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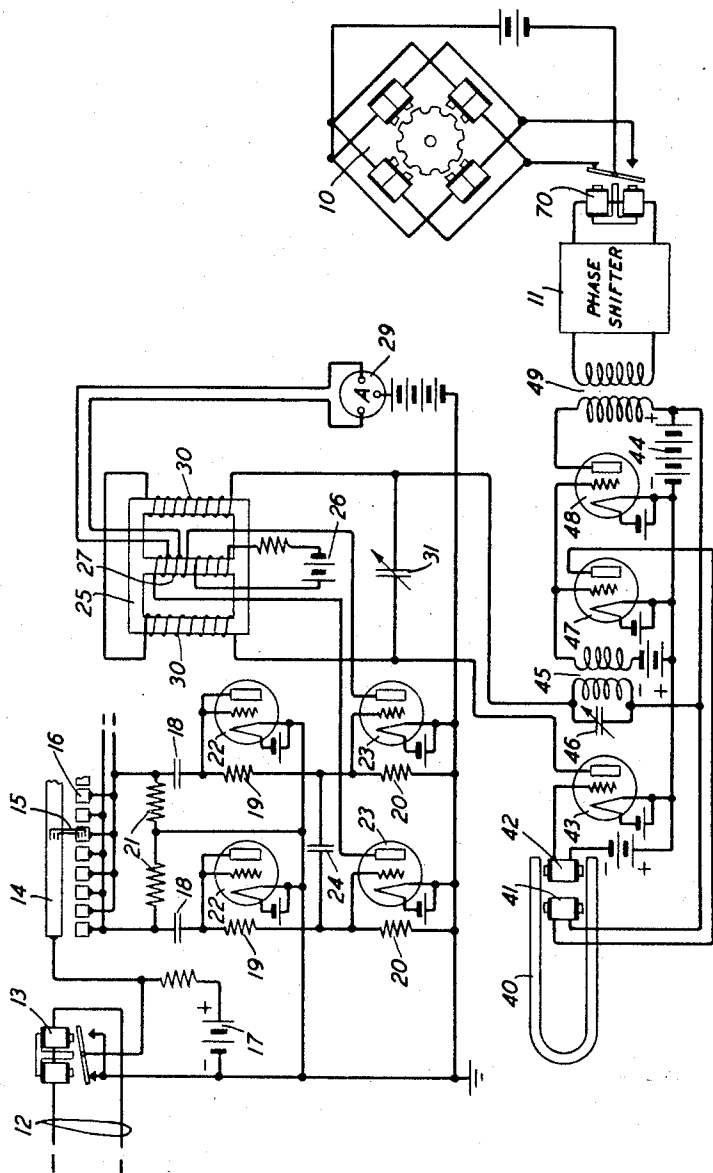
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2,126,265

PHASING AND SYNCHRONIZING OF SIGNALING APPARATUS

Original Filed Feb. 24, 1930 2 Sheets-Sheet 1

FIG. 1



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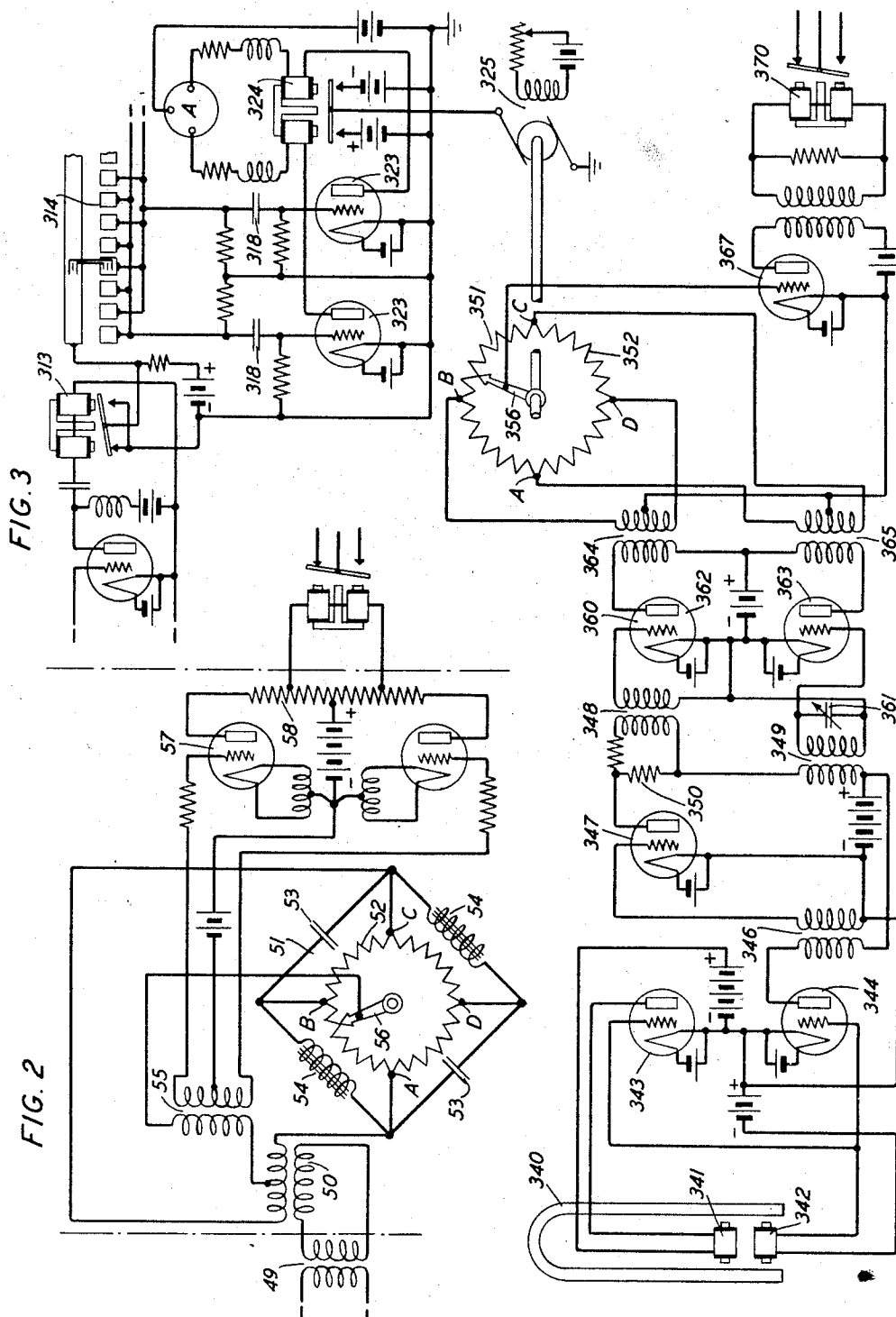
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PHASING AND SYNCHRONIZING OF SIGNAL-
ING APPARATUS

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Continuation of application Serial No. 430,515,
February 24, 1930. This application April 7,
1937, Serial No. 135,385

27 Claims. (Cl. 172—293)

This application is a continuation of my ap-
plication for Letters Patent of the United States
Serial No. 430,515, filed February 24, 1930, and
the benefit of the filing dates of said application
and/or any and all other applications of the
present applicant, taken together or separately,
is claimed to the full extent allowed by law.

This invention relates to a phase shifting cir-
cuit for driving synchronous motors. The in-
vention is particularly useful in connection with
synchronously rotating distributors in printing
telegraph systems, but is applicable also to pic-
ture transmission and television systems.

An object of this invention is to modify the
phase relation of a rotary distributor with re-
spect to the signal impulses received thereby,
while the distributor is being driven in syn-
chronism with a distant source of impulses.

When multiplex signals are received by a
distributor, it is necessary to orient the re-
ceiving brush with respect to the incoming sig-
nals, so as to distribute them to the proper
receiving segments. The brush of the receiving
distributor must be not only in synchronism
with the sending distributor brush, but also in
such phase relation thereto that the former, at
any instant, passes over a segment at the same
time that an impulse is received from a corre-
sponding segment on the sending distributor.

The aforementioned object is attained by the
interposition of a phase shifter between the
receiving distributor motor and the tuning fork
circuit which drives it. The phase shifter con-
sists of an input circuit which receives a syn-
chronous alternating current from the tuning
fork circuit; an output circuit which drives the
motor; and a mechanism, comprising a re-
volvable slider for adjusting the phase relation
between the input and output currents.

To effect the desired phase modification, a
phase splitting device is inserted between the
input and output circuits. Such a device com-
prises two condensive and two inductive ele-
ments, the inductive elements alternating in
position with the condensive elements to form
a closed circuit. A closed resistor of compara-
tively high resistance has four equally distrib-
uted terminals connected to the respective ele-
ments so that each element is shunted by a
section of the resistor. Two opposite terminals
are connected to the respective terminals of the
secondary winding of a transformer receiving
the input current. A derived voltage, which
may be adjusted to any desired phase relation
with respect to the current in the secondary

winding, is obtained between the midpoint of
the input winding and a slider which may be
adjusted to contact with the closed resistor at
any desired point. The derived voltage is im-
pressed across an output circuit having a high
resistance, causing the flow of a small current
which is amplified to drive the distributor motor.

A feature of this invention is a vacuum tube
amplifier of the push-pull type for amplifying
the derived current. The latter is kept at a very
small value, so as not to alter the voltage phase
relations of the phase splitter.

Another object of this invention is to provide
a manually operable frequency changer. The
slider of the phase adjusting mechanism re-
ferred to in preceding paragraphs may be ro-
tated by an angle less than 360 degrees and set
in this position, in which case the mechanism
acts as a phase shifter; or may be rotated con-
tinuously to change the frequency of the output
current with respect to the input. For each
revolution the output current gains or loses one
cycle.

Other objects and features will appear more
clearly from the accompanying drawings taken
in connection with the following description and
subjoined claims.

In the drawings, Fig. 1 shows a continuous
corrector for maintaining a distributor in syn-
chronism with incoming impulses, together with
a phase shifter for orienting the distributor with
respect to the impulses. Fig. 2 shows a phase
shifter adapted to be employed in the circuit
of Fig. 1. Fig. 3 illustrates a modified form of
phase shifting device which may be employed
as a frequency changer.

Fig. 1—Brief description of apparatus

The circuit arrangement of Fig. 1 embodies
generally, four principal elements, (1) a tuning
fork circuit; (2) a continuous electrical corrector
arrangement for maintaining the vibrations of
the tuning fork at fixed frequency relation
with incoming impulses; (3) a motor for
driving the distributor brushes supplied with
current originating in the tuning fork circuit;
and (4) a phase shifter intermediate the out-
put of the fork circuit and the motor for ad-
vancing or retarding the motor a fraction of a
revolution or a number of revolutions if desired,
without disturbing the frequency relation be-
tween the motor and the impulses.

Continuous corrector—Description of apparatus

The continuous corrector arrangement may

be embodied in various forms. For example, Patent 1,747,248, granted February 18, 1930, to applicant discloses in Fig. 1 an embodiment which is suitable for the same purpose as the corrector arrangement of Fig. 1 of this application.

Referring to Fig. 1, an incoming line 12 is connected to operate the receiving relay 13. The armature of the relay is connected to a continuous ring of the correcting distributor 14. A brush 15 is driven by the motor 10 at such speed that the brush passes over two segments 16 during the receipt of each unit impulse. The continuous ring is also connected to a battery 17 which is short-circuited by the relay contacts whenever one of them engages the armature. An application of electromotive force to the distributor and consequent discharge of current from the battery 17 takes place upon every line reversal. These discharges are necessarily short since it is well known that a polar relay of the type illustrated moves its armature from one contact to the other in an interval of a thousandth of a second or less. Furthermore, it is obvious that the discharges always take place in the same direction regardless of the direction of polarity reversal which moves the armature of relay 13.

Alternate segments 18 are connected to each other with the odd numbered segments in one circuit and the even numbered segments in another. Each set of segments is connected to ground through a separate series path consisting of a condenser 19, resistance 19, and resistance 20. Each set of segments is also grounded through a separate resistance 21. Intermediate each condenser 18 and resistance 19 are connected the grid and plate of a vacuum tube 22, having a grounded filament.

A pair of amplifier tubes 23 have their grid circuits connected across the respective resistances 20. A storing condenser 24 connects the two grids to each other. A modulator coil 25 is disposed in the output circuits of the vacuum tubes 23. This coil is biased by current from a battery 26. One winding 27 is connected to the respective plates of amplifier tubes 23. An ammeter 29 may be tapped across the last mentioned winding to provide a visual indication of current in the latter. A third winding 30 connected in parallel with a variable condenser 31 provides a variable impedance.

Synchronous current impulses are derived from a tuning fork 40 which has a frequency of vibration bearing a fixed relation to the frequency of the incoming impulses when the continuous corrector is in operation. This fork typifies a periodic means setting the frequency of rotation of the distributor substantially in synchronism with the incoming signals. The frequency of this fork is adjusted in a known manner to approximate the frequency of the fork at the sending end (not shown). Between the tines of the fork are disposed a driving magnet 41 and a pick-up coil 42. The coil 42 is located in the grid circuit of vacuum tube 43. The anode-cathode path of the tube 43 forms part of a series circuit which extends from the negative terminal of a battery 44, filament and plate of tube 43, variable impedance 30, 31, primary winding of transformer 45 and positive terminal of battery 44. In parallel with the primary winding of transformer 45 is a variable condenser 46. The secondary winding of this transformer is connected to two parallel grid circuits of vacuum tubes 47 and 48, re-

spectively. The filaments of tubes 47 and 48 are each connected to the negative side of battery 44. The anodes are indirectly connected to the positive side of the battery, through driving magnet 41 and primary winding of transformer 49, respectively. The secondary winding of the latter transformer is connected to the phase shifter.

Phase shifter—Description of apparatus

A phase shifter is interposed between the secondary winding of transformer 49 and motor relay 70. The function of the phase shifter is to supply to the motor relay a current having the same frequency as the current through the secondary winding of transformer 49, but having an adjustable phase relation with respect to the latter current.

Referring to Fig. 2, single phase current is supplied to the phase shifter through the primary winding of transformer 50. The secondary winding is connected across opposite terminals of a phase modifying device 51. The phase modifying device comprises four equal resistors 52 arranged to form a closed circuit. Each resistor is of high resistance, for example, 15,000 ohms. Paralleling the respective resistors are a condenser 53, inductance 54, another condenser 53 and another inductance 54. The condensers and inductances are selected to be resonant at the frequency of the input current. The elements 53 and 54 have a resistance component in series with the reactance. It is desirable that the resistance components of the respective elements be equal in value. To this end a rheostat may be inserted in series with each element.

Another transformer 55 has a primary winding whose terminals are connected respectively to the mid-point of the secondary winding of transformer 50 and to an arm or slider 56. The secondary winding of transformer 55 supplies current to a push-pull vacuum tube arrangement 57 whose output is a resistor 58. The drop of potential across this resistor 58 supplies current to the output circuit of the phase shifter.

Distributor motor circuit—Description of apparatus

Referring again to Fig. 1, the output of the phase shifter is connected to motor relay 70 which is connected in the conventional manner to drive a motor 10 of the well-known LaCour type. This motor is connected by the usual arrangement (not shown) to drive the distributor arm upon which are mounted the distributor brushes 15.

Signal interpreting, receiving and recording means are understood to be connected to the incoming line 13 in any suitable manner, such as would be understood by one skilled in the art; the purposes of the present invention include (1) to facilitate the establishment of synchronism for the recording of signals and (2) to cause the signals themselves to maintain synchronism more exactly after establishment to improve reception in high speed systems.

Operation of circuit shown in Fig. 1

The operation of the circuit shown in Fig. 1 briefly is as follows: The arm 15 of distributor 14 is driven by motor 10 at a speed which is maintained continuously in synchronism with the received impulses from line 12. By means of the phase shifter, the distributor brush together with the motor 10 may be oriented so that it passes

over each segment at the same instant that an impulse, intended for that particular segment, is received. The operation of the circuit described is in more detail as follows:

5 Normally brush 15 of distributor 14 passes over two segments for each received impulse, and is passing from an odd to an even numbered segment at the instant when a positive charge is impressed upon the continuous ring. These positive impulses cause corresponding surges in the plate current of vacuum tubes 22 which leak off from condenser 18 to the input circuits of amplifier tubes 23. Any slight speeding up or slowing down of the distributor brush causes the charges to be impressed in unequal amounts upon the odd and even numbered segments, as a result of which the plate current in one tube 22 is greater than the plate current in the other. The plates of condenser 24 then become unequally charged, causing a current to flow in the plate circuit of amplifier tubes 23. This plate current opposes or aids the biasing current in the modulator coil 25, depending on whether the distributor is speeding up or slowing down. Changing the magnetic field set up by the biasing current has the effect of increasing or decreasing the inductance of the coil 30, and consequently the impedance of the variable impedance arrangement 30, 31.

30 The variable impedance 30, 31 controls the magnitude of alternating current in the plate circuit of vacuum tube 43. The frequency of this current is controlled by tuning fork 40 acting to vary the inductance of pick-up coil 42. The output current of vacuum tube 43 is amplified and connected to the driving magnet 41. Variation in magnitude of the output current changes in turn the amplitude of vibration of the fork, the period of vibration of the fork, the frequency of the current amplified by vacuum tube 43, and the frequency of current supplied to the phase shifter.

Operation of the phase shifter

45 In the phase shifting arrangement shown in Fig. 2, the current in the secondary winding of transformer 50 bears a fixed phase relation with respect to the input current, while the primary current of transformer 55 bears a fixed phase relation to the output current. The secondary winding of transformer 55 consumes practically no current, and consequently the load on the transformer 55 is zero. As a result, two conditions concur: first, the currents in both windings of transformer 55 have always the same phase relation with respect to the voltage across the primary winding of transformer 55; and second, the impedance of this primary winding is increased to such value that the current in this winding is insufficient to disturb the phase relations existing between the various sections of resistance 52.

To facilitate explanation, the various terminals of the closed resistor 52 have been designated A, B, C and D, respectively, the letters being chosen so that A and C represent the points of supply from the input transformer 50. When the arm 56 is connected to the point A, transformer 55 is connected in parallel with the left half of transformer 50 and when the arm is at the point C transformer 55 is shunted across the right half of the same winding. Rotation of the arm from point A to point C is effective to reverse the direction of current in the transformer 55; or in other words, alter the phase relation

between the input and output currents of the phase shifter by 180 degrees. By suitable adjustment of the arm 56, the phase relation between the current in the secondary winding of transformer 50 and the primary winding of the transformer 55 may be selected at any desired angle. If the arm is at the point B, the voltage of the primary winding of transformer 55 leads the current in the secondary winding of transformer 50 by 90 degrees. This result is explained in the following paragraph.

At such a frequency that the respective condensers and inductances resonate, the currents between points A and B, A and D, B and C, and D and C are each in phase with the current in the secondary winding of transformer 50. The voltage across the points A and B leads the current from A to B and hence the current in the secondary winding of transformer 50 by some angle less than 90 degrees. The voltage drop between A and B may be resolved into two components, one in phase with the said transformer current, and the other 90 degrees in advance of the same. While the elements 53 and 54 have been illustrated in Fig. 2 as condensers and inductances respectively, it is to be understood that in practice each of these elements consists of a reactance in series with a resistance. The effect of a resistance component between the points A and B and an equal resistance component between B and C is that the component of the drop in voltage between the points A and B which is in phase with the transformer current, is approximately equal to the in-phase component of the voltage drop between the points B and C. Each of these in-phase components of the voltage drop is equal to one-half of the secondary voltage of transformer 50. The difference of potential between the mid-point of the secondary winding of transformer 50 and the point B is equal to that component of the voltage drop AB which leads the transformer current by 90 degrees, inasmuch as the in-phase component of this drop is equal and opposite to the induced voltage in the right half of said secondary winding. It can be shown that if the arm 56 be moved to point D, the primary voltage of transformer 55 lags the secondary current in transformer 50 by 90 degrees. If the arm contacts with resistance 52 intermediate the points A and B, B and C, C and D or D and A, respectively, the input and output voltage phase relation is represented by an acute or obtuse angle. As the arm is revolved through 360 degrees it gradually and progressively advances (or retards) the phase relation between the primary current of transformer 55 and the secondary current of transformer 50 until the former current gains (or loses) a complete cycle with respect to the latter current.

Variations of the phase relation between the primary current in transformer 55 with respect to the input current of the phase shifter, is effective to vary correspondingly the current through resistor 58 and motor relay 70. The latter variation causes the armature of the relay 70 to increase or decrease its speed of vibration, during the time that the arm 56 is being moved. The change in frequency of vibration of the relay alters correspondingly the speed of the motor 10 which drives the distributor brushes. When the arm 56 comes to rest, the relay armature, motor and brushes move again at their original speed.

The frequency of the current supply to the dis-

tributor motor 10 is equal to the frequency of the incoming impulses from line 12 plus or minus, as the case may be, the speed of revolution of the slider 56. When the phase shifter is applied to the circuit shown in Fig. 1, movement of the slider 56 is usually only temporary. The phase shifter, however, is adaptable to other systems as a frequency converter. When the slider 56 is revolved continuously, the frequency of the output current is changed by an amount corresponding to the speed of the slider.

Modification disclosed in Fig. 3

Fig. 3 shows a synchronizing arrangement of the continuous corrector type in which a phase shifter similar in some respects to that of Fig. 2 cooperates to maintain a distributor in synchronism with the incoming impulses. These impulses are received by an incoming relay 313 and impressed through the distributor 314 upon the input circuits of vacuum tube 323. An arrangement is provided for storing upon the grid circuits of vacuum tube 323, charges which are a function of the difference in frequency between the incoming impulses and the movement of the distributor brush. The arrangement operates in substantially the same manner as the arrangement of Fig. 1 which comprises relay 13, distributor 14, condenser 18 and amplifier tubes 23. The arrangement shown in Fig. 3, however, does not include all the corresponding elements in Fig. 1.

The plates of vacuum tubes 323 are connected together through the winding of a three-position relay 324. Inequality of grid voltage of the tube 323 causes a current to flow in one direction or the other through relay 324. The armature of relay 324 is connected to one terminal of the armature of a separately excited motor 325. The opposite terminal of the motor armature is grounded. The contacts of the relay armature are connected to grounded batteries of opposite polarity whereby the direction of rotation of the motor is dependent upon the position of the relay armature.

The motor 325 is adapted to drive the arm or slider 356. This arm is part of a phase modifier 351, and is adapted to contact with a resistor 352 at any point. The resistor 352 is arranged to form a closed circuit having four sections through each of which a current flows, the currents in adjacent sections being displaced in-phase by 90 degrees. These currents are each in approximate synchronism with the incoming line impulses. These currents originate with a tuning fork 340 with which the currents are in synchronism, and pass through an amplifier and phase splitter to the phase shifter 351.

The apparatus and operation of the frequency setting tuning fork, amplifier and phase splitter circuits is as follows: A pick-up coil 342 disposed within the tines of tuning fork 340 is connected in parallel to the parallel grid circuits of two vacuum tubes 343 and 344. One of these tubes has a plate circuit connected to the driving magnet 341; while the other plate circuit is connected through a transformer 346 to a vacuum tube amplifier 347. Thus, currents having the frequency of vibration of the tuning fork are induced in the pick-up coil 341 and amplified. A part of the amplified current is fed to the driving magnet to maintain vibration on the tuning fork while another part of the current is supplied to amplifier 347. The phase splitter comprises a transformer 348 and a transformer

349 each having a primary winding in the output circuit of vacuum tube 347. The primary winding of transformer 348 is connected in series with the plate circuit while the primary winding of transformer 349 is shunted by a resistance 350. The secondary windings of the transformers are connected in the respective grid circuits of amplifier 360. The secondary winding of transformer 349 is shunted by a condenser 361. By means of this condenser the current in the secondary winding of transformer 349 may be adjusted in phase relation with respect to the current in the secondary winding of transformer 348.

Amplifier 360 comprises two vacuum tubes 362 and 363 respectively, having their input circuits connected to transformers 348 and 349, respectively, and their output circuits connected to transformers 364 and 365, respectively. The secondary winding of transformer 364 is connected across oppositely disposed terminals of resistor 352, such terminals being designated for convenience A and C. The remaining terminals B and D are connected to the secondary winding of transformer 365.

An arm 356 corresponding in function to arm 56 of Fig. 2 is adapted to be driven by motor 325 and has a sliding connection with resistor 352. The arm is connected to one terminal of the input circuit of an amplifier 367. Another terminal of this input is connected to the mid-points of the secondary windings of both transformers 364 and 365. A relay 370 is connected in the output circuit of amplifier 367. This relay corresponds in function to the relay 70 of Fig. 1, and drives a distributor motor (not shown). This distributor motor corresponds in construction and operation to the motor 10 of Fig. 1 and may be connected to the distributor brush arm to drive it in the customary manner.

The phase modifier 351 operates in a manner similar to the phase modifier 51 of Fig. 2. The condenser 361 is adjusted so that the voltage across the points B and D is displaced 90 degrees in phase relation with respect to the voltage across the points A and C. The amplifier 367 is connected to points in the phase modifier which correspond to the points of connection of the primary winding of transformer 55 in Fig. 2. Because of the close similarity in operation between the phase modifier 351 and the phase modifier 51 of Fig. 2, a detailed description of the operation of the former is deemed unnecessary. In general, however, the operation is as follows:

Motor relay 370 is energized by current which originates with tuning fork 340 and passes through the phase shifter 351. The frequency of the currents supplied to the motor relay is equal to the frequency of the fork plus or minus the speed of revolution of arm 356. If the arm is started from rest, advanced through an angle of n degrees and stopped, the current in relay 370 is advanced n degrees in phase relation with respect to the current in the tuning fork circuit.

The arm 356 is moved automatically by motor 325 which is started whenever the tuning fork and incoming line impulses commence to depart from exact synchronism. The phase modifier 351 does not affect the frequency of vibration of the tuning fork, but compensates for the difference in frequency between the tuning fork and incoming line impulses by adding to or subtracting from the output circuit of the tuning fork,

a frequency determined by the speed of the motor.
What is claimed is:

1. In a motor synchronizing system, a motor, an incoming line, periodically oscillating means for generating current for driving said motor of a frequency determined by unit length of signaling impulses incoming over said line, and means for shifting the phase of the generated current after generation thereof for driving the motor, said means operating under control of the incoming impulses.

2. In a signaling system, a line, a rotary distributor, a motor for driving said distributor, a circuit including a tuned element for generating current having a frequency determined by the speed of a succession of impulses incoming over said line for driving said motor, and a device for shifting the phase of the motor current after generation thereof, whereby the distributor may be orientated with respect to the incoming impulses.

3. A receiving system for signal waves comprising a distributor device, a source of waves at least approximately synchronized with the incoming waves, said source controlling power to drive said distributor, a phase shifting device connected in circuit to be traversed by the waves from said source of power, devices operating under the control of incoming waves to control said phase shifting device, and instrumentalities under the control of said phase shifting device for shifting the phase of said distributor with respect to incoming signaling waves.

4. A system in accordance with claim 3 in which the phase shifting device has a rotor and the source supplies current to drive the distributor through the phase shifting device, and an electrodynamic device (325) under the control of the incoming signal waves operates the rotor.

5. A system in accordance with claim 3 in which the phase shifting device comprises a network of impedance elements and an element (356) rotatable with respect thereto, the impedance elements being traversed by the current which controls the rotation of the distributor, and the angular position of the element with respect to the network being under control of the devices which operate under the control of the incoming waves.

6. An impulse reception system comprising a distributor over which incoming impulses are distributed, a source of energy for driving said distributor, an electromechanical device operated by energy supplied from said source coupled to said distributor to drive it, and a phase modifying device between the source and the electromechanical device, said phase modifying device comprising four impedance means arranged to form a closed circuit having four connected points, said source being connected to impress voltage upon said impedance elements across two oppositely disposed points in the closed circuit square, means for connecting across the two other connected points a similar voltage about 90 degrees out of phase, and an output circuit having one terminal connected to a point in said closed circuit square and its other terminal adjustable over said square.

7. A system according to claim 6 wherein the output circuit is connected to a repeater of the high input impedance voltage controlled type.

8. A system according to claim 6 in which adjacent pairs of said four impedance elements are inductive and capacitive and form a combina-

tion resonant at around the frequency of the supplied voltage.

9. An impulse receiving system comprising a rotating distributor, a line supplying impulses of message conveying character to said distributor, a source of waves for driving said distributor in approximate synchronous relation to said impulses, a device between said source and said distributor for varying the phase of the waves, said device being controlled and operated by said distributor.

10. An impulse receiving system comprising a rotating distributor, a line supplying impulses of message conveying character to said distributor, a source of waves for driving said distributor in approximate synchronous relation to said impulses, said distributor being connected to devices for regulating the waves supplied to drive said distributor in order to maintain synchronism, and a phase shifter controllable independently of said distributor to change the phase of the wave supplied to drive it.

11. In a telegraph system, a receiving rotary apparatus, driving means therefor, a source of signals consisting of two different line conditions of irregular duration, driving means for said rotary apparatus operating in substantial synchronism with said signals, an electric motor in addition to said driving means associated with said rotary apparatus so as to shift the phase position thereof in a gradual manner with respect to the incoming signals to apply a corrective movement thereto, to compensate for deviation in the phase position of said rotary apparatus, and means responsive to a reversal of said signals for determining the direction of phase correction.

12. In a signaling system, a source of periodic signals, a rotary apparatus operating in substantial synchronism with said signals including a commutator operating in unison with said rotary apparatus and having at least one pair of segments, a frequency setting source for said apparatus, means acting in response to each reversal of said signals for producing a discharge of electric current limited to a short duration and of uniform direction with respect to said commutator, means for transmitting said discharge through said segments of said pair depending upon the position of the rotary apparatus at the time said discharge occurs, and means for adjusting the phase relation of said rotary apparatus with respect to said frequency setting source either forward or backward depending upon the position of said segments at the time of said discharge.

13. In a signaling system, a source of periodic signals, a rotary apparatus operating in substantial synchronism with said signals, means for adjusting the phase relation of said rotary apparatus with respect to the average period of said signals comprising a distributor operating in unison with said rotary apparatus, a relay responsive to the polarity of said signals, means connected electrically intermediate said relay and distributor for producing impulses of short duration and uniform polarity for each reversal of said signals, said distributor distributing said impulses to the phase adjusting means in accordance with the phase position of said signals relative to said rotary apparatus, and a phase correcting motor controlled in accordance with the distribution.

14. In a signaling system, a source of periodic signals, a rotary apparatus operating in substantial synchronism with said signals, means for ad-

justing the phase relation of said rotary apparatus with respect to the average period of said signals comprising a distributor operating in unison with said rotary apparatus, a relay responsive to the polarity of said signals for producing impulses of short duration and uniform direction for each reversal of signals, a unilaterally conducting network connected intermediate the tongue of said relay and said distributor, said distributor distributing said impulses to the phase adjusting means in accordance with the phase position of said signals relative to said rotary apparatus, and a motor controlled according to the distribution to correct the phase of said apparatus with respect to the signals.

15. In a signaling system, a source of periodic signals, a rotary apparatus operating in substantial synchronism with said signals, means for adjusting the phase relation of said rotary apparatus relative to the average period of said signals, comprising a distributor operating in unison with said rotary apparatus, said distributor having a plurality of pairs of segments, a relay having windings acting oppositely upon the tongue of the relay, the corresponding segments of each pair being connected to one winding of said relay and the remaining segments of each pair being connected to the opposite winding, means for supplying impulses of uniform polarity to said windings through their corresponding segments, depending upon the position of the distributor brush at the instant a reversal occurs in said signals, and means responsive to the position of said relay for adjusting the phase relation of said rotary apparatus either forward or backward.

16. In a synchronizing system, a synchronous distributor, a source of signal impulses, means for producing a correcting effect in response to reversals in polarity of said signal impulses, said means including a relay responsive to correcting impulses and operable to one side or the other depending upon the time of occurrence of said reversals relative to an average position, and means controlled by said relay for accelerating or decelerating said distributor.

17. A synchronizing system for telegraphy for maintaining a synchronous distributor in correct phase relation with respect to a succession of incoming impulses of the type received over a telegraph line from a sending station, comprising (1) relay means for applying to said distributor an electromotive force of short duration upon each reversal of polarity of voltage or current received by said relay, (2) distributor means having fast and slow elements, (3) electrical conductors connected to said distributor means over which the resultant current is distributed according to the phase position of said distributor means with respect to the reversals, (4) a phase correction controlling element having a phase retarding condition and a phase accelerating condition, (5) connections whereby said element assumes one or the other of said conditions dependent upon the distribution of said current by said distributor means, and (6) an electromechanical correcting instrumentality for advancing or retarding the phase of said distributor means according to the position of and under the control of said correction controlling element.

18. A system according to claim 17 in which the relay means for producing a current of short duration is a relay having its armature moved from one contact to the other upon reversals of polarity of received impulses.

19. A system according to claim 17 in which the relay means for producing an electromotive force of short duration comprises a relay having an armature which is off both its contacts upon every reversal and in which a source applies the electromotive force to the distributor during such time as the relay is off its contacts.

20. A system according to claim 17 in which the correction controlling element is an electric relay with connections whereby it is biased to one position by application of said electromotive force of short duration resulting from a reversal early in phase and to the other position by application of said electromotive force resulting from a reversal late in phase.

21. A system according to claim 17 in which the electromechanical correcting element is a motor operable backward or forward and the rotatable means includes a distributor element rotating at a frequency set by a periodic device, and means whereby operation of said motor advances or retards said distributor with respect to said device.

22. A synchronizing system comprising (1) means including a relay for applying an electromotive force of short duration upon each effective reversal of polarity of received voltage or current, (2) a distributor having fast and slow segments over which a conductive contact means has relative movement, (3) conductors over which the current resulting from the applied electromotive force is distributed in a manner dependent upon the relative position of said contact means with respect to said segments, (4) a phase correcting means including a relay having a phase advancing position and a phase retarding position, (5) circuit connections whereby said relay is caused to assume one or the other of said positions dependent upon and determined by distribution of said current, and (6) an electric motor for advancing or retarding the phase of said distributor as its phase relative to reversals of received voltage or current may demand.

23. In a signaling system having a rotary apparatus and a source of current reversals, the method of maintaining substantially uniform speed of said rotary apparatus in synchronism with said reversals comprising producing a difference of potential of short duration and uniform direction between two points in timed relation to each reversal, utilizing said difference of potential to supply current to a circuit of one polarity for reversals timed early with respect to the position of said rotary apparatus and of another polarity for reversals timed late with respect to the position of said apparatus, current of one polarity only being supplied at a time through said circuit, and causing the phase position of said rotary apparatus to be varied backward or forward according to the polarity of the current in said circuit.

24. A signaling system comprising a conductor for supplying incoming intelligence representing impulses which are transmitted as multiples of a unit length, a mechanical distributor (14, 16) over which said impulses incoming over said conductor are distributed, a source of energy (40 to 49) for driving said distributor, an electromechanical device (10) operated by energy supplied from said source and coupled to said distributor, a phase modifying device (11) between the source and the electromechanical device, and devices whereby said phase modifying device varies the phase of said distributor with respect to said impulses, said phase modifying device comprising an impedance network including an element in which

current flows and a contactor shiftably contacting with said element.

25. A signaling system comprising a conductor for supplying incoming intelligence representing impulses which are transmitted as multiples of a unit length, a mechanical distributor (14, 16) over which said impulses incoming over said conductor are distributed, a source of energy (40 to 49) for driving said distributor, an electromechanical device (10) operated by energy supplied from said source and coupled to said distributor, a phase modifying device (11) between the source and the electromechanical device, and devices whereby said phase modifying device varies the phase of said distributor with respect to said impulses, in which the phase modifying device comprises an impedance network having points thereon at which appear voltages varying over a 360 degree range and a contactor movable over said points.

26. A signaling system comprising a conductor for supplying incoming intelligence representing impulses which are transmitted as multiples of a unit length, a mechanical distributor (314) over which said impulses incoming over said conductor are distributed, a source of energy (340 to 349) for driving said distributor, an electromechanical device (10) operated by energy supplied from said source and coupled to said distributor, a phase

modifying device (351) between the source and the electromechanical device, and devices whereby said phase modifying device varies the phase of said distributor with respect to said impulses, in which the phase modifying device comprises a rotor provided with driving means whereby the phase may be continuously and progressively shifted.

27. A signaling system comprising a conductor for supplying incoming intelligence representing impulses which are transmitted as multiples of a unit length, a mechanical distributor (314) over which said impulses incoming over said conductor are distributed, a source of energy for driving said distributor, an electromechanical device (10) operated by energy supplied from said source and coupled to said distributor, a phase modifying device (351) between the source and the electromechanical device, and devices whereby said phase modifying device varies the phase of said distributor with respect to said impulses, in which the phase modifying device comprises a movable contactor shiftably over points energized in different phase relation and instrumentalities controlled by the difference in phase of the distributor and the incoming impulses for controlling the movement of said contactor.

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