local segment 7', conductor 22, windings of stepper relay 30, and reset relay 31 to negative battery. Operation of the reset relay 31 establishes a circuit from plus battery on its front contact through its tongue, conductor 32, through reset commutator 34, conductor 35, and resistance 19 to negative battery. Since selecting relay 1^a had not been energized no function is performed by this circuit, but if this selecting relay 1^a had been previously selected and thereby locked up, this operation of the reset relay would have unlocked selecting relay 1^a, due to the fact that the same potential was applied to both sides of the coil.

The stepper relay 30 operates simultaneously with the reset relay 31 and locks itself over a circuit from plus battery through lever 40, stepper magnet 41, locking coil and armature of stepper relay 30 to negative battery. Stepper magnet 41 of the transmitting apparatus operates exactly in the same manner as stepper magnet 13 of the receiving apparatus. It unlocks itself and rotates its ratchet 42 so that the raised portion 26 of each commutator leaves the upper brush and contacts with the corresponding center brush of the set of three brushes cooperating with each commutator.

As long as the signals are being received at the same rate that they are being sent, the channel repeater will continue to operate as above described, receiving a combination of impulses from the incoming line L_1 on one set of selecting relays and retransmitting this combination about

two revolutions of the rotary distributor later into the succeeding line section L_2 .

If for any reason the incoming signals should come in at a slower rate than they are retransmitted to the outgoing line, or if no signals should be received for an interval, the transmitting commutator will overtake the receiving commutator. This condition will be brought about if the receiving commutator remains in the position shown and the transmitting commutator is rotated until the lugs 26 engage the middle brush of each set.

Let us assume for the sake of description, that the receiving commutator is stopped in the last mentioned position with the contact lugs 26 engaging the upper brush of each set and with no signals being received over the line L_1 . As none of the selecting relays have been operated, the sixth pulse relay 15 remains unoperated and its contacts are open. No local pulses are therefore sent to the stepper relay 20 and hence the selecting commutators C_1 remain in the same position. The last previously selected combination has been transmitted from the selecting relays 1^a associated with the commutators C_1 and the transmitting commutator C_2 has been stepped into the position where the contact lugs 26 make connection with the central position brushes of each set. Since all of the relays are on their spacing or back contacts, spacing signal is being transmitted continually into the outgoing line L_2 , as the sending ring brush b_3 travels over the sending segments of the distributor TD. Whenever the local brush b_4 engages its local segment 7', the reset relay 31 is operated, but as previously described, the operation of this relay performs no function when the selecting relays are already in their spacing position. Under these conditions the stepper relay 30 does not function as before, due to the fact that when the transmitting commutator C_2 overtakes the receiving commutator C_1 , a circuit is formed through the auto-control commutator disks ac' , ac'' , which short circuits the stepper relay coil 30. This circuit may be traced from plus battery through local brush b_4 , local segment 7', conductor 45, middle brushes of auto-control commutator ac'' of the transmitting mechanism (which, as has been assumed, are connected to the contact lug of the auto-control disk), conductor 46, upper brush of the auto-control commutator ac' , which is now in engagement with the contact lug 26 on the auto-control commutator disk, conductor 46, back to the left hand connection of the stepper relay coil 30 and through coil 31 to negative battery. Due to this short circuit around the stepper relay 30, the transmitting commutators C_2 also remain stationary as long as no signals are being received.

When, however, a signal combination is received on the incoming line L_1 , the sixth pulse relay 15 is again energized and the receiving stepper relay 20 can operate, thereby causing the step-by-step rotation of the selecting commutators C_1 . This in turn opens the shunt through the auto-control commutators so that the transmitting commutators C_2 are again free to be stepped around in the manner described.

It is not essential to my invention that the distributors should operate continuously. My channel repeater is only a storing device which receives the signals from one distributor and retransmits them through another distributor and it is immaterial, therefore, whether these dis-

tributors are maintained in continuous synchronism or whether they are of the start-stop type. I have shown in Fig. 3, an arrangement having a relay connected in the auto-control circuits in such a manner that the sending distributor, provided with a start-stop device locks up as soon as the auto-control mechanism is operated. When the auto-control function is released, the start-stop device again permits the distributor to rotate.

In the modification shown in Fig. 3, I employ two biased relays 50 and 51 to control the operation of the stepper relay 30 and the reset relay. Each of the biased relays is provided with oppositely operating windings. When the auto-control circuit *ac'* is open, the windings *b₂* overcome the effect of windings *b₁* and throw the armatures of relays 50 and 51 to the left-hand side; and when the auto-control circuit closes a circuit through the conductors 45 and 57, thus short-circuiting the windings *b₂*, the windings *b₁* move the armatures to the right hand side. The relay 51 thus short-circuits the stepper relay 30, and the relay 50 closes a circuit which energizes the start-stop magnet 52 and stops the retransmitting distributor TD. In this manner the distributor TD which repeats into line *L₂* is stopped by the auto-control mechanism when no signals are received by the receiving distributor and is again started when signals are resumed.

I have described two arrangements in which my channel repeater may be embodied but it will be evident to engineers that other modifications may be made within the purview of the invention.

I claim:

1. A retransmitting apparatus comprising a receiving current distributor, a plurality of relays adapted to be selectively actuated by current impulses associated therewith, a transmitting current distributor operating non-synchronously with said receiving distributor, commutating mechanism interposed between the receiving distributor and said relays and controlled by the receiving distributor, and commutating mechanism interposed between said relays and the transmitting distributor and controlled by transmitting distributor.

2. In a retransmitting apparatus as set forth in claim 1, the brushes of said transmitting distributor operating at a greater speed than the brushes of said receiving transmitter and being normally in excess of a revolution behind the former.

3. In a retransmitting apparatus as set forth in claim 1, the brushes of said transmitting distributor operating at a greater speed than the brushes of said receiving distributor and being normally in excess of a revolution behind the former and means associated with said mechanism for arresting the operation of the commutator associated with said transmitting brushes when their position relative to the receiving brushes approaches within a predetermined distance thereof.

4. A retransmitting apparatus having a receiving distributor connected to one line section, a transmitting distributor connected to another

line section, commutating mechanism and impulse storing devices associated with said distributors, said transmitting distributor operating at a greater speed than the receiving distributor and means for arresting the operation of the communicating mechanism associated with said transmitting distributor at intervals dependent upon the different rates of speed of the distributors.

5. A retransmitting apparatus having a receiving distributor connected to one line section, a transmitting distributor connected to another line section, and means intermediate said distributors for storing the received impulses and releasing said impulses to the transmitting distributor at intervals dependent upon the different rates of speed of the distributor brushes and their phase difference.

6. A telegraph system for relaying signal current impulses comprising a telegraph line divided into sections; and a relaying apparatus interposed between adjacent sections including a continuously operating current distributor associated with one section, a plurality of relays cooperating therewith to be selectively acted upon by a plurality of current impulses, holding circuits for said relays, a source of relaying current, a continuously operating current distributor interposed between said source and another section of said line, a commutator interposed between said relays and said first named distributor, operating step-by-step under control thereof, and a commutator interposed between said relays and said second named distributor, operating step-by-step under control thereof to release said holding circuits.

7. A telegraph system for relaying signal current impulses comprising a telegraph line divided into sections; and a relaying apparatus interposed between adjacent sections including a current distributor associated with one section operating in synchronism with the received impulses, a current distributor associated with an adjacent line section operating continuously at a speed greater than said first named distributor, step-by-step commutating mechanism and storing relays interposed between said distributors for transferring impulses received by the first-named distributor to the other distributor and means for arresting the operation of said second-named current distributor at intervals dependent upon their different rates of speed and the phase angle between their moving elements.

8. In a telegraph system, a character signaling channel associated with a receiving distributor connected to a line, a character signaling channel associated with a transmitting distributor connected to a second line, the character speed of the transmitting channel being as great or greater than the character speed of the receiving channel, means for successively storing the characters received from the receiving channel on a plurality of storing relay banks, and successively transmitting said stored character signals over the transmitting channel, and means for transmitting spacing signals into the second line at intervals when the rate at which characters are being received is less than the character rate of the transmitting distributor.

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