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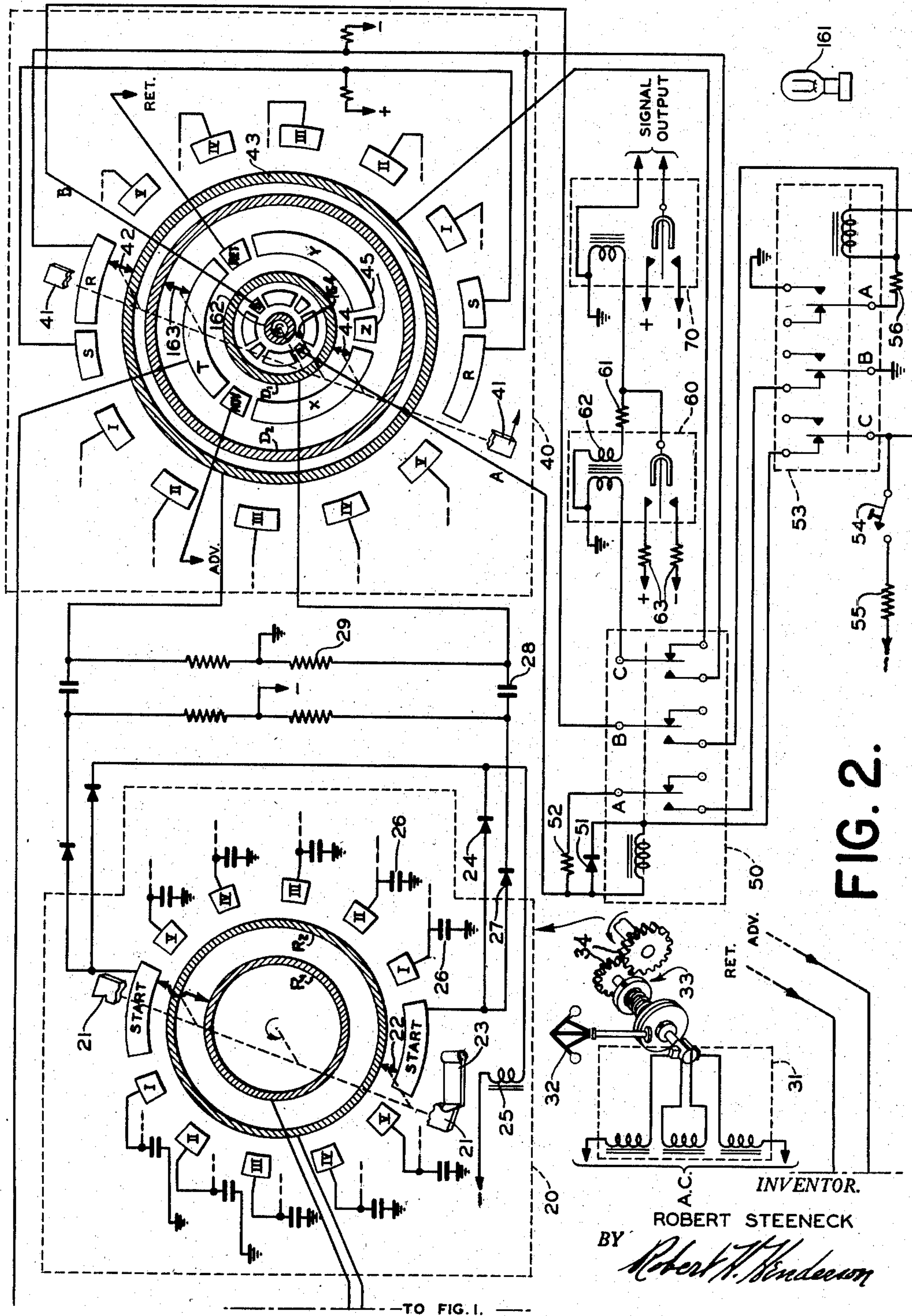
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PRINTING TELEGRAPH SIGNAL NORMALIZER

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3 Sheets-Sheet 2



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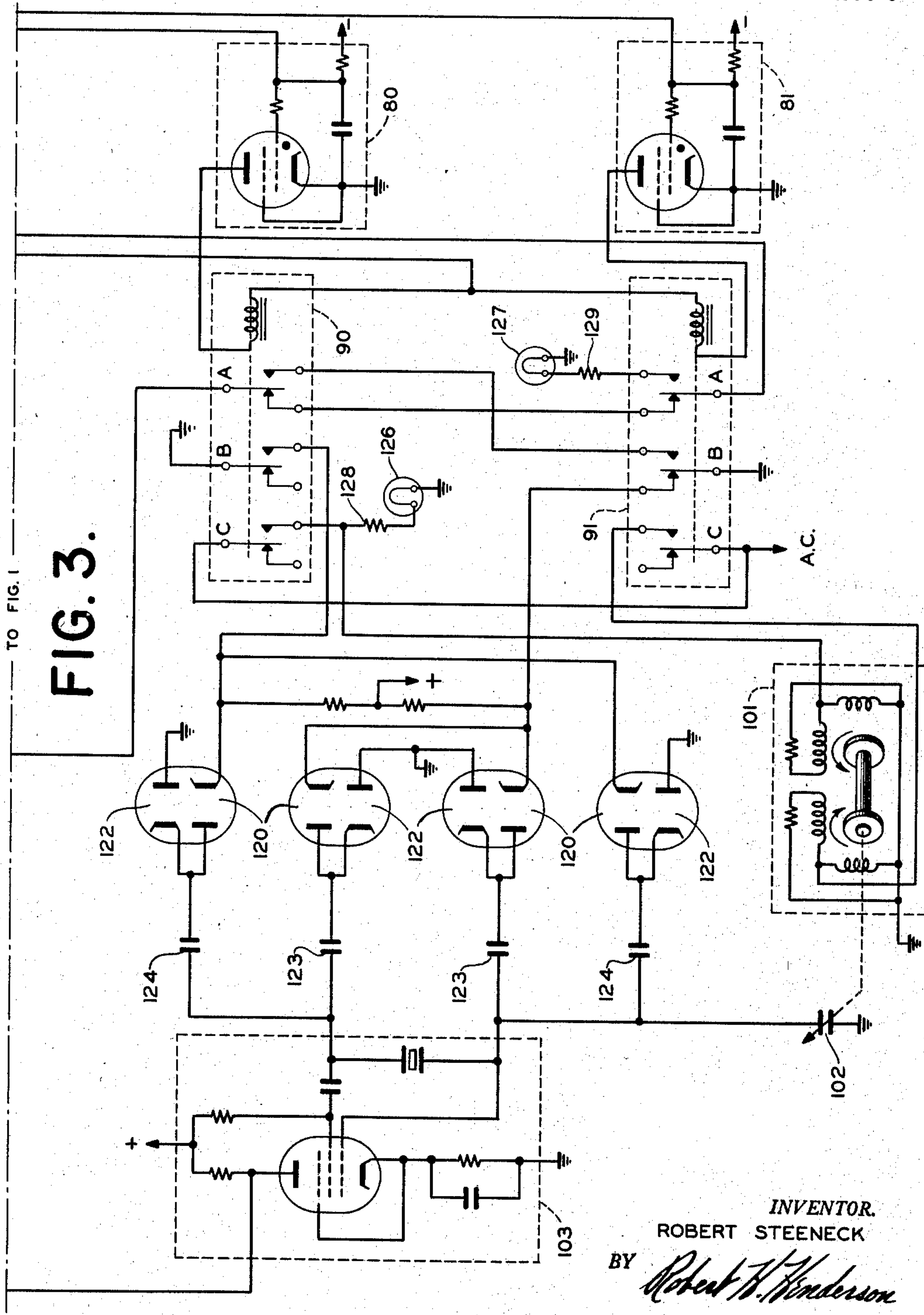
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1

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PRINTING TELEGRAPH SIGNAL NORMALIZER

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11 Claims. (Cl. 178—70)

This invention relates to the production of signals for the printing telegraph, and more particularly to a device for producing an even flow of character signals from a source providing character signals which are interspersed with rest periods.

Printing telegraph signals originating in the start-stop code as a solid succession of characters by distributors accurately timed to an arbitrary speed are gathered at a distant point for multiplex transmission on distributors which are operated at a constant and precisely established speed. To conveniently avoid synchronization problems, the speed of these latter distributors is maintained at a value slightly higher than that of the first. As a necessary consequence of this, each multiplex transmission is necessarily interspersed with rest periods of one character duration, which are generated each time the multiplex distributors, because of their higher speed, advance by a distance of one character beyond the position of the originating start-stop distributors.

By means of the instant invention, such a transmission is converted into a continuous steady flow of characters at the originating rate and having the artificially introduced rest periods expunged without leaving any gaps in the transmission of the received signal. This is accomplished entirely from the receiving end of the telegraph channel; that is to say, without the need for any synchronizing information to be transmitted.

One of the objects of this invention is to detect and correct at the receiving end of a printing telegraph circuit any drift in phase relationship that may occur between an original steady rate transmission of signals and the receiving end steady rate retransmission of said signals, thus establishing a circuit where the transmission and the retransmission of characters occur in synchronism.

Another object of the instant invention is to adjust the speed of a telegraph retransmitting device to closely match the steady rate speed of a transmitting device connected thereto, in order to reduce the number of phase corrections required in a given time interval.

A further object of the instant invention is to detect the presence of an abnormal phase condition on a telegraph circuit and to avoid the application of phase or speed corrections to a repeater while such a condition exists.

Another object of the instant invention is to provide visual means for observing and monitoring the phase relationship between a transmitting and a retransmitting device in a telegraph channel.

A further object of the instant invention is to provide convenient manual means for quickly bringing the retransmitting end of a telegraph circuit into correct phase relationship with the transmitting device thereof.

Another object of this invention is to detect and correct any phase difference in the amount of one full character in a transmission when due to circuit faults and to effect said phase correction within a time short enough to enable correctly phased retransmission of the character arriving out of proper phase.

2

A further object of the instant invention is to provide a telegraph signal normalizer wherein all operating mechanical components except distributors of proven reliability have been eliminated.

In the instant invention, printing telegraph signals of the start-stop type arriving at the receiving end of a circuit in groups separated by rest periods of one character duration as previously described are, after conversion by a relay to polarized form, analyzed by a distributor having double the usual number of segments, sufficient to accommodate two complete characters, and the component impulses (except the start pulses) are led to corresponding segments of a retransmitting distributor. Storage condensers associated with each segment enable the received pulses to be available for retransmission for as long as an entire character period. A pickup brush on the retransmitting distributor is rotated at such constant speed as to cause the retransmission to lag behind the input signals by a progressively greater amount.

When the rotating brush of the receiving distributor after having responded to a long series of characters during which the retransmitter has lagged behind to the extent of somewhat more than a whole character, encounters the distinctive signal of a rest period, the said rest period is deleted from the retransmission because of the inherent properties of the circuitry already described, but which is hereinafter described with greater particularity. As a consequence of the deletion of each periodic said rest period signal, the retransmitter is thereby advanced in phase the necessary extent of one character period to nullify the accumulated phase lags of the retransmitter.

When the speed of the synchronous motor driving the retransmitting distributor happens to correspond precisely with the net rate of arrival of meaningful characters the distributors will repeat continuously this pattern of progressive lagging and instantaneous advance. Any variations which occur in this arrival rate, however, must be matched by a change in rate of the transmitting distributor, and this is accomplished by employing as a frequency source for the synchronous driving motor thereof, a variable crystal oscillator. The oscillator is so constructed that its frequency may be instantaneously shifted by a predetermined amount for a fixed time, in order to produce an immediate phase shift, in either direction as required, and it is also so constructed that its normal operating frequency may be continuously and slowly altered in either direction by energizing an appropriate motor drive, geared to a frequency determining element of the circuit.

Starting pulse signals received on the two starting segments of the receiving distributor are separately differentiated and led respectively to two opposed brushes on the rotating arm of the retransmitting distributor for commutation. If synchronization between distributors were to occur, all such pulses from the rotating brushes would fall at a single spot on the retransmitting distributor face plate. Under the conditions of operation described, however, the pulses fall in a zone which travels in an arc of about 180° around the face plate, then snaps back to a starting position, repeating the process continuously. Neon glow lamps connected to each said brush and to ground, and revolving on opposite ends of the brush arm of the retransmitter distributor, show this pattern of operation clearly and are useful as well in making manual adjustment of phase by means of a differential gearing mechanism attached to the retransmitter distributor rotor shaft.

When the speed of the retransmitter distributor differs from that corresponding to the average incoming character rate, the differentiated start pulse pattern above described, creeps or revolves around the retransmitter face

plate in a forward or reverse direction according to whether the retransmitter is operating at more or less than the desired speed. Conductive segments are appropriately located on the face plate of the retransmitter distributor to collect the differentiated start pulses when they have lagged or advanced beyond the normal 180 degree zone, and they are then led to the grids of appropriate thyatrons for operating relays to add or remove capacity from the crystal oscillator circuit for a definite time in order to shift its phase in the required direction by an amount sufficient to provide immediate correction of the drift. In addition thereto, the differentiated start pulses, in falling on the "advance" or "retard" segments, energize further circuitry for operating slow speed reduction-gear motors to turn a variable capacitor in the crystal circuit ahead or backward for slowly producing a small change in the normal frequency of the oscillator, in the desired direction. It is evident that by this means the necessity for operating the above described phase-shifting circuitry is minimized, enabling the device to operate for relatively long periods of time in substantial synchronism with the average arrival rate of incoming signals, during any period in which the said average is constant or nearly constant.

The remainder of the circle swept out by the said brushes defines a zone in which differentiated start pulses do not fall during normal operation. A segment on the retransmitter face plate located in the said zone is connected to circuitry for shifting the telegraph input when pulses are so received, from one brush on the receiving distributor to another one diametrically opposed thereto. This restores the pulses to the correct zone of impingement by introducing a phase reversal therein, and prevents the phase and speed control malfunction which would otherwise occur when such pulses encountered the "Advance" or "Retard" segment. It is a feature of this arrangement that during the operation of the said phase reversal circuitry and for definite period of time thereafter, the equipment previously described for both phase and frequency adjustment of the oscillator is disabled. Such a provision is advantageous because circumstances requiring such phase reversal are usually caused by occasional adventitious malfunction of the signal originating equipment, or else by transmission difficulties, neither of which implies any need for oscillator adjustment. If such deletion were not provided, the changes in oscillator frequency resulting would usually constitute the misadjustment of an oscillator already properly set, at a time when the difficulty of synchronization may be much greater than normally exists.

A fuller understanding of the invention may be gained by reference to the accompanying drawings of a specific illustrative example thereof, wherein:

Fig. 1 is a schematic diagram of a portion of a telegraph signal normalizer constructed in accordance with the present invention;

Fig. 2 is a continuation of Fig. 1; and

Fig. 3 is a continuation of Fig. 1.

Referring now to the drawings, in Fig. 1 is seen an input winding 1 of a polar telegraph relay 2 wherein through the polarizing effect of a constant magnetic field such as that produced by the movable magnet 3, but which may in fact be either a permanent magnet field or an electromagnetic field, the incoming printing telegraph signals are converted to polarized form on the tongue of the relay 2. Reinforcement of the signals occurs from contact of the tongue with positive and negative local battery supplied through current limiting resistors 4 and 5. Polar signals therefrom are led through tongue and back contact C of relay 10 (later to be described) and thence to contact ring R₂ on the face plate of receiving distributor 20 shown in Fig. 2. Rotatable brush arm 21 bearing brush 22 is held by magnetic sprag 23 over the face plate segment designated "start" until a characteristic starting pulse traverses the segment and a dry disc rectifier 24 for operating electromagnet 25 to attract sprag 23 and release arm

21. Motor 35, speed controlled by governor 32, then drives brush arm 21 through slip clutch 33 and reduction gears 34 for one half revolution in conventional start-stop manner. Signals incoming over ring R₂ are thereupon distributed by brush 22 to face plate segments I to V, where they are retained by the storage condensers 26 connected to each segment. Segments I to V on each side of receiving distributor 20 are also connected to corresponding segments on the face plate of retransmitting distributor 40, as indicated merely by broken lines on the drawing for the sake of clarity. Brush arm 41 is rotated at an appropriate speed by means later to be described, and carries brush 42 for contacting each said segment to the sending ring 43, which is connected through back contact C and tongue of relay 50 and thence through the coil of latching relay 60 to ground. Full polar signals developed on the tongue of relay 60 because of the latching effect of a small current, limited by resistor 61, flowing through the relay coil 62, occur at a low power level because of the current limiting effect of resistors 63. They are amplified in relay 70 to provide an output signal of suitable power. When a rest period occurs in the incoming telegraph signals, it comprises a continuous positive charge throughout the character period, which is blocked by rectifier 24, and therefore does not release sprag 23. Consequently, no new signals are stored on the segments of distributors 20 or 40, but since the brush 42 of distributor 40 is, at the start of the rest period, more than a full character behind the incoming signals, it continues to transmit those signals previously stored. Arrival of further character signals at the end of the rest period causes distributor 20 to start, and to store them on the segments of both distributors, just ahead of the brush of distributor 40. In this way, the rest period signal is deleted without interrupting the continuity of the retransmitted signal.

Start signals received on the segment designated "start" of distributor 20 are passed through dry disc rectifier 27 and differentiated to pulses by capacitor 28 and resistor 29, then applied to the ring D₁ of distributor 40 which is contacted by the rotating brush 44 to the ring of segments 45. In normal operation, these pulses fall on the segments x, y, and z thereof, and are unused. If distributor 40 is rotating too rapidly, pulses will ultimately impinge on segment "RET" of ring 45 whence they are led to the grid circuit of conventional thyatron circuit 80 where they cause to be locked to ground the coil circuit of relay 90 which is supplied through the back contact of relay 93 and the front contact of (normally energized) relay 94 through current limiting resistor 95 from positive battery supply. Thyatron timing circuit 92, which has held the coil circuit of relay 93 cut off from ground return because of negative battery applied to its grid through back contacts A of relays 90 and 91 and current limiting resistor 96, finds this source of negative potential removed from its grid by the opening of back contact A of relay 90, the grid begins to approach cathode potential due to the discharge of its grid circuit capacitor through its grid leak resistor. Relay 90 is thus locked up for at least the predetermined time before which thyatron 92 will fire due to decay of the negative charge on its grid, which firing grounds the coil return of relay 93, permitting flow through the coil of half cycles of alternating current supply, limited by resistor 98 and re-enforced in the coil by discharge, during the remaining half cycles of coil induced current through the rectifier 97. Pulling in of relay 93 by thyatron 92 at the conclusion of the timing period, as described, opens its contact supplying positive potential to the coil of relay 90, and therethrough to thyatron 80, which promptly reverts to the nonconducting condition before back contacts A of relay 90 could again fall closed and thyatron 92 and relay 93 again operate to reenergize relay 90.

Differentiated start pulses falling on segment ADV of ring 45 indicate a need for advancement in retrans-

mitter phase and are led to thyatron 81 which operates relay 91 in the same manner above described by which thyatron 80 operates relay 90. When pulses fall on both ADV and RET segments simultaneously, or within the predetermined delay period, tongue B of relay 91 applies ground through tongue A of relay 90 to the timing circuit of thyatron 92 to fire it and thus open relay 92, quenching both thyatrons 80 and 81 in this ambiguous situation, and reopening relays 90 and 91.

Tongues C of relays 90 and 91 are supplied with A.C., and their front contacts connect respectively to forward and backward motors in the reduction geared motor assembly 101 which is fastened to the rotatable shaft of variable condenser 102. Pulses on the RET segment of ring 45 thus cause the condenser to be turned slowly in one direction and pulses on the ADV segment cause rotation in the opposite direction. Numeral 103 represents a signal generator comprising a pentode vacuum tube in a quartz crystal oscillator circuit with the crystal operating at the frequency of equivalent parallel circuit resonance. In this mode of operation, a crystal is subject to having its operating frequency varied by a variation of the circuit capacitance across it and such a change is produced by adjustment of condenser 102, since the capacity of each side of the crystal to ground is a part of the capacity thereacross. Sinusoidal output from signal generator 103 is conveniently reduced in frequency by conventional dividers 104 to energize push-pull transformer 105. Output signal therefrom drives amplifier 107 through coupling resistors 108, whose output is coupled by resistors 109 to the tuned circuit 111, resonant at a frequency in the neighborhood of the operating frequencies expected and sufficiently broadly tuned to provide substantially resonant loading to the amplifier 107 at all such frequencies. A synchronous motor having speed reduction gears 112 is connected to and driven by the sinusoidal output of circuit 111 and turns the brush arm 41 of the retransmitter distributor 40 through the differential gear and hand crank mechanism 113, which is used for adjusting by hand the phase of the said distributor 40 when, because of failure of the equipment or for other reasons, it becomes desirable so to do.

Actuation of relay 90 or 91 as above described to effect oscillator frequency change in a desired direction is also effective to close a front or open a back contact B thereof respectively to apply or remove ground from the cathodes of an outer or inner pair of diodes 120 respectively.

Since these cathodes, when ungrounded, are biased through resistors 121 to a potential which makes conduction through them impossible, they then represent an open circuit in both directions. A further diode 122 associated with each and oppositely poled, thereupon rectifies sufficient of the signal current to elevate the signal circuit to such positive potential as will cause cutoff of further direct current flow through it and thus isolates the signal circuit from ground.

When grounded, the said cathodes merely comprise parts of oppositely poled rectifiers in parallel, providing conduction to ground for the pairs of tuning condensers 123 and 124 whereby they can increase or decrease oscillator frequency by being thus switched out of or into the oscillator circuit. The advantage of this method of switching lies in the fact that when the cathodes are biased positively and the diodes therefore open, the capacity to ground of the remaining oscillator circuitry is increased but little, and it is therefore feasible to approach rather closely the series resonant frequency of the crystal in order to provide for a substantial change in frequency by tuning, since the mere addition of more capacity beyond a certain point soon reached, is relatively ineffective to cause frequency change.

Since the duration of closure of relays 90 and 91 is determined at a fixed value by thyatron 92, as previously explained, the change of oscillator frequency caused by

the removal of condensers 123 or the insertion of 124 persists for a fixed time, and results in a definite phase change of the oscillator output in the desired corrective direction. Indicator lamps 126 and 127, operated through resistors 128 and 129 conveniently demonstrate the operation of relays 90 and 91 respectively for monitoring purposes. Lamp 131 operated through resistor 132 likewise shows the operation of relay 94, as will be explained hereafter.

Impingement of differentiated start pulses on the segment T of distributor 40 indicates an incorrect phase relationship between distributors 20 and 40 by an amount in excess of a complete character period. Such positive pulses are led through the tongue and back contact A of relay 10 through limiting resistor 140 and load resistor 141 to negative battery supply. Conventional thyatron circuit 142 which normally remains in the cut off condition because of negative battery applied to its grid through resistor 141 is triggered by these positive pulses to apply ground to one side of the coil of relay 10, the other side of which coil is connected to positive battery through the coil of relay 150. Condenser 151, also connected between the said other side and ground, and therefore bearing positive charge, provides immediate current flow through the coil of relay 10 under these conditions. Relay 10 thus pulls in and holds in because thyatron circuit 192 remains conductive, changing the signal input over relay 2 from ring R₁ to ring R₂ of distributor 20 by motion of the tongue C of relay 10, which is the effect desired because said signals are then distributed to the segments of distributor 20 by a diametrically opposed brush, and when picked up by brush 42 of distributor 40, will contain the start pulses located on the opposite and correct side of the distributor.

After pulling in as described, relay 10 is held in by conduction through thyatron 142 until an interruption occurs in its positive power supply. Tongue A of relay 10 switches the circuit over which said pulses arrive from back to front contact A thereof, and thus into a thyatron circuit 152 identical to that of 142. Tongue B of relay 10 provides power thereto over a circuit which also has a capacitor 153 to the plate of thyatron 142. Any pulse arriving at tongue A of relay 10 then fires thyatron 152, which because of its connection through capacitor 153 to the former thyatron, momentarily depletes the plate potential thereof, causing it to extinguish and relay 10 to drop open.

Relay 150, having its coil in series with that of relay 10, operates simultaneously therewith, and a charge from minus battery is applied through resistor 96 to the tongue of contacts A thereof, whereby the capacitor 154 or 155 not then being connected by tongue B, is charged negatively. Upon a change in position of the relay occurring, the condenser so charged is connected by tongue B to the grid of thyatron circuit 161 which is operated by A.C. applied to the plate thereof, thus quenching it during the interval required for said capacitor to discharge, and allowing relay 94 to fall open, preventing the operation of relays 90 and 91 to affect the oscillator frequency during such period. An indicator light 156 is connected in series with resistor 157 and to front contact C of relay 150 for energization by tongue C thereof during operation of the relay to indicate correct operation.

Two neon indicator lamps such as 161 are provided at the opposite ends of rotating distributor arm 41 of distributor 40, one connected between brush 44 and a brush not shown contacting the ground ring 162 and the other similarly connected to brush 163. By this means, the arrival of differentiated start pulses is made visible, and the zone of their impingement clearly exhibited. This makes the operation of the phase reversal mechanism easy to monitor, and also shows by distinctive signals the presence of faults or malfunction in the transmission channel supplying the normalizer, so that manual readjustment of phase can be made.

As it is on some occasions desirable to delete one or more characters from the retransmission arbitrarily at the location of the signal normalizer, an arrangement for so doing is provided in the invention. Relay 50 has a rectifier 51 across its coil, making it slow to open, and is connected to a further segmented ring of distributor 40 at the segment A thereof, which is so located as to be connected by a rotating brush 164 to the ground ring 162 near the start of a character. The opposite side of the coil of relay 50 is connected through back contact and tongue C of relay 53 to a key 54 and thence through current limiting resistor 55 to negative battery. If key 54 is held depressed, relay 50 is therefore pulled in as soon as distributor 40 starts to traverse a next character. This switches the telegraph output of tongue C from sending ring 43 to negative battery. Tongue A, in pulling in, connects the coil of relay 50 through a suitable resistor 52 to a back contact and tongue B of relay 53 and thence to ground. Relay 50 thus remains energized although brush 163 travels beyond segment A and no longer provides a ground. When brush 163 reaches diametrically opposed segment B, however, as occurs after a complete character period has elapsed, ground is thereby applied to tongue B of relay 50, which through its front contact B thus energizes relay 53. Pulling in, relay 53 locks in over tongue and front contact A through resistor 56 for so long as segment B is contacted, provided key 54 is still depressed. In doing so, its back contacts C and B are broken, allowing relay 50 to fall open and again switch its output over tongue C to the sending ring 43. If key 54 is released at any time between this event and the beginning of transmission of the character next following, a single character will have been deleted and replaced by a rest signal.

Although this invention has been described in terms of a device operated from the extremely stable basic frequency obtainable from an oscillating quartz crystal, it is to be understood that in any case where the instantaneous power supply frequencies at the start-stop signal originator and at the retransmitter are both very closely controlled, as they occasionally but rarely are, the local crystal becomes unnecessary, and when the described phase correction means and frequency correction means are then applied to a power line synchronous retransmitter motor by the use of a mechanical differential inserted in its shaft for each, or in some other convenient manner, the device is fully operative in these special circumstances without the use of a crystal or of circuitry therefor.

Although this invention has been described in terms of a specific illustrative example thereof, it is to be understood that to those skilled in the art various modifications and expedients will occur which do not, however, depart from the spirit of the invention disclosed. It is therefore intended that the instant invention shall be subject only to the limitations of the appended claims.

What is claimed is:

1. In a printing telegraph signal normalizer for character signals comprising permutation code bits in time sequence and having cyclic rest periods, which comprises multipath bit distribution means for plural characters, path connected bit storage means, and time sequential path collating retransmitter means, a source of variable speed power for said retransmitter means, character phase detecting means in said retransmitter means, means connected thereto and to said power source responsive only to excursions of character phase exceeding a predetermined minimum amount to correctly vary the speed of said retransmitter means during said excursions, further such means to correctly alter said retransmitter speed by a predetermined amount for a predetermined time upon each such excursion, and character phase controlled switching means connected to said bit distribution means for deletion of rest period signals received, without

interruption of a continuous output of character signals at a steady rate.

2. In a printing telegraph signal normalizer for character signals comprising permutation code bits in time sequence and having cyclic rest intervals, which comprises multipath bit distribution means, path connected bit storage means, and time sequential path selecting retransmitter means, a stable source of variable speed power for said transmitter means, character phase detecting means in said retransmitter means, means connected thereto and to said power source responsive only to excursions of character phase exceeding a predetermined minimum amount to correctly vary the speed of said retransmitter means during said excursions, further such means to correctly alter said retransmitter speed by a predetermined amount for a predetermined time upon each such excursion, outphase detecting means in said retransmitter means and electronic phase advancing means operated thereby to instantaneously advance said distribution means one character.

3. The device in accordance with claim 2 wherein are relay means in circuit with said outphase detecting means coupled to said means to vary and to said means to alter the retransmitter speed, operative to overrule such variation and alteration during outphase.

4. In a permutation code signal normalizer comprising a start-stop receiving distributor electrically connected to a synchronous motor driven sending-on distributor by way of signal storage capacitors and having start pulse signal commutation brushes on the sending-on distributor for detecting abnormal pulse phase displacement in either direction, the combination comprising a first directionally sensitive starting pulse signal operated and reversible actuator control means wherein are ionizable gas operated thermionic trigger tubes for pulse signal detection and actuation control, a second such actuator control means, an oscillating quartz crystal controlled power supply for said synchronous motor having a first circuit element thereof mechanically movable for frequency variation and a second circuit element thereof alternatively switchable for frequency changing, a gear motor actuator for driving said first circuit element electrically connected to said first actuator control means to correctly vary the frequency of said power supply at a relatively slow rate in response to an abnormal pulse phase displacement, time delay means, an actuator comprising a relay operatively connected to said second circuit element and electrically connected to said second actuator control means and said time delay means to correctly alter the frequency of said power supply instantaneously in response to an abnormal pulse phase displacement for the duration of a predetermined fixed period of delay, whereby to produce a substantially immediate phase correction simultaneously with the start of a continuous frequency correction throughout a period of abnormal phase conditions.

5. A regenerative repeater and normalizer for permutation code signals comprising a start-stop receiving distributor, start segments and code segments therein for dissection of two consecutive code characters, two oppositely disposed commutation brush arms therein having separate input connections for alternative operation, character storage condenser banks connected to the code segments thereof, a sending-on distributor having code segments connected to the said storage banks, a rotating commutation brush arm and a brush thereon in said sending-on distributor for providing successive output connection to said code segments, two further and oppositely disposed brushes thereon and coupling means in circuit therewith and with said start segments of said receiving distributor, a further segment in said sending-on distributor, located for contact by said further brushes only within a zone of abnormal start pulse phase excursion, sliding contacts to said further brushes, and means in circuit therewith to transfer an input signal between

said separate input connections upon appearance of a signal from said start pulses at said further brushes, whereby abnormal phase excursion of the signals causes switching to an opposite input brush.

6. The device of claim 4 wherein there are gaseous discharge indicator tubes affixed to the said rotating commutation brush arm, each connected to a said brush, whereby phase indicating patterns are displayed.

7. Printing telegraph signal repeater and normalizer comprising a start-stop distributor having segments for reception of two characters on opposite sides thereof, a starting magnet thereon, a brush arm therein having identical opposite ends for alternate engagement by said starting magnet, a retransmitting distributor in circuit therewith controlled to run at a speed corresponding to the uninterrupted retransmission of information at the average rate of reception thereof and signal storage condensers in circuit therewith, whereby periodic rest periods in a telegraph signal are deleted from the retransmission and the retransmission caused to constitute a steady and uninterrupted flow of information.

8. The device of claim 7 wherein a synchronous motor operates said retransmitting distributor.

9. The device of claim 7 wherein an oscillating quartz crystal and a synchronous motor controlled thereby operates said retransmitting distributor.

10. The device of claim 7 wherein an oscillating quartz crystal and a synchronous motor controlled thereby operates said retransmitting distributor and wherein there are commutating brushes and zone segments for start pulses in the said retransmitting distributor for detecting lag and lead, and wherein there is means for varying the frequency of the said crystal, connected to the said zone segments and controlled thereby.

11. The device of claim 7 wherein a synchronous motor operates said retransmitting distributor and wherein there are commutating brushes and zone segments for start pulses in the said retransmitting distributor for detecting lag and lead, and wherein there is means for correcting the speed of said synchronous motor in circuit with and controlled by said zone segments.

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