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SYNCHRONOUS TELEGRAPHY

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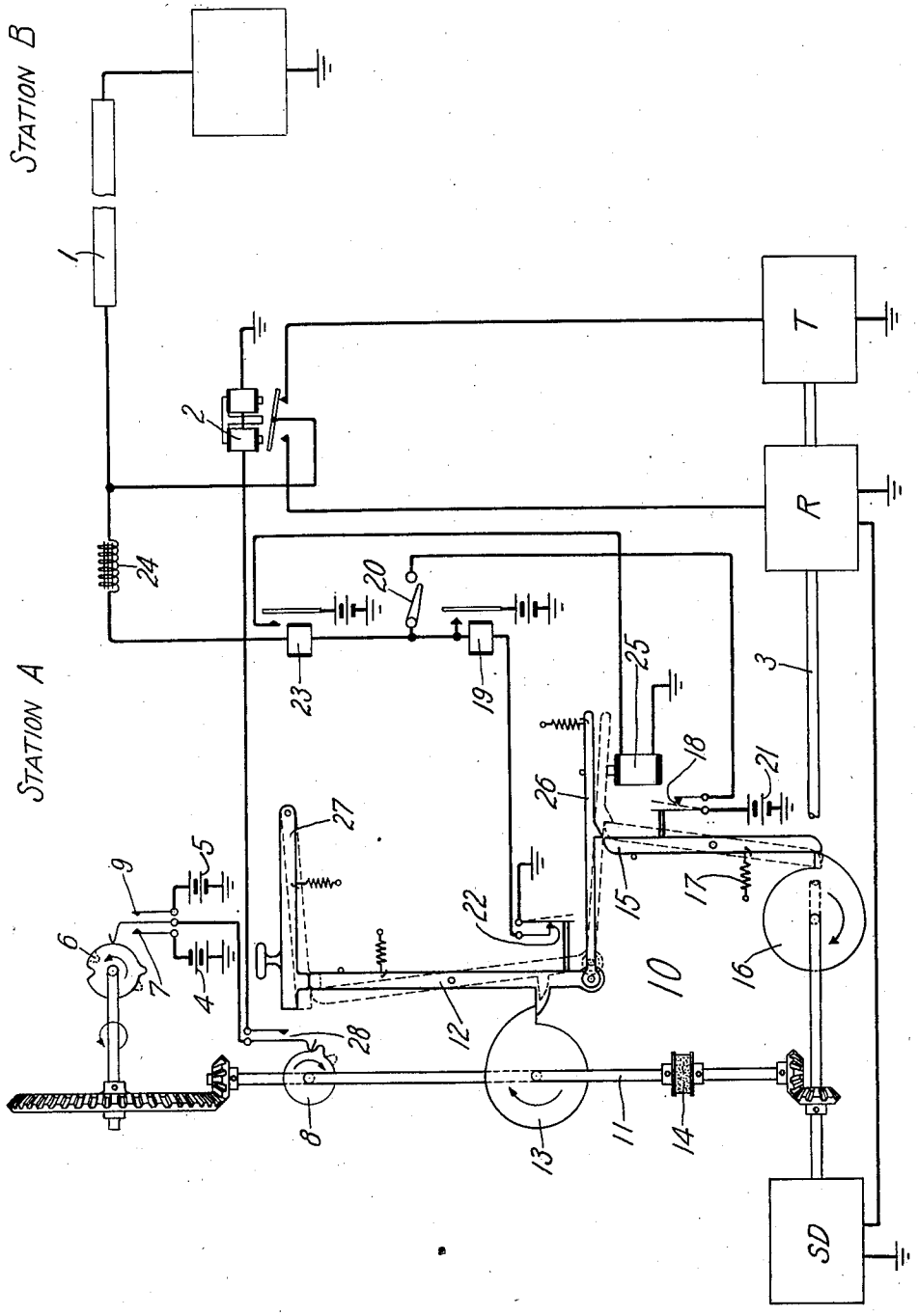

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SYNCHRONOUS TELEGRAPHY

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This invention relates to synchronous communication systems and an object is to start auxiliary apparatus at an accurately definite time relative to the cycle of operation of main synchronous apparatus.

The invention relates more particularly to that type of synchronous telegraph system in which transmission is effected in only one direction at one time and the direction of transmission is periodically reversed by automatic switching means at each station. It has as an object in such a system the starting of automatic switching means at separated stations substantially simultaneously.

In systems of this type it has been proposed to periodically reverse the direction of transmission by means of an automatic switching mechanism at each station driven from the distributor shaft at that station through a friction clutch. In operation the switching mechanisms at all stations are initially set in their proper positions and restrained from rotating by a brake. After the distributors at all stations are properly synchronized the brakes restraining the switching mechanisms are released by transmitting a special impulse over the line from one of the stations. This impulse operates a relay at each station which releases the brake at that station, but, due to the time required for an impulse to traverse a long cable and to the fact that two relays do not necessarily operate at the same speed, such an arrangement does not release the timing mechanisms at the different stations at exactly the same instant.

It has heretofore been proposed to start the timing mechanisms at the different stations with greater accuracy by controlling the starting relay at each station through a circuit involving segments on the synchronous distributor at that station so that the time of operation is controlled to a certain extent by the local synchronous distributor.

The present invention eliminates the necessity of a special electrical circuit involving segments of the local distributors by substituting a mechanical tripping arrangement which is operated by the distributor brush drive shaft to release the timing mechanism. In this way the time of starting the reversing timing mechanisms at different stations may be controlled exactly and positively.

The drawing discloses schematically a simplex telegraph system adapted for transmission alternately in each direction under the control of automatic timing means for periodically reversing the direction of transmission. 1 represents a line conductor, which in this instance is shown as a submarine cable, extending between two stations A and B and adapted to be connected to either receiving or sending equipment at each station by means of automatic switching equipment. The apparatus at station A has been shown in some detail but that at station B represented by a square, since the equipment at the two stations is identical. The receiving and sending equipment need not be described in detail; suffice it to say that the receiver, indicated by square R, and the transmitter, indicated by square T, comprise faces of a rotary synchronous distributor the brushes of which are driven from a shaft 3 by synchronous driving means SD. The latter comprises not only a constant speed motor but synchronous correcting means operating to maintain the distributor in synchronism with the distant station when the latter is transmitting. For a more complete description of suitable receiving, transmitting and synchronizing apparatus, the reader is referred to Clokey Patent 1,601,941, October 5, 1926.

The actual change from transmitting to receiving condition, and vice versa, at each station is made by a polar relay 2 which moves its armature from one contact to the other at intervals controlled by contacts 28, 7 and 9. These contacts are actuated by cams driven through a train of gears from the shaft 11. Shaft 11, in turn is driven from the main distributor shaft 3 through a friction clutch 14.

Once the cams 6 and 8 at different stations are properly set they remain in phase as long as their respective distributor shafts 3 remain in phase but since if the motors SD are once shut down there is no provision for restarting them simultaneously, it is necessary, after they are started and synchronized, to stop the shaft 11 at each station, set the cams 6 and 8 to a predetermined position, and

then release the shafts 11 at the two stations simultaneously, or at known intervals.

To release the shafts 11 at each station this invention provides a special starting mechanism 10, of which a full understanding may be readily obtained by following through its operation in starting the timing mechanism.

Assume that the distributor at the two stations are running in synchronism but that the shaft 11 at each station is prevented from rotating by catch 12. The timing gear train at each station is then set in the predetermined position. This may be done by manually pressing the catch 12 out of engagement with the cam 13 and allowing the friction clutch 14 to rotate the cams, or means may be provided for unmeshing the gears whereby each gear wheel can be set in the desired position and then remeshed with its driving gear. With the proper setting, cam 6 at station A is just 180° out of phase with the corresponding cam at station B since when the latter station is switched from sending to receiving the former must be switched from receiving to sending, and vice versa.

With the cams set and locked as shown in the drawing the timing system is ready to be set in operation. It should be noted that the top of member 15 is periodically moved to the left (as shown in full lines) by cam 16, and snapped to the right (to the position shown in dotted lines) by spring 17 as cam 16 releases it. Each time the top of member 15 moves to the right-hand position it closes contacts 18 supplying current to relay 19 but the relay cannot operate at this time because switch 20 is open. To release the timing mechanisms at the two stations the operator at either station, in this case we will assume the operator at station A, closes switch 20. The first time member 15 moves to the right following the closure of this switch, current is supplied from battery 21 to contacts 18, switch 20, relay 19 and contacts 22 to ground, operating relay 19, which is locked up by current supplied from battery over its own contact to ground through contacts 22. Current is simultaneously applied from the contact of relay 19, through relay 23 and inductance 24 to the cable, and thence through an inductance, two relays and a contact at the distant station corresponding respectively to those at station A. Inductance 24 is to prevent the usual telegraph signaling impulses from flowing in the starting relay circuit. Relay 23 at station A thereupon operates and applies battery over its contacts to magnet 25, which attracts arm 26 against the end of member 15 so that when member 15 moves to the left the catch on the end of arm 26 engages with it and when member 15 is subsequently snapped to the right by spring 17, when released by cams 16, the main catch 12 is pulled out of engagement with cam 13 and permits the timing mechanism to be rotated by the friction clutch 14. As the lower end of main catch 12 is pulled to the right the upper end moves to the left, where it is secured by the stop 27, and permanently opens contacts 22, which breaks the flow of current through relay 19 and causes that relay to release. The impulse transmitted over the cable causes the release of shaft 11 at station B in the same manner as that outlined above for station A.

It should be noted that between the time when member 15 closes contact 18 to apply an impulse to relays 19 and 23, and to the cable, and the time when cam 13 is released by catch 12, the main distributor shaft 3 makes practically one complete revolution. Thus if the cable 1 is not too long and has a speed of propagation not too slow, the relays and magnets at station B, which correspond to relays 19 and 23 and magnet 25 at station A, may be operated before catch 12 at station A is released, since, when the distributors at the two stations are properly synchronized, members 15 are released simultaneously. Thus the timing mechanisms at the two stations will be started at practically the same instant and will operate to reverse the direction of transmission at each station substantially simultaneously.

It may happen that the cable 1 is so long and has such a low speed of propagation that the distributor shafts will complete more than one revolution before the impulse transmitted to the cable at station A reaches station B. In such a case the timing mechanism at station A would start at the end of one revolution but the timing mechanism at station B would not start until the end of the second or possibly a later revolution. Under such conditions a system of the type shown would not start the mechanisms at each end of the cable simultaneously, but the mechanism at station B would always be started a definite number of revolutions of the distributor shaft later than the mechanism at station A and since this difference in starting time can be very exactly determined the timing mechanism at station B may be initially set sufficiently ahead of that at station A to accurately compensate for the difference in starting time.

Although the shaft 11 has been shown as driven through a friction clutch and adapted to be restrained from turning by cam 13, it may in some instances be preferable to couple the shaft 11 to its driving shaft through a clutch of the type which, when disengaged entirely releases the shaft 11. Such a clutch may be released either mechanically or magnetically and is regarded as an equivalent of the friction clutch and stop cam system illustrated in the drawing.

Although a system comprising only two terminal stations has been disclosed in the

drawing, the invention is also applicable to a system in which there are more than two stations. For instance it is sometimes the practice to connect two sections of cable in series, and insert a repeating station between them for amplifying and reshaping the impulses received over one section for retransmission over the other section. In such a system it is necessary to reverse the receiving and transmitting apparatus at all three stations and the timing mechanism at all three stations may be released at definite intervals, in accordance with this invention, in response to an impulse applied to the cable from one of the stations.

What is claimed is:

1. In a synchronous signaling system comprising a plurality of connected stations with synchronous driving means at all stations running in phase, a mechanism to be set in motion at each station and means for starting each mechanism in response to a starting impulse from one of said stations characterized in this, that it comprises a tripping device actuated mechanically from the synchronous driving means at that station whereby the exact time of starting is determined.

2. In a synchronous communication system, a mechanism running at constant speed and periodically completing a cycle of motion, a second mechanism to be set in motion at a definite time in said cycle and means for starting said second mechanism comprising manually controlled switching means, electromagnetic means operated under the joint control of said manually controlled switching means and said first mechanism to begin the starting operation at said definite time, and tripping means mechanically operated from said first mechanism one cycle of time later to complete the starting operation.

3. In a synchronous communication system a plurality of stations, a communication channel extending therebetween, synchronous distributing equipment at each station maintained in phase with that at the other stations, secondary synchronous apparatus at each station, and means for starting the secondary apparatus comprising a mechanism adapted to be set by an impulse received over said line and to be subsequently released by the synchronous distributing equipment at that station.

4. In a synchronous telegraph system comprising a plurality of connected stations with synchronous apparatus at each station maintained in phase with the synchronous apparatus at the other stations, a secondary synchronous switching means at each station, means for stopping said secondary means, and means for releasing said stopping means comprising a releasing member under the joint control of an electromagnet and a cam driven from the synchronous apparatus whereby the exact time of releasing said stopping means is controlled by said synchronous apparatus.

5. A telegraph conductor and a plurality of stations connected thereto, a distributor shaft at each station rotating at the same speed as, and in phase with, those at the other stations, switching means at each station adapted to be effectively coupled to, or uncoupled from the synchronous distributor shaft at that station, and means for effectively coupling the switching means to the distributor shaft comprising a mechanism adapted to be set in response to an electric impulse and to be subsequently released by a mechanical tripping means operated from said distributor shaft.

6. In combination, a line conductor with a station at each end thereof, a synchronous distributor at each station, tripping means mechanically operated from the distributor at each station to trip at constant, definitely related time intervals, a device to be operated at each station at definitely related time intervals, electromagnetic means at each station connected to said conductor for coupling said tripping device to said mechanism, said electromagnetic means being responsive to an electric impulse received over said conductor, and switching means at said stations for applying an electric impulse simultaneously to the electromagnetic means at that station and to the line conductor.

7. A system as defined in claim 5 further characterized in that said switching means comprises contacts closed by said mechanical tripping means whereby the impulse is applied to the electromagnetic means and to the conductor at a time substantially equal to that of one cycle of operation of the tripping means before said tripping means trips.

8. In a synchronous telegraph system comprising two stations connected by a line conductor and synchronous distributors running in phase at each station, the method of starting secondary apparatus at each station substantially simultaneously which comprises setting said apparatus at each station in a mechanically responsive position by an impulse applied to said line at one of said stations, and subsequently mechanically releasing the apparatus under the control of the synchronous distributors at the respective stations.

In witness whereof, I hereunto subscribe my name this 4th day of January, 1928.

ALLISON A. CLOKEY.