

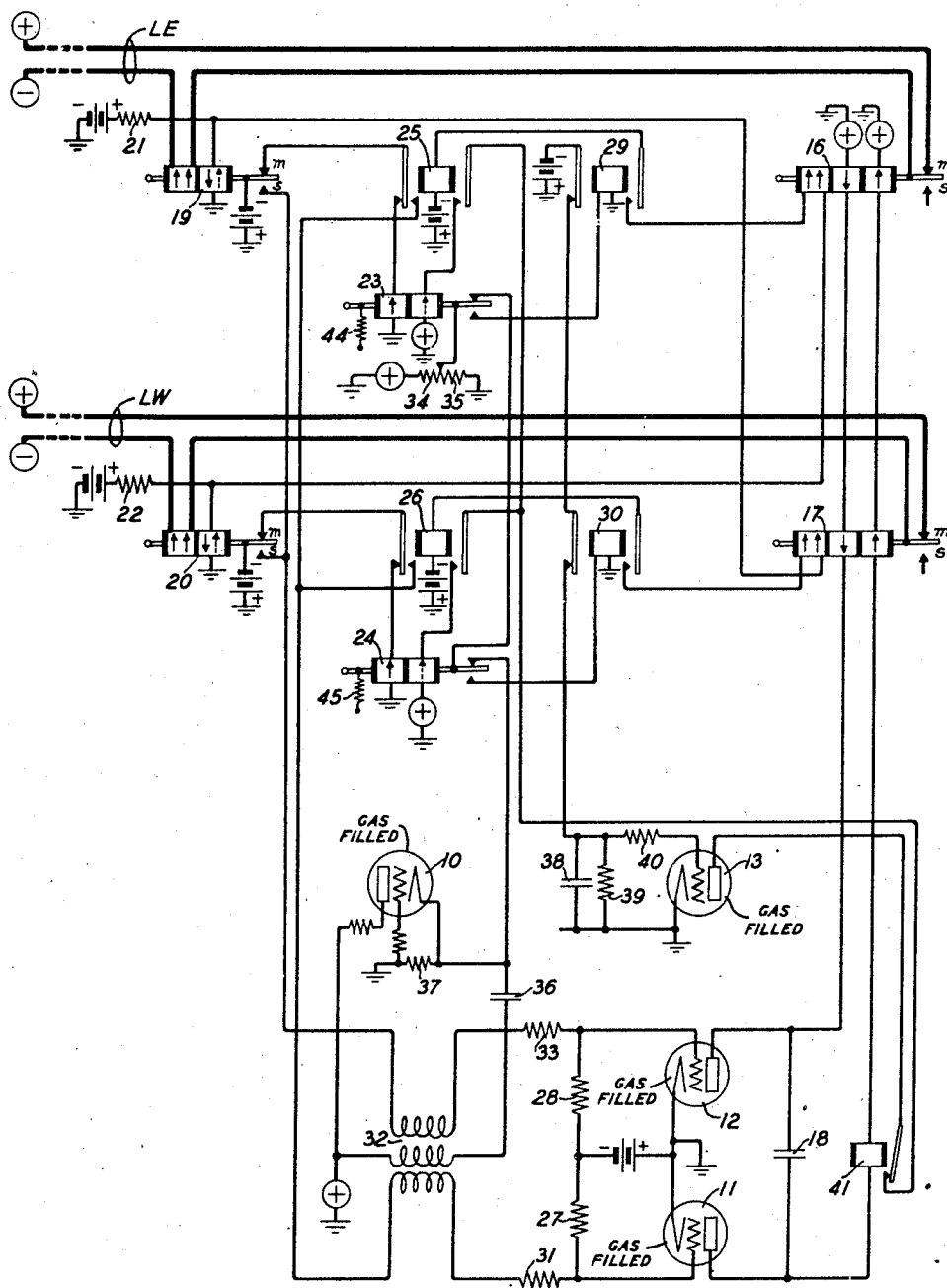
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REGENERATIVE TELEGRAPH REPEATER

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REGENERATIVE TELEGRAPH REPEATER

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This invention relates to regenerative telegraph repeaters and particularly to repeaters of this type for use in start-stop telegraph systems.

The primary object of the invention is to provide a low cost regenerative repeater for use in start-stop printing telegraph systems.

A more specific object is to regenerate and repeat start-stop telegraph signals without the use of the usual rotary contact devices or other rotating mechanical equipment.

A feature of the invention is a start-stop regenerative repeater having, in lieu of a rotary distributor, a vibrating circuit for timing individual signal impulses and a second slower speed vibrating circuit for stopping the first vibrating circuit at the end of each series of impulses comprising a signal character, the vibrating circuits each including a gaseous space discharge tube.

In accordance with another feature of the invention a pair of gaseous space discharge tubes are used for passing the marking and spacing impulses, respectively, and their time of operation is determined by the aforementioned vibrating circuit for timing individual signal impulses.

Thus a repeating system arranged in accordance with the general principles of the invention for repeating signals from one line circuit into another will be provided with two oscillating circuits which both are started immediately upon the reception of a start impulse. Each oscillating circuit comprises a gaseous discharge tube, a condenser and a resistance for controlling the condenser current. The charge condition of the condenser determines the state of ionization of the tube, and this charge condition commences to change at a rate determined by the resistance and at the time of reception of the start impulse. One of these condensers will have its charge changed at a slow rate to bring about a sudden change in the ionization of its associated tube during the reception of the succeeding stop impulse, whereas the other condenser changes its charge more quickly, so that its associated tube will suddenly change its ionization during the reception of the next succeeding impulse of the start-stop series of impulses representing a character. This fast oscillating circuit thereafter repeats its performance once for each impulse of a signal series. The slow oscillating circuit is connected to stop the fast oscillating circuit during the reception of the stop impulse and to restore the repeater system to its normal condition, ready for reception of the next impulse series.

In accordance with a preferred feature of the invention, two repeating circuits are furthermore

provided in the repeating system, each including gaseous discharge tubes, one circuit being for repeating marking impulses and the other for repeating spacing impulses. The ionization of these repeating tubes is controlled by the fast oscillating circuit in conjunction with the incoming impulses, the oscillating circuit determining the time at which a change in ionization shall take place in either repeating tube and the incoming impulses selecting one tube or the other in accordance with the nature of the impulses.

An interconnecting circuit is provided between the two repeating tubes whereby the active tube is rendered inactive when the other tube is selected for repeater action.

In a preferred embodiment of the invention the fast and slow oscillating circuits as well as the marking and spacing repeating circuits are made common to the two halves of a two-way repeating system operating on the single line principle. The reversal of the direction of transmission takes place without the loss of impulses or characters.

The invention will now be described as applied in a preferred embodiment and for this purpose reference will be made to the accompanying drawing which shows in diagrammatic form a simplified circuit arrangement for a telegraph repeating system adapted for transmission in both directions, one at a time, between two line circuits. The particular repeater circuit shown is arranged for two-way operation between two half-duplex telegraph loop circuits LE and LW and since half-duplex operation requires the transmission of signals in only one direction at a time, the circuit is provided with but one signal regenerating element, the direction of which is reversible without the loss of any character when the direction of transmission is changed.

In a printing telegraph system of the start-stop type, each character signal is transmitted by means of a series of impulses, each impulse series usually consisting of a start impulse, five signal impulses, and a stop impulse. The start impulse of any character is an open or spacing impulse. Each of the five impulses following the start impulse may be either an open or closed impulse, that is a spacing or a marking impulse, depending upon the particular character being transmitted. The final or stop impulse of any character is a closed or marking impulse.

In this invention the aforementioned character signals are regenerated and repeated in either direction under control of three-element gaseous discharge tubes functioning in circuit arrange-

ments the detailed operation of which is subsequently set forth. The type of tube suitable for the purposes of the invention is generally known as the trigger tube. It is characterized as a three-element tube containing a monatomic gas, such as argon, at low pressure. In operation, the cathode-anode circuit may be connected to a source of normal potential and ionization of the gas is prevented by the application of a blocking potential, usually negative, to the control or grid element. The cathode-anode circuit within the tube may then be rendered conductive due to ionization of the enclosed gas either by making the grid potential less negative or by making the anode potential more positive. To thereupon deionize the tube to render it non-conducting, it is necessary to reduce or disconnect the anode or plate potential. A tube suitable for this purpose is known as the 256—A tube of Western Electric Company manufacture. With a plate voltage of 130 volts it may be adjusted to change from the non-conductive to the conductive state at a grid potential of -4.5 volts.

Correctly timed individual signal pulses are generated by a vibrating circuit consisting of gaseous discharge tube 10, condenser 36 and resistance 37. A second vibrating circuit, functioning at a slower speed, and consisting of gaseous discharge tube 13, condenser 38 and resistance 39 provides timed control means for stopping the individual impulse generating circuit at the end of each series of impulses comprising a character signal. Two additional gaseous discharge tubes, tube 11 and tube 12, provide means for passing marking and spacing impulses, respectively, to the windings of the east transmitting polar relay 16 and the west transmitting polar relay 17, one or the other of these latter relays repeating the regenerated signals over the line loop with which it is associated, depending upon the direction of transmission at that time. Receiving polar relay 19 is associated with the east line loop LE and responds to impulses incoming over that loop, in turn controlling the functioning of the marking and spacing discharge tubes 11 and 12 with respect to which of these tubes should function during a particular locally regenerated impulse, for the purpose of passing that impulse to the transmitting relay in the west line loop LW. Receiving polar relay 20 is associated with the west line loop LW and functions, for signals incoming over the west line loop, in a manner identical with that of the east receiving relay 19.

Assuming now that both line loops LE and LW are closed to battery at the distant ends of the loops, the receiving relays 19 and 20 both hold their armatures in contact with their marking contacts due to the line current flowing in the left or line windings of these relays. The circuit for relay 19 is traceable from the upper conductor of line LE, over the marking contact and armature of relay 16, and through the left winding of relay 19 to the lower conductor of line LE. The circuit for relay 20 is traceable from the upper conductor of line LW, over the marking contact and armature of relay 17, and through the left winding of relay 20 to the lower conductor of line LW. The right or biasing windings of relays 19 and 20 are normally energized in local circuits to positive potential through resistances 21 and 22 respectively. The direction of current flow through the biasing windings is such that the armatures tend to move to the spacing contacts but, due to the greater opposing current

flow in line windings, the armatures are held on the marking contacts so long as the line loops remain closed. The armature of polar relay 23 is held on the upper contact against the effect of biasing spring 44 by the current flowing from ground through the left winding of the relay over the back contact of relay 25, to negative potential over the marking contact and armature of relay 19. Similarly, the armature of polar relay 24 is held on the upper contact of that relay against the effect of biasing spring 45 by the flow of current from ground through the left winding of relay 24, over the back contact of relay 26, to negative potential over the marking contact and armature of relay 20. Relays 23 and 24 may, of course, be biased toward their lower contacts by other well-known means, such as an additional winding properly connected to serve as a biasing winding.

Assume further that the marking discharge tube 11 is in its ionized condition at this time since both of the receiving relays 19 and 20 are on their marking contacts. With tube 11 ionized, current flows from positive potential through the right windings of transmitting relays 16 and 17, winding of relay 41, and over the anode-cathode circuit of tube 11 to ground. The right windings of relays 16 and 17 are so connected that this flow of current holds the armatures of these relays on their marking contacts thereby holding the east line LE and the west line LW closed. Relay 41 is also operated in the above circuit, but performs no useful function at this time. Under these conditions, spacing tube 12 will be non-conducting, as will be explained later, and the upper side of condenser 18 will be subject to the full positive potential through the middle windings of relays 16 and 17, whereas the lower side of condenser 18 will be subjected practically to ground potential through the low potential drop to ground in tube 11. The condenser 18 will thus be charged accordingly. A negative potential is applied to the grids of tubes 11 and 12 through resistances 27 and 28, respectively. This potential is more negative than the critical potential at which the tubes ionize at normal anode potential. Tube 12 is therefore prevented from ionizing, although tube 11, which previously ionized in a manner which will later be described, remains in the ionized condition. Tube 10 is prevented from ionizing at this time by a positive potential of the proper intermediate value supplied to its cathode from the adjustable potentiometer 34, 35 in a circuit over the upper contacts in series of relays 23 and 24. Tube 13 is prevented from ionizing at this time due to a negative potential on its grid which is of a value in excess of the critical value at which the tube ionizes. This negative potential is supplied to the grid of tube 13 over the back contacts in series of relays 29 and 30 and through resistance 40.

With the above conditions obtaining in the repeater circuit let it now be assumed that the east line loop LE is opened as a result of a start impulse of a character signal being transmitted at the distant end of that loop. Upon the cessation of current flow in its left winding receiving relay 19 operates its armature to its spacing contact due to the current flowing in its right or biasing winding. A circuit is thereupon completed from negative potential over the armature and spacing contact of relay 19, through the upper winding of transformer 32 and through resistance 33 to the grid of the spacing discharge

tube 12. The negative potential supplied over the marking or spacing contacts of relays 19 and 20 to the grids of tubes 11 and 12 is of the value as the potential supplied to these grids through resistances 27 and 28. The completion, just described, of the circuit through the upper winding of transformer 32, therefore has no effect on tube 12 at this time. The circuit through the left winding of relay 23 is opened at the marking contact of relay 19 thereby causing the armature of relay 23 to move to the lower contact due to the action of the biasing spring 44. Relay 29 now operates in a circuit from ground through its winding, over the lower contact and armature of relay 23, to positive potential at the potentiometer 34, 35. In operating, relay 29 completes a low impedance circuit from negative potential through the winding of relay 25, over the front contact of relay 29, through the left or holding winding of relay 16, to ground through the right or biasing winding of relay 20 and to positive potential through high resistance 22, thereby reversing the flow of current in the right winding of relay 20 for a purpose which will subsequently be set forth. Relay 25 operates over the circuit just traced and transfers the circuit of the marking contact of relay 19 to pass through the lower winding of transformer 32, through resistance 31 to the grid of the marking discharge tube 11.

The aforementioned operation of the armature of relay 23 to its lower contact opens the circuit from the potentiometer 34, 35 to condenser 36 thereby removing the intermediate positive potential from the upper plate of that condenser. The condenser 36 had previously been partially charged from positive potential through the middle winding of transformer 32, and now continues to charge through resistance 37 to ground. As condenser 36 continues to charge it will apply an increasing potential across the cathode-anode space and as the charging current decreases the potential drop across resistance 37 and, therefore, the potential difference between the cathode and the grid will decrease. When the potential difference between the grid and cathode falls to the critical value for the potential which then exists between the anode and cathode, tube 10 ionizes and becomes conducting. At the same time a direct path is established through the cathode-anode space from positive potential to ground through resistance 37. The potential drop over the cathode-anode space is quickly reduced as condenser 36 is discharged and the potential difference between the grid and the cathode due to the drop in resistance 37 increases. As the discharge current through the tube becomes smaller the cathode-anode potential drop will be reduced to the point where ionization of the tube can no longer be maintained. Tube 10 therefore again deionizes and opens its anode-cathode circuit, thereby stopping any further discharge of condenser 36. Condenser 36 immediately begins recharging from positive potential through the middle coil of transformer 32 and to ground through resistance 37 and, when the critical grid-cathode potential is reached as set forth above, tube 10 again ionizes and completes the discharge path for condenser 36. This free oscillation of tube 10 continues so long as the circuit extending from its cathode to the junction of resistances 34 and 35 is held open at the upper contacts of either relay 23 or relay 24. The point on potentiometer 34, 35 is adjustable and is set at a potential

which will give the condenser 36 an original charge such that the charge on the condenser, upon opening of the marking contacts of relay 23 or relay 24, will reach the point at which the tube 10 ionizes at an instant coincident with the middle or peak of the start impulse received by relays 19 or 20. The values of condenser 36 and resistance 37 are so chosen that the oscillations of tube 10, that is, the recurrent ionizations of that tube as set forth above, occur one signal dot length apart. Thus by proper adjustment of potentiometer 34, 35 the successive instants at which the tube 10 becomes ionized may be oriented to occur isochronously with the centers of the successive impulses of a signal series.

As set forth above, condenser 36 charges and discharges in a circuit which includes the middle winding of transformer 32, thereby inducing voltages in both the upper and lower windings of transformer 32. The windings are so connected that the voltages induced by the charging current will be in a direction to increase the negative potential already applied by battery to the grids of tubes 11 and 12, and thus will have no effect upon these tubes, whereas the discharging current will induce voltages in the opposite direction to reduce the negative potential already applied to the grids, thereby permitting the ionization of one or the other of these tubes. At the time of the first discharge of condenser 36 following the opening of line LE, the circuit to the lower winding of transformer 32 is open at the marking contact of relay 19, the armature of that relay having moved to the spacing contact in response to the start impulse. The spacing contact of relay 19 being closed, the voltage induced in the upper winding of coil 32 is, however, impressed upon the grid of the spacing tube 12 through resistance 33. The upper winding of coil 32 is so connected that this surge momentarily reduces the negative potential on the grid of tube 12 below the critical value and tube 12 thereupon ionizes and becomes conducting. As previously stated, with tube 11 ionized and tube 12 deionized, the upper side of condenser 18 was positively charged with respect to its lower side. As tube 12 now ionizes and becomes conducting current flows from positive potential through the middle winding of relay 16, middle winding of relay 17, and over the anode-cathode circuit of tube 12 to ground. The charged condenser 18 suddenly being connected to low potentials on both sides first quickly discharges, thereby sending a current through tube 12, in aid of the current already present therein, and through tube 11, in opposition to the current therein, so that the anode potential of tube 11 becomes too low to maintain the ionization of tube 11. Upon cessation of current through tube 11 condenser 18 continues to build up its charge, until the lower side becomes fully positively charged with respect to the upper side, whereupon the current through the right-hand windings of relays 16 and 17 ceases. The flow of current through the middle windings of relays 16 and 17 over the anode-cathode circuit of the spacing discharge tube 12 tends to move the relay armatures from their marking contacts. In the present condition relay 16 holds its armature on its marking contact due to the force exerted by its left winding, which has been energized over a previously traced circuit and which is so constructed and connected that it exerts a force greater than the force exerted by the middle winding of the relay and in the opposite direction. Relay 17, 75

however, since only its middle winding is energized, moves its armature from its marking contact and thereby opens the west loop LW, thus repeating, over the line, the start impulse received over the east loop LE. The armature of the west receiving relay 20 does not move off the upper contact of that relay when the west loop LW is opened at the upper contact of the west transmitting relay 17, due to the force exerted by the previously reversed current flow in the right winding of relay 20, this current reversal having taken place upon the operation of relay 29 as hereinbefore set forth.

Following the ionization of tube 10 and the subsequent discharge of condenser 36 in response to the start impulse received over the east loop, the oscillation of tube 10 and the charging and discharging of condenser 36 is repeated, as hereinbefore described, at approximately the middle portion of each of the remaining signal impulses of the character being transmitted. No change in the circuit takes place during the subsequent discharges of condenser 36, so long as the armature of the east receiving relay 19 remains on its spacing contact in response to the continued reception of spacing impulses. The spacing discharge tube 12 remains ionized and the west transmitting relay 17 therefore holds the west loop open, thereby repeating the spacing impulses over that loop.

When a closed loop or marking signal impulse is received over the east loop, the current through the left winding of relay 19 causes the armature to move to its marking contact. This opens the circuit through the upper winding of coil 32 to the grid of the spacing tube 12 and closes the circuit from negative potential at the armature of relay 19, over the marking contact of that relay, left front contact of relay 25, and through the lower winding of coil 32 and resistance 31 to the grid of the marking discharge tube 11. Upon the next discharge of condenser 36 the voltage induced in the lower winding of coil 32 reduces the negative potential on the grid of tube 11 below the critical value and the marking tube 11 thereupon ionizes and becomes conducting. Current now flows from positive potential through the right windings of relays 16 and 17, winding of relay 41, and over the anode-cathode circuit of tube 11 to ground. The resultant sudden discharge of condenser 18 through tubes 11 and 12 in series momentarily causes the potential on the upper side of the condenser and on the anode of tube 12 to be reduced to a value incapable of maintaining ionization and tube 12 therefore becomes non-conducting. The condenser 18 next recharges in the opposite direction, its upper side becoming positive with respect to its lower side. When condenser 18 has completely recharged no further current flows through the middle windings of transmitting relays 16 and 17. The current now flowing in the right windings of these relays tends to move the armatures to their marking contacts. The east transmitting relay 16 is already on its marking contact due to the current flow in its left winding as hereinbefore set forth. The armature of the west transmitting relay 17 moves to its marking contact in response to the current through its right winding and thereby closes the west loop LW, thus repeating the marking impulse over that loop. So long as the armature of the east receiving relay 19 remains on the marking contact in response to marking impulses, the subsequent discharges of condenser

36 have no further effect on the circuit, and the marking discharge tube 11 remains ionized and holds the armature of the west transmitting relay 17 on the marking contact, thus holding the west loop closed.

If a spacing signal impulse be subsequently received the armature of receiving relay 19 moves to the spacing contact of the relay in response to this impulse. Upon the next ionization of tube 10 and the resultant discharge of condenser 36, the spacing discharge tube 12 ionizes and the marking discharge tube 11 delonizes in the manner previously described. The armature of the west transmitting relay 17 thereupon opens the west loop to repeat the spacing impulse.

Following the retransmission of the start impulse which is a spacing impulse, the five signal impulses comprising the character, in any combination of marking and spacing impulses depending upon the particular character being transmitted, are received, regenerated and retransmitted in the manner set forth above. Following the last of the five signal impulses a final or stop impulse is transmitted. This stop impulse is a marking impulse and causes the armature of receiving relay 19 to move to or remain on its marking contact, depending upon whether the preceding impulse was spacing or marking. Upon the subsequent ionization of tube 10 and the discharge of condenser 36 the marking discharge tube 11 ionizes, if not already in that condition. Relay 41, therefore, will be operated and the armature of relay 17 will be on the marking contact in response to the final or stop impulse of any character.

When the armature of receiving relay 19 moved off the marking contact in response to the open start impulse transmitted at the beginning of the character the armature of relay 23 moved from the upper to the lower contact and thereby completed the operating circuit for relay 29 as previously described. The operation of relay 29 opened the circuit from the negative potential on its left armature to the upper side of condenser 38 and to the grid of tube 13. Condenser 38 had been fully charged up to this time and, upon the removal of the negative potential from its upper side, it started to discharge to ground through resistance 39 thereby continuously reducing the negative potential on the grid of tube 13. The values of condenser 38 and resistance 39 are so chosen that the negative potential on the grid of tube 13 will fall to the critical value at which ionization of the tube can take place, near the end of the interval required for the transmission of the series of signal impulses comprising a character. The adjustment should be such that this critical value will be reached simultaneously with the arrival of the beginning of the stop impulse. Thus when the marking tube 11 is subsequently ionized at the arrival of the center of the stop impulse and relay 41 operates as set forth in the preceding paragraph, a circuit is completed from positive potential through the right winding of relay 23, over the right front contact of relay 25, contact of relay 41, to the anode of tube 13. Since the grid potential of tube 13 has now been reduced to less than the critical value by the continued discharge of condenser 38, tube 13 ionizes and becomes conducting. The right winding of relay 23 is now energized over the anode-cathode circuit of tube 13 and causes the armature to move to its upper contact. This opens the operating circuit for relay 29 and again closes the circuit from the

junction of potentiometer resistances 34 and 35 to the cathode of tube 10 to prevent any further ionization and oscillation of tube 10 after this time. Relay 29 releases, in turn releasing relay 25. The release of relay 25 opens the circuit through the right winding of relay 23, thereby causing tube 13 to deionize due to the removal of the positive potential from its anode. Relay 23 holds its armature on its upper contact at this time due to the force exerted by its left winding, which is now energized in a circuit from ground through that winding, over the back contact of the released relay 25, to negative potential over the marking contact and armature of relay 19, which is in its marking position in response to the previously received stop impulse. The aforementioned release of relay 29 also opens the circuit through the left or holding winding of relay 16 and thereby causes the current flowing in the right winding of relay 20 to reverse. With relay 29 released, negative potential is again connected over its back contact and over the back contact of relay 30 to the grid of tube 13 and to the upper side of condenser 38. Condenser 38 recharges and the control circuit for tube 13 is thereby prepared for functioning during the transmission of the following character. Any subsequent character signals received over the east loop LE are regenerated and repeated over the west loop LW in the manner hereinbefore set forth. From the description given above it will be seen that once relay 23 is operated to its lower contact during a start impulse it cannot again be operated to its upper contact until the stop signal is received. In the interim relays 25 and 29 are held operated by the lower contact of relay 23, thereby preventing energization of the left winding of this relay; and through the circuit through the right winding of relay 23 is completed, this winding cannot operate the armature until the tube 13 ionizes due to the timed discharge of condenser 38. This occurs at the time of the reception of the center of the stop impulse, the exact timing being such that all relays will be restored to normal in time for the reception of the next start impulse. Provision should, of course, be made to prevent relay 23 from becoming deenergized during the return of relay 25 to normal. Thus it may be arranged that the left back contact of relay 25 close before the right front contact opens, or the decay of the current in the right winding of relay 23 may be delayed by any well-known condenser or resistance path, to occur in conformity with the increase in current through the left winding or subsequently thereto.

In the event that a break signal be transmitted over the east loop LE, the armature of the east receiving relay 19 will move to its spacing contact as a result of the opening of the east loop. The repeater circuit will function as previously described in connection with the transmission of the spacing start impulse and will cause the armature of the west transmitting relay 17 to open the west loop LW to repeat the break signal. The tube 10 will continue to oscillate for the duration of the break signal, but without further effect. Relay 29 operates as previously set forth and opens the negative potential from the upper side of condenser 38. Condenser 38 starts to discharge through resistance 39 and the negative potential on the grid of tube 13 drops to the critical value at which ionization of the tube can take place after an interval of about six signal impulse periods. Tube 13 does

not ionize at this time however since its anode circuit is open at the contact of relay 41, this latter relay having released upon the deionization of the marking discharge tube 11 which followed the ionization of the spacing discharge tube 12 in response to the opening of the east loop LE.

At the termination of the break signal the closure of the east loop causes the armature of the east receiving relay 19 to again move to its marking contact. Upon the next ionization of tube 10 the marking discharge tube 11 ionizes and the spacing tube 12 deionizes in the manner previously described. Relay 41 operates over the anode-cathode circuit of tube 11 and completes the circuit from positive potential through the right winding of relay 23, over the right front contact of relay 25 and front contact of relay 41 to the anode of tube 13. Since the negative potential on the grid of tube 13 has already fallen to or below the critical value due to the continued discharge of condenser 38, that tube now ionizes. Current thereupon flows through the right winding of relay 23 and causes the armature of that relay to move to the upper contact thereby releasing relay 29 and again connecting the potential at the junction of resistances 34 and 35 to the cathode of tube 10 to prevent further oscillations of that tube. The release of relay 29 causes the release of relay 25, which in turn opens the anode circuit of tube 13 and thereby causes that tube to deionize. Relay 29 also connects negative potential over its back contact and the back contact of relay 30 to the upper side of condenser 38 and the grid of tube 13. Condenser 38 recharges and prepares the circuit for subsequent retransmission of signal impulses in either direction.

Signal impulses may be repeated from the west line LW to the east line LE whenever relay 23 is on its upper contact and relay 29 is therefore unoperated. The opening of the west line LW for the transmission of a start impulse causes the armature of the west receiving relay 20 to move from the marking contact to the spacing contact. This opens the circuit through the left winding of relay 24 and the armature of that relay moves to the lower contact due to the force exerted by the biasing spring 45. The opening of the upper contact of relay 24 removes the potential at the junction of resistances 34 and 35 from the cathode of tube 10 and from the upper side of condenser 38. The closure of the circuit over the lower contact of relay 24 operates relay 30, which in turn completes a low resistance circuit from negative potential through the winding of relay 26, front contact of relay 30, left holding winding of relay 17 to ground through the right winding of the east receiving relay 19 and to positive potential through high resistance 21. This reverses the flow of current in the right winding of relay 19 to hold the armature of that relay on its marking contact during subsequent openings of the east loop LE for the retransmission of signals incoming over the west loop. The left winding of the west line transmitting relay 17 is so connected that the force exerted by the flow of current through that winding holds the armature of the relay on its upper contact and thereby holds the west line LW closed during subsequent ionizations of the spacing discharge tube 12 during the repeating of signal impulses from the west line to the east line. The operation of relay 30 also removes the negative potential

from the grid of tube 13 and from the upper side of condenser 33. The operation of discharge tubes 10, 11, 12 and 13 and their associated control circuits in repeating signals from the west line to the east line is identical with that hereinbefore described in connection with east to west transmission.

At the conclusion of the west to east transmission the west receiving relay 20, if it has not already done so due to a preceding marking signal impulse, moves its armature to its marking contact in response to the final or stop impulse of the last character signal impulse series transmitted. The marking discharge tube 11 thereupon ionizes and the repeater circuit restores to its normal condition with tube 11 ionized and tubes 10, 12 and 13 deionized in the manner hereinbefore set forth in connection with the conclusion of the east to west transmission.

20 What is claimed is:

1. A start-stop telegraph system comprising signal repeating relay means, a fast oscillatory circuit for timing the operations of said repeating relay means, a slow oscillatory circuit for stopping the oscillations of said fast circuit after the production of a predetermined number of impulses, and relay means for directing the operation of said repeating relay means and for starting simultaneously said fast and slow circuits and for effecting the stopping of said fast circuit under control of said slow circuit, said fast oscillatory circuit comprising a gaseous discharge tube containing cathode, grid, and anode elements surrounded by a monatomic gas, a source of substantially constant potential connected between said grid and anode elements, timed circuit means for applying an intermediate potential to said cathode element and for varying said intermediate potential to render the cathode-anode circuit within said tube alternately conducting and non-conducting.

2. A start-stop telegraph system comprising repeating relay means, a fast oscillatory circuit for timing the operations of said repeating relay means, a slow-oscillatory circuit for stopping the oscillations of said fast circuit after the production of a predetermined number of impulses, relay means for directing the operations of said repeating relay means and for starting simultaneously said fast and slow circuits, and a source of a fixed intermediate potential connected for application by said relay means to said fast circuit under control of said slow circuit to effect the stopping of said fast circuit, said fast oscillatory circuit comprising a gaseous discharge tube containing cathode, grid and anode elements, a source of potential connected between said grid and anode elements, circuit means including capacitance and impedance connected to said three elements to apply a varying intermediate potential to said cathode element as the capacitance charges and discharges to change the conductivity of said tube at regular intervals in accordance with constants of said circuit means.

3. A start-stop telegraph system comprising a fast oscillatory circuit which includes a gaseous discharge tube containing cathode, grid and anode elements, a source of potential connected between said grid and anode elements, circuit means including capacitance and impedance connected to said three elements to apply an intermediate potential to said cathode element and to vary said intermediate potential as the capacitance charges and discharges to

change the conductivity of said tube at regular intervals in accordance with the constants of said circuit means for the production of impulses, said impulse producing system further comprising a slow-oscillatory circuit for stopping the oscillations of said fast circuit after the production of a predetermined number of impulses, relay means for starting simultaneously said fast and slow circuits, and a source of intermediate potential connected for application by said relay means to said cathode for effecting the stopping of said fast circuit under control of said slow circuit and connected for disconnection from said cathode by said relay means for effecting the starting of said fast circuit, said source of intermediate potential being adjustable to advance or retard the impulses with respect to the instant of starting by said relay means, said system further comprising repeating relay means connected to said fast circuit for synchronization and connected to the first said relay means for repeating of impulses therefrom.

4. An impulse repeating system comprising a gaseous discharge tube containing cathode, grid and anode elements, a source of substantially constant potential connected between said grid and anode elements, circuit means including capacitance and impedance connected to said three elements to repeatedly render said tube alternately conducting and non-conducting by varying the potential of said cathode element to be alternately near the potential of said grid element and near the potential of said anode element, sending relay means operative into either of two positions in response to changes in the conductive conditions of said tube and receiving relays means for determining the position into which said sending relay means is to be operated by the changes in said tube in accordance with incoming impulses.

5. A start-stop regenerative system for repeating character signals each including a series of impulses, which comprise repeating relay means and timing means therefor responsive to operate in unison with individual impulses, and control relay means and other timing means therefore responsive to operate in unison with individual signal series of impulses, said timing means each including a gaseous discharge tube for producing timed current impulses.

6. A start-stop regenerative system for repeating character signals each composed of a series of impulses, which comprises repeating relay means, control relay means, a fast oscillatory circuit for timing the transmission of individual impulses by said repeating relay means, a slow-oscillatory circuit responsive to the reception by said repeating relay means of a start impulse to discontinue the oscillations of said fast circuit during the reception of a stop impulse, said fast circuit including a gaseous discharge tube, a source of potential and a network containing capacitance and resistance for controlling said tube to be momentarily conductive at intervals in unison with incoming impulses.

7. A start-stop regenerative system for repeating character signals each composed of a series of impulses, which comprises repeating relay means, control relay means, a fast oscillatory circuit for timing the transmission of individual impulses by said repeating relay means, a slow-oscillatory circuit responsive to the reception by said repeating relay means of a start impulse for operation of said control relay means during the

reception of a stop impulse, said fast circuit including a gaseous discharge tube, a source of potential and a resistance timed condenser for controlling said tube to be momentarily conductive at intervals in unison with incoming impulses, and said control relay means including an adjustable source of intermediate potential for orienting the series of conductive intervals of said tube relative to the incoming impulses and for discontinuing said series of intervals during a stop impulse under control by said slow circuit.

8. A start-stop regenerative repeating system comprising a pair of gaseous discharge tubes each for producing current and no-current conditions alternately, receiving relay means having alternate contacts for preparing alternately one or the other of said tubes for operation, fast timing means for controlling the alternations of said tubes to be in unison with incoming impulses, and slow timing means for stopping the alternations of said tubes after the repeating of a predetermined series of impulses, said fast and slow timing means each including a gaseous discharge tube.

9. A regenerative repeating system comprising a pair of gaseous discharge tubes each for producing current and no-current conditions and having an input side and an output side, receiving relay means for preparing the input side alternately of one or the other of said tubes, timed means including a gaseous discharge tube for initiating the current condition of said tubes in their prepared condition, a source of potential and impedance means connected to each of said output circuits, and capacity means connected between said two output circuits to terminate the current condition of one of said tubes upon the initiation of the current condition of the other tube.

10. A two-way regenerative repeating system comprising west receiving relay means and west

transmitting relay means, east receiving relay means and east transmitting relay means, west control relay means, east control relay means, a marking gaseous space discharge tube for operation to marking of said transmitting relay means, a spacing gaseous space discharge tube for operation to spacing of said transmitting relay means, said marking tube being connected for control by said receiving relay means in marking position and said spacing tube being connected for control by said receiving relay means in spacing position, said west and east control relay means being responsive to said west and east receiving relay means, respectively, in spacing position to prevent operation of said east and west transmitting relay means, respectively, a timed impulse circuit including capacity means and a gaseous space discharge tube for impressing control potentials upon said marking and spacing tube in synchronism with incoming impulses upon operation of either of said control relay means, and capacity means connected between the operating circuit from said marking tube and the operating circuit from said spacing tube to said transmitting relay means to stop the current flow in either one of said tubes immediately upon starting of the current flow in the other of said tubes.

11. A start-stop regenerative repeating system for repeating character signals each composed of a series of impulses, comprising a first oscillatory system having a frequency corresponding to the impulse frequency and a second oscillatory system having a frequency corresponding to the frequency of the character signals, and relay means for repeating said character signals under the timed control by said first and second oscillatory systems, characterized in this that said first and second oscillatory systems each includes a gaseous discharge tube for producing current impulses.

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