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W. S. LEMMON

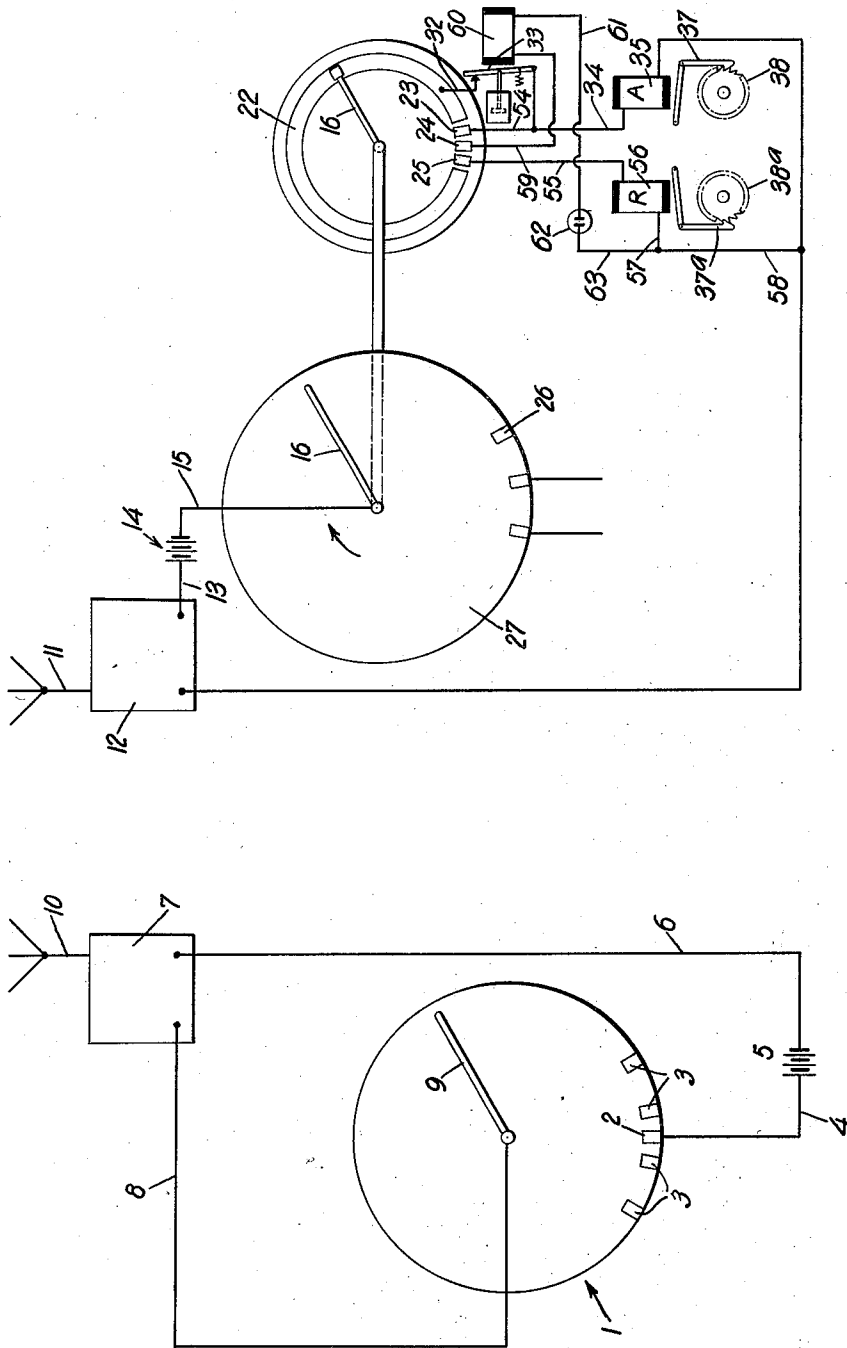
2,053,091

SYNCHRONIZING SYSTEM

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3 Sheets-Sheet 1

Fig. 1.



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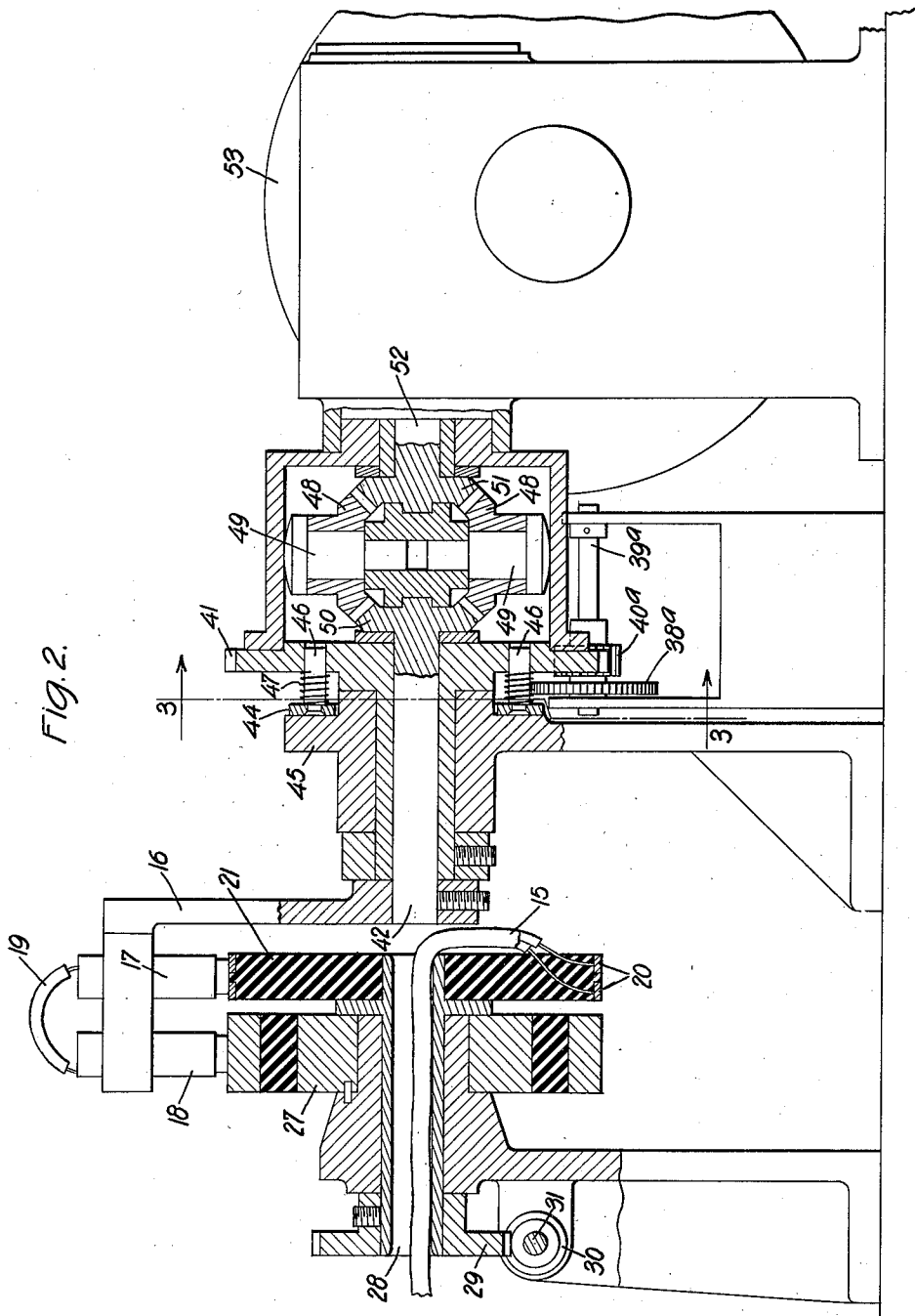
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SYNCHRONIZING SYSTEM

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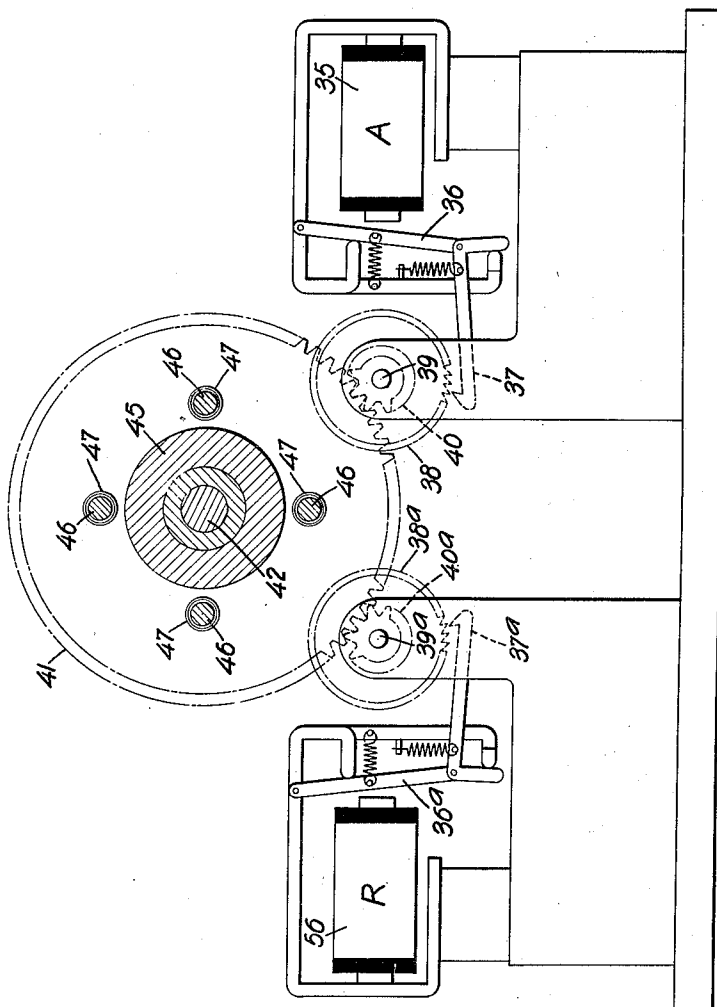
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3 Sheets-Sheet 3

Fig. 3.



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SYNCHRONIZING SYSTEM

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11 Claims. (Cl. 178—41)

This invention relates to communication systems employing synchronous, in-phase operation of a transmitter and a receiver. It applies particularly to a system wherein the intelligence is conveyed by electrical impulses identified by their timing with reference to an arbitrary time scale.

For such a system it is requisite that corresponding cycles of the sender and receiver begin and end simultaneously. For example, if the letter "a" is represented by an impulse transmitted 30° after the beginning of a sender cycle, the same letter must be received by the receiver 30° after the beginning of a receiver cycle. If the sender and receiver are in phase, the letter "a" will be reproduced when the letter "a" is sent, but if they are out of phase another letter will be indicated in the receiver when the letter "a" is sent.

It is an object of the present invention to provide in a timed signal telegraph system having a sending collector and a receiving distributor operated at substantially the same speed, means for sending a phase control impulse at a predetermined point in the cycle of the sending collector and means in the receiver responsive to reception of the control impulse in any position of the receiving distributor other than that representing phase correspondence, for applying a corrective step to the receiving distributor.

It is a further object of the present invention to provide means in the receiver for operating a signal to indicate when the receiving distributor is running in phase with the transmitting collector.

It is a further object of the invention to eliminate from the phase control means a portion of the control circuit contact means which extends through the same arc as the letter or character contacts of the receiver. It is a particular object of the invention to achieve this result automatically when phase correspondence has been secured.

Other objects and advantages will hereinafter appear.

In the drawings forming part of this specification,

Figure 1 is a diagrammatic view illustrating sending and receiving apparatus;

Figure 2 is a fragmentary, side elevation partly in section illustrating a portion of the receiver; and

Figure 3 is a transverse, vertical section taken on the line 3—3 of Figure 2, looking in the direction of the arrows.

The sender comprises a commutator ring 1 which includes a phase control contact 2 and a multiplicity of letter contacts 3. The phase control contact is connected through a conductor 4 to a battery 5, thence through a conductor 6 to suitable transmitting or broadcasting means indi-

cated by the rectangle 7. The transmitting means 7 is connected by a conductor 8 with the hub portion of a sending collector 9. The battery 5 is effective to produce an impulse through the transmitting means 7 each time that the collector arm 9 wipes across the contact 2. The collector arm 9 rotates at uniform speed and hence the control impulses are sent out at uniform time intervals.

Between successive control impulses the collector arm wipes across all of the letter contacts 3 in predetermined order, completing a circuit through the transmitter 7 as it touches each contact. The contacts 3 are adapted to be selectively charged by means not shown, and any such contact that is charged will cause an impulse to be sent out as a collector arm 9 wipes across it. Such an impulse will obviously be timed with reference to the phase control impulse in accordance with the position of the particular letter contact 20 which is charged.

The sender may be used in line telegraphy or for radio. A radio antenna 10 is indicated.

In the receiver an antenna 11 is connected to an amplifier 12 and this amplifier is connected through a conductor 13 to a battery 14. The battery 14 is in turn connected through a conductor 15 with the hub portion of a rotary distributor arm 16. The distributor arm 16 carries two brushes 17 and 18 which are connected to one another by a conductor 19. The conductor 15 is connected to a solid collector ring 20 with which the prong 17 is in continuous contact. The ring 20 is mounted upon a disc 21 which also carries a ring segment 22 and contacts 23, 24 and 25. The brush 17 wipes across the ring segment 22 and the contacts 23, 24 and 25 as it rotates. The brush 18 as it rotates wipes across letter contacts 26 which are carried by a disc 27.

The discs 21 and 27 are fast upon a hollow shaft 28 and may be manually adjusted with the shaft as desired. For this purpose, the shaft 28 has fast upon it a worm wheel 29 which meshes with a worm 30 fast on the shaft 31. This manual adjustment is ordinarily a fixed adjustment and is not disturbed in normal operation.

Each letter contact 26 carried by the disc 27 corresponds in position with one of the letter contacts 3 of the commutator disc 1 of the sender. The contact 24 corresponds in position with the control contact 2 of the sender while blank spaces are provided on both the discs 1 and the disc 27 corresponding to the positions of contacts 23 and 25.

When the apparatus is first set into operation no letter impulses are transmitted. If the control impulses come through when the brush 17 is in contact with the ring segment 22 a circuit is set up for stepping the arm 16 forward. This operation is repeated in each cycle until the im-

pulse comes through with the brush 17 in engagement with contact 23. Here the effect of the engagement is still the same and the arm 16 is stepped forward until the control impulse is transmitted to the contact 24. The sender and receiver are now in phase. When the control impulse is transmitted to the contact 24 no corrective step is required and none is applied, but instead a signal indicating lamp is energized to show the operator that the sender and receiver are operating in phase. Should the speeds of the sender and receiver be different, however, any lagging of the receiver will simply cause the brush 17 to engage contact 23 so that a corrective step is applied to restore the in-phase relationship. Should the receiver gain on the sender the brush 17 will transmit the control impulse to the contact 25 and this will produce a backward corrective step to restore the in phase relationship.

The electrical and mechanical means for achieving the operations above outlined will now be described. The current transmitted through the brush 17 to the ring 22 is carried through conductor 32, a switch 33, a conductor 34, a coil 35 of advancing electromagnet A, and a conductor 36 back to the amplifier 12, and thence through the conductor 13 to the battery 14. The impulse transmitted through the winding of electromagnet A attracts the armature 36 of the electromagnet and causes a pawl arm 37 connected thereto to turn a ratchet 38 one step in a clockwise direction, as seen in Figure 3. The ratchet 38 is fast upon a shaft 39 and this shaft in turn has a pinion 40 fast upon it. The pinion 40 meshes with a gear 41 which is co-axial with the shaft 42 of arm 16, and which is fast with a differential housing 43. The gear 41 and the housing 43 are normally held against rotation by friction members 44 which bear against a stationary frame member 45. The friction members 44 are supported upon plungers 46 which are slidably mounted in the gear 41 and which are impelled outward against the frame member 45 by compression springs 47. Pinions 48 are mounted on radial studs 49 carried by the housing 43. The pinions 48 mesh with a pinion 50 which is fast on the shaft 42 and with a pinion 51 which is fast on a shaft 52. The shaft 52 is driven from the motor 53. The effect of rotating the ratchet 38 a single step is to turn the housing 43, which carries the pinion 48, through a small angle, and thus to advance the shaft 42 relative to the shaft 52.

When a power impulse is transmitted through the contact 23 the effect is the same as that described for the transmission through the ring 22, the only difference being that the current is transmitted directly from contact 23 to conductor 34 through a conductor 54. This also serves to energize the electromagnet 35 and to advance the shaft 42 relative to the shaft 52.

When the control impulse is transmitted to the contact 25 from the distributor 16 the current flows through a conductor 55, the winding 56 of a retarding electromagnet R, and thence through conductors 57 and 58 to the conductor 36. The winding 56 thereupon attracts an armature 36a which acts through a pawl arm 37a to rotate a ratchet 38a. The ratchet 38a acts through a shaft 39a and a pinion 40a to rotate the gear 41 and the connected housing 43 in the direction opposite to that in which the ratchet 38 rotates said gear and housing. This causes the shaft 42 to be retarded relative to the shaft 52 and causes the distributor 16 to be returned

to an in-phase condition so that the control impulse is delivered to the contact 24.

When the control impulse is delivered to the contact 24 the current passes through conductor 59, thence through the winding 60 of a dash-pot relay whereby the switch 33 is controlled. The current passes thence through a conductor 61 and a luminous electrical discharge tube 62 which may be filled with any suitable rarefied gas, such as neon, and thence through a conductor 63 to conductor 58. The luminous electrical discharge tube 62 is caused to signal to the operator that the receiving distributor arm 16 is running in phase with the collector arm 9 of the sender. This signal is received so long as the in-phase operation is continued, not being interrupted momentarily from time to time as a single control impulse is delivered through the contact 23 or the contact 25 because of the slow action of the relay. The tube has no filament subject to burning and is therefore a very dependable signal. The dash-pot relay controls the switch 33 and in fact the switch 33 is the retarded armature element of the relay. The switch 33 is pulled open by the energization of the winding 60, and is held open by reason of the fact that the control impulses come through so frequently that the slow acting switch 33 does not have an opportunity to return and make contact. Thus the ring 22 is rendered inoperative as soon as in-phase operation is secured and it is maintained inoperative throughout the time when letter impulses are received. Since the letter impulses are not transmitted until phase correspondence has been secured, it is not possible for letter impulses to come through and pass through the ring 22 to interfere with the maintenance of the in-phase condition.

I have described what I believe to be the best embodiments of my invention. Although the described embodiment is concerned with a telegraph system, it will be understood that the invention may be applied to many other uses, such as systems for the transmission of facsimiles or pictures in which it is important to have the electrical impulses which are transmitted, timed in exact accordance with the movement of certain of the arrangements of the system. It will be understood, therefore, that I do not wish to be confined to the embodiments shown, but what I desire to cover by Letters Patent is set forth in the appended claims.

I claim:

1. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a collector operating at uniform speed and a receiver comprising a distributor operating at substantially the same speed, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle and means in the receiver responsive to reception of the control impulse in all positions of the distributor other than that representing phase correspondence to apply one or more adjusting steps to the receiving distributor for stepping the same into phase correspondence with the said collector.

2. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a collector operating at uniform speed and a receiver comprising a distributor operating at substantially the same speed, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle and means in the receiver automatically responsive to the control impulses to adjust the receiving distrib-

utor step by step into phase with the sending collector.

3. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a rotary collector operating at uniform speed and a receiver comprising a rotary distributor operating at substantially the same speed, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle and means in the receiver comprising a rotary brush carried with the distributor, a ring segment in contact with the brush through the major portion of the travel thereof, and means in circuit with the brush and ring for applying an adjusting step to the distributor when an impulse is transmitted through the ring.

4. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a collector operating at uniform speed and a receiver comprising a distributor operating at substantially the same speed, a ring segment in circuit with the distributor through a portion of each cycle of the distributor for transmitting control impulses before phase correspondence has been secured and for transmitting signal impulses after phase correspondence is secured, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle, means in the receiver responsive to the received impulses to adjust the phase of the distributor, and means for rendering the ring circuit inoperative when phase correspondence is secured.

5. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a rotary collector operating at uniform speed and a receiver comprising a rotary distributor operating at substantially the same speed, a transmitting element in circuit with the distributor through a portion of each cycle of the distributor for transmitting control impulses before phase correspondence has been secured and for transmitting signal impulses after phase correspondence is secured, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle, means in the receiver responsive to the received impulses to adjust the phase of the distributor, and means automatically rendering the transmitting element inoperative to affect the phase adjusting means when phase correspondence is secured.

6. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a rotary collector operating at uniform speed and a receiver comprising a rotary distributor operating at substantially the same speed, a transmitting element in circuit with the distributor through a portion of each cycle of the distributor for transmitting control impulses before phase correspondence has been secured and for transmitting signal impulses after phase correspondence is secured, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle, means in the receiver responsive to the received impulses to adjust the phase of the distributor, and a means comprising a control circuit and slow acting relay responsive thereto for automatically rendering the transmitting element inoperative to effect adjustment when phase correspondence has been secured.

7. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a rotary collector operating at uniform speed and a receiver comprising a rotary distributor operating at substantially the same speed,

means in the sender for transmitting a phase control impulse at a predetermined point in each cycle and means in the receiver responsive to reception of the control impulse in the position of the distributor representing phase correspondence, and made effective thereby to indicate that the distributor is in phase with the sending collector.

8. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a rotary collector operating at uniform speed and a receiver comprising a rotary distributor operating at substantially the same speed, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle, means in the receiver for automatically adjusting the distributor to phase correspondence and a signal circuit in parallel with the adjusting means and energized by reception of the control impulse in proper phase correspondence to indicate that phase correspondence has been secured.

9. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a rotary collector operating at uniform speed and a receiver comprising a rotary distributor operating at substantially the same speed, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle and means in the receiver responsive to reception of the control impulse in the position of the distributor representing phase correspondence to indicate that the distributor is in phase with the sending collector, comprising a luminous electrical discharge tube.

10. In a system for conveying intelligence by electrical impulses, in combination, a transmitter for sending out control and signal impulses in timed relation to one another, a receiver for such impulses, said transmitter and receiver having members rotating in substantial synchronism with each other, and means whereby said control impulses are caused to apply adjusting steps of predetermined extent to the said rotating member of the receiver if said member is out of synchronism with the corresponding member of the transmitter.

11. In a system for conveying intelligence by electrical impulses, in combination, a sender comprising a rotary collector operating at uniform speed and a receiver comprising a rotary distributor operating at substantially the same speed, a transmitting element in circuit with the distributor through a portion of each cycle of the distributor for transmitting control impulses before phase correspondence has been secured and for transmitting signal impulses after phase correspondence is secured, means in the sender for transmitting a phase control impulse at a predetermined point in each cycle, means in the receiver responsive to the received impulses to adjust the phase of the distributor, and means for automatically rendering the transmitting element inoperative to effect adjustment when phase correspondence has been secured, comprising a control circuit responsive to in-phase reception of the control impulses including a relay, and retarding means acting on the relay to delay the re-establishment of the operativeness of the transmitting element to effect adjustment for a period exceeding that of a cycle of the distributor when the distributor deviates from phase correspondence.

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