

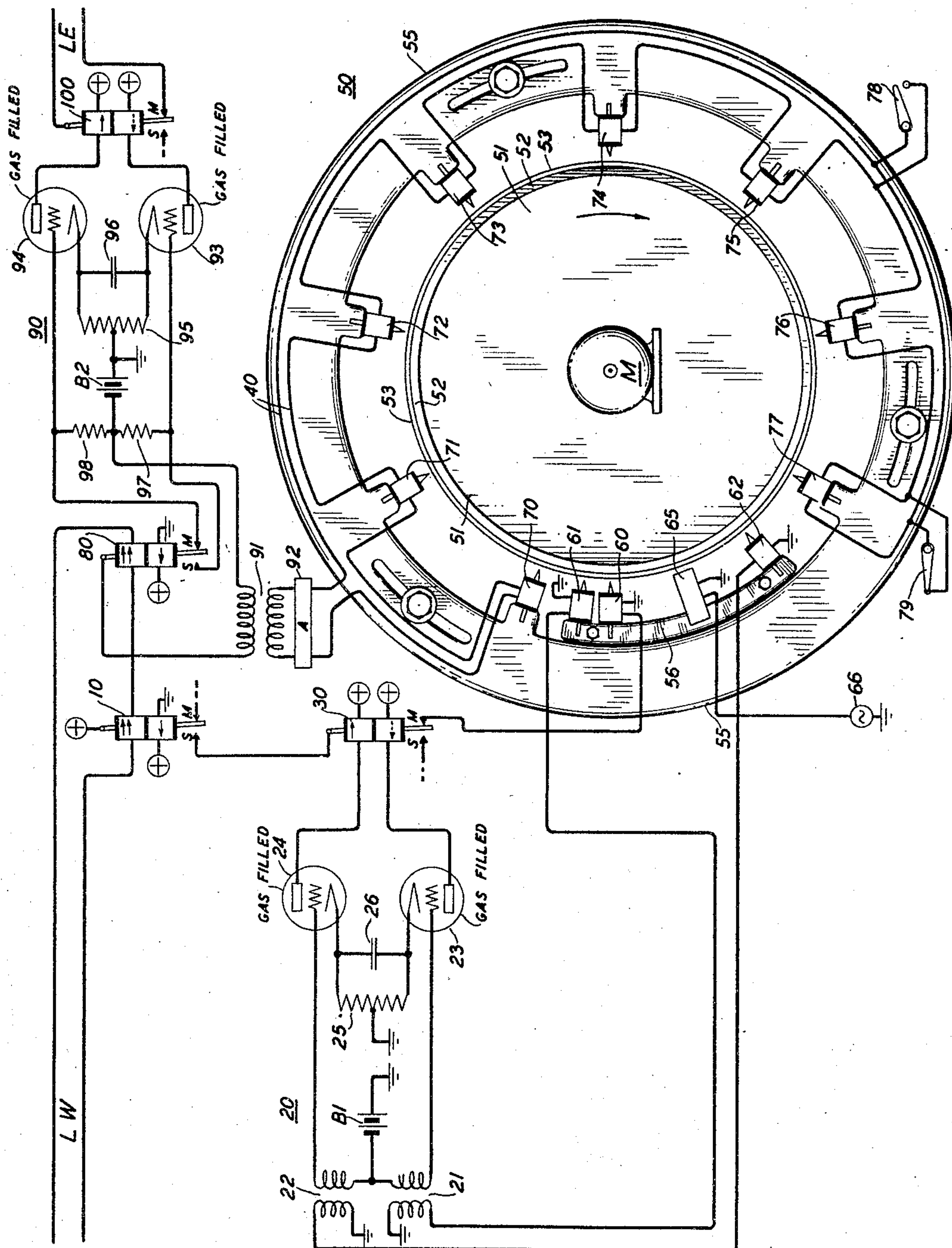
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PULSE GENERATING SYSTEM AND ITS USE IN SIGNAL TRANSMISSION SYSTEMS

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PULSE GENERATING SYSTEM AND ITS USE
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The invention relates to a pulse generating system and more particularly to a system of this type for establishing a series of accurate time intervals. The invention also relates to signal transmission systems using this type of timing system for control of the outgoing signal impulses.

In view of the continuously increasing demand for high speed of operation in start-stop telegraph systems it is becoming increasingly necessary to use equipment operating with a high degree of accuracy at high speeds. In the start-stop regenerative repeaters of the present day telegraph plant a timing device, the distributor, is in general use which has a rotating contact element, started out from rest position by a start impulse to make one revolution and then stop. Whereas these devices have been developed to operate with sufficient accuracy at the present speeds of transmission, they require frequent supervision for their proper operation. There is a tendency to variation in the operation, partly due to wear of the friction coupling between the continuously running driving shaft and the intermittently driven contact member and partly due to deformation of the elements partaking in the impact at stopping.

It is therefore an object of the invention to provide a start-stop timing device which has no intermittently driven element.

It is a further object of the invention to provide in a telegraph repeater a rotating timing device which will require less supervision and maintenance than the present distributors.

It is a still further object of the invention to provide a pulse generating system which requires no friction coupling and which will have no stopping impact.

In accordance with a feature of the invention the pulse generating or timing system includes a constantly moving element which is operated continuously and at a closely controlled constant speed; the system further includes a stationary activating member for imparting an impression to the speed determining element at a start instant; the system also includes a plurality of stationary interval determining elements equal in number to the number of intervals which are to be established and distributed adjacent to the moving element with predetermined spacings corresponding to the desired lengths of intervals, each of the stationary elements being responsive to the passing impression on the moving element for establishment of a time instant in a desired manner.

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In accordance with a specific feature of the invention the timing system comprises a rotating disc driven at constant speed and having along its periphery a continuous strand of magnetic material in the shape of a wire or ribbon and of the kind suitable for use, for example, in magnetic voice recording. The disc or any circular portion thereof may, however, be entirely of such magnetic material. About the disc are distributed a plurality of stationary electromagnets with their poles immediately adjacent the magnetic strand. One of these magnets is the recording magnet, which in response to an incoming start impulse will place a spot or mark on the strand by changing its magnetic state. Of the remaining magnets there may be one for each impulse of a start-stop telegraph signal and each will have an impulse generated in its winding, as the spot passes by its pole, which may be used for timing of outgoing telegraph impulses.

In accordance with other features of the invention provision is made for adapting the timing system to control of a start-stop telegraph repeater, which particularly involves exclusion of all impulses of the incoming signals, except the start impulses, from the timing device and the impression of the timing pulses by the pick-up magnets upon the outgoing impulses.

The invention will now be described more in detail as to its organization and operation and reference will be made to the accompanying drawing which shows a preferred embodiment of the invention.

The drawing shows in schematic form the equipment and circuit connections for a start-stop regenerative telegraph repeater adapted for receiving start-stop signals from the line west LW and for retransmitting them in regenerated form into the line east LE.

The system includes the timing device 50. This device comprises a flat disc 51 having a rim portion 52 adapted to receive and hold a strand 53 of magnetic material. The disc 51 is directly coupled or suitably geared to a source of driving power M, which drives the disc at constant speed. The source of power M may be a synchronous motor operated from a constant frequency current supply or it may be any other convenient power source, the speed of which may be closely controlled by any well-known automatic means. The rim 52 may be of any suitable material, and thus may be of low remanence magnetizable material, normally in the non-magnetic state but providing a low reluctance path for the magnetizing field impressed upon the device.

The magnetic strand 53 may be in the form of a wire, but is preferably a narrow thin ribbon of magnetic material capable of retaining magnetism. Any one of various magnetic compositions treated as variously described in the art may be employed. The ribbon or strip is placed tightly about the circumference of the rim 52 and may be placed in a shallow groove in the rim to comprise a uniform magnetic path extending around the disc.

Along the periphery of the disc a number of stationary electromagnets are suitably arranged. Thus the recording magnet 60 for magnetizing the strand 53 comprises a suitably shaped core of magnetic material having low remanence and a magnetizing winding.

A plurality of magnets 70 to 77 of construction similar to the magnet 60, are distributed about the periphery of the disc 51 with even spacing. These magnets are in the nature of pick-up magnets, since they will be affected by the spot on the strand 53 as it passes by them in succession.

A wipe-out magnet 65 has its pole-face placed near the traveling strand 53 to restore the normal magnetic condition in all portions of the strand shortly before they pass under the recording magnet 60.

Many arrangements of magnetic recording devices have been proposed which would be suitable for the purposes of the invention. Thus the magnetic track may be normally magnetized by the wipe-out magnet 65, which in that case would be a permanent magnet developing a predetermined uniform remanent magnetism in the strand. Or the track may be normally demagnetized, in which case the wipe-out magnet 65 would be an electromagnet energized by a high frequency alternating current source. Suggestions along these general lines have been disclosed in United States Patent 1,459,202, issued to L. F. Fuller on June 19, 1923. The poles of the recording and reproducing magnets are suitably sharpened and arranged relatively to the strand 53, and one or both poles of each magnet may be brought into close proximity of the strand. The field set-up by the recording magnet may be directed into the strand in one of several ways, as, for example, transversely or longitudinally of the strand. Suggestions along these lines have been disclosed in United States Patent 1,774,821, issued to S. N. Baruch on September 2, 1930.

The effect of the recording magnet 60 upon the magnetic strand 53 may thus be to produce either a magnetized spot in the generally demagnetized strand or a demagnetized spot in a magnetized strand. The main object is to produce a change in the magnetized state of the strand which will affect the reproducing magnets by producing corresponding variations in the magnetic flux through the core of each magnet. Assuming the direction of rotation of the disc 51 as indicated by the arrow, when the spot produced by magnet 60 on the strand 53 reaches opposite the pointed pole of magnet 70, the flux from the stored magnetism in the spot will pass into the core of magnet 70, thereby inducing a current in the winding of that magnet. Similar currents will be induced in the magnets 71 to 77 in succession, as the magnetized spot on the strand 53 reaches the poles of those magnets.

Assuming that strand 53 is normally demagnetized by magnet 65, when a current impulse of a predetermined length is impressed upon the winding of magnet 60 a magnetic spot or mark

of a length corresponding to the duration of the current impulse will be impressed on the strand 53 and as the mark passes in front of magnet 70 two oppositely directed current pulses will be produced, one at the front of the spot when the flux enters the magnet 70 and one at the end of the spot when the flux leaves the magnet core. The distance between these opposite pulses is determined by the duration of the original current impulse in magnet 60. Thereafter a similar pair of pulses will be produced by the other magnets 71 to 77, inclusive, and with the disc rotating at constant speed the separation between the similar pulses will be determined by the angular displacement between the corresponding magnets 70 to 77.

The magnets may be mounted in any desirable manner. They may be adjustably mounted on a supporting frame 55 for adjustment of the air-gap between their poles and the magnetic strand 53 and they may be adjustably mounted individually for their proper angular location relative to the magnet 60. As shown in the drawing magnets 71 to 77 may be oriented relative to the magnet 60 without changing the spacing between them, as by angular adjustment of the frame 55. Magnets 60, 61, 62 and 65 are mounted on a separate non-magnetic support 56 which may be fixed in position.

When the timing device 50 is used in a telegraph repeater, such as shown in the drawing, two additional pick-up magnets 61 and 62 are provided for purposes which will be explained hereinafter.

In the following description of the telegraph repeater and its operation it will be assumed that the signals are based on the seven and one-half unit code, which includes a start impulse and five selecting impulses, all of the same unit length, and a stop impulse of about one and one-half unit lengths.

The incoming line circuit LW is connected through the upper operating windings of the polar relays 10 and 80. These relays are normally held against their marking contacts by the normal line currents; during spacing or no current condition in the line circuit, relays 10 and 80 are operated to their spacing contacts by their lower biasing windings. Relay 80 corresponds to the usual receiving relay and repeats the marking and spacing characteristics of the impulses into a circuit 90 extending to the sending polar relay 100 which, in turn, repeats the impulses into the outgoing line LE. The relay 10 controls the current in the recording magnet 60 over a circuit extending from plus battery over its spacing contact and over the marking contact of polar relay 30 through the magnetizing winding of recording magnet 60 to ground.

The wipe-out magnet 65 is normally energized by a source of alternating current 66 of a suitable high frequency, i. e., 5,000 to 20,000 cycles per second.

The auxiliary pick-up magnets 61 and 62 are connected through a circuit 20 to the polar relay 30 for excluding all incoming impulses, except the "start" impulse, from the recording magnet 60.

Relay 30 is normally held against its marking contact by current in its upper winding and may be operated to spacing by current in its lower winding.

The circuit 20 includes two gas-filled electron discharge tubes 23 and 24 having their cathode-anode circuit connected from ground over resist-

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ance 25 and through corresponding windings of relay 30 to plus battery of sufficient potential to sustain a discharge current in tubes 23 and 24 upon firing. The magnets 61 and 62 are connected through transformers 21 and 22 for impressing firing pulses upon the tubes 23 and 24. Thus when a pulse is produced by magnet 61 through the primary winding of transformer 21, a pulse is generated in the secondary winding of the transformer which will overcome the negative potential applied by biasing battery B1 to the control grid of the tube 23, thereby applying a resultant positive potential to the grid for firing of the tube. Upon the spot passing beyond magnet 61, a reverse pulse induced in the magnet will produce a reverse impulse in the secondary circuit of transformer 21 without any effect upon the tube 23, which remains conducting.

An impulse subsequently produced by magnet 62 will operate in a similar manner through the transformer 22 to apply a resultant positive potential to the control grid of tube 24 for firing of this tube.

Condenser 26, having become charged from the potential across the lower half of resistance 25 during the discharge in tube 23, will now momentarily apply its potential to the anode-grid circuit of tube 23, thereby extinguishing the tube; the tube 24 will continue its discharge until similarly extinguished by tube 23, when the latter is again fired by magnet 61. In this manner the magnet 61 serves to operate relay 30 to spacing and the magnet 62 serves to operate the relay to marking. During stop condition in the line circuit, tube 24 will be left in fired condition, thereby holding relay 30 against its marking contact.

The pick-up magnets 70 to 77 are connected in a series circuit 40 for impressing their pulses upon the primary winding of transformer 91. The secondary winding is connected over the contacts of relay 80 to the circuit 90 for timing the outgoing impulses. If necessary, an amplifier 92 may be inserted in the transformer circuit to amplify the pulses from the timing device 50 sufficiently to insure proper operation of the circuit 90. The amplifier is preferably inserted in the primary circuit, as shown in the drawing.

The circuit 90 is somewhat similar to circuit 20. The circuit includes two gas-filled electronic discharge tubes 93 and 94 having anode-cathode circuits connected through the windings of relay 100 and interconnected through resistance 95 and condenser 96 for automatically and alternately extinguishing their discharge in a manner similar to that described for circuit 20. The control grids of the tubes are normally held at negative potential from the biasing battery B2.

With relay 80 in marking position, an impulse from transformer 91 will be impressed on resistance 95 to oppose the negative potential from battery B2 and thereby apply a resultant positive potential to the control grid of tube 94 and fire the tube for operation of relay 100 to marking. When relay 80 is in spacing position, a pulse from transformer 91 will be impressed upon the resistance 97 for firing the tube 93. The firing of tube 93 extinguishes the tube 94 by the action of condenser 96 and relay 100 will be operated to spacing. Thus when relay 80 is in marking position, relay 100 will be operated to marking by a pulse from the timing device 50, and with relay 80 in spacing position, relay 100 will be operated to spacing.

With the timing device arranged as shown in the drawing, the speed of the disc 51 and the

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spacing between the magnets 70 to 77 are such that the magnetized spot on strand 53 will reach in front of the successive magnets in synchronism with the incoming impulses of a character series of impulses in the line circuit representing a character. Thus upon leaving the magnet 60, the spot will arrive at magnet 70 during the incoming start impulse and will produce a pulse for the control of the outgoing start impulse. As the spot continues it will reach magnet 71 during the incoming No. 1 selecting impulse for timing of the outgoing No. 1 selecting impulse. The spot will thereafter reach the succeeding magnets 72 to 75 during the succeeding selecting impulses, Nos. 2 to 5, and the spot will reach the magnet 76 during the incoming stop impulse for timing of the outgoing stop impulse.

For a code using six selecting impulses, the magnet 77 may be included in the pulse circuit by opening of the switch 79. For a code using only four selecting impulses, the switch 78 may be closed to exclude the magnets 76 and 77 from the pulse circuit 40.

By angular adjustment of the support 55, all the pick-up magnets may be oriented with respect to the reproducing magnet 60 to introduce any desired time lag between the incoming and the outgoing impulses. As shown in the drawing, the time lag is about equal to one-half a unit impulse length. The distance taken against the direction of rotation, between the magnet 70 corresponding to the start impulse and the magnet 76 corresponding to the stop impulse, should be at least one and one-quarter unit lengths but may be considerably more.

The pick-up magnet 61 shortens the length of the magnetized spot, as will be described hereinafter, and may be placed close to the magnet 60. The magnet 62 is effective at the end of each series of pulses to prepare the circuit for recording magnet 60 for the next series and therefore should be placed after the magnet corresponding to the stop impulse. The wipe-out magnet 65 may be placed immediately before the magnet 60.

The operation of the system will now be described.

It will be assumed that the system is in marking condition, as shown in the drawing, awaiting the arrival over the line LW of a series of impulses representing a character. When the start impulse arrives the current in the line circuit LW will be reduced to zero and relays 10 and 80 operate to spacing. Relay 10 then extends the circuit from plus battery over its spacing contact and over the marking contact of relay 30 to the winding of recording magnet 60, which impresses its magnetism on the continuously moving strand 53. When the front edge of the spot arrives before magnet 61, a pulse is produced through the winding and through the transformer 21 thereby firing the tube 23, extinguishing the tube 24 and operating relay 30 to spacing. As a result, the current flowing through magnet 60 is discontinued and the formation of the magnetic spot is discontinued. When the spacing between magnets 60 and 61 equals about an eighth of a unit pulse, the spot will have a corresponding length. Relay 30 now remains on spacing until the end of the signal series of impulses, thereby preventing subsequent operations of relay 10 from affecting magnet 60.

After a predetermined time lag equal to one-half a unit length, the front of the spot arrives at magnet 70 thereby producing a pulse through

the transformer 91. With relay 80 on spacing, this pulse will fire the tube 93 thereby extinguishing the tube 94 and operating relay 100 to spacing. Thus a mark-to-space transition will be impressed upon the line LE. When the rear edge of the spot reaches magnet 70, a reverse pulse is produced which will have no effect upon the tube 93.

Assuming that the selecting impulse No. 1 is a marking pulse, relays 10 and 80 will be operated to marking. Exactly one unit pulse interval after reaching magnet 70 the front of the spot arrives before magnet 71 and a pulse will be produced over transformer 91 and marking contact of relay 80 to fire tube 94, extinguish tube 93 and operate relay 100 to marking. Thus a space-to-mark transition will be sent out over line LE.

Similar operations will be performed during the succeeding selecting impulses. With the stop impulse being a marking impulse, relays 10 and 80 will be operated into the marking position and when the spot arrives before the magnet 76, the pulse produced thereby will fire tube 94, extinguish tube 93 and operate relay 100 to marking, thus conditioning the line circuit for the next signal series.

When thereafter the spot arrives before magnet 62, the pulse produced thereby will fire the tube 24, extinguish the tube 23 and operate relay 30 back to marking, thereby conditioning the timing device 50 for reception of the next start impulse. As the spot finally passes under the wipe-out magnet 63, the strand 53 will be demagnetized and prepared for the next series of operations.

What is claimed is:

1. A transmission system for signals received with inaccurately timed impulses and a timing system for correcting the timing of said impulses and comprising a continuously and uniformly rotating element, a plurality of stationary elements disposed adjacent to the path of said rotary element with predetermined spacings, stationary activating means connected to be responsive to an impulse from each of said signals and operative through said continuously rotating element to successively activate said stationary elements to each produce a pulse, and common circuit means for impressing said pulses in succession upon said transmission system for timing of said impulses.

2. A transmission system for signals each comprising a plurality of inaccurately timed impulses and a timing system for correcting the timing of said impulses and including a continuously rotating pulse generator connected to said transmission system for producing a plurality of accurately timed pulses in response to an impulse from each of said signals incoming to said transmission system and connected for impressing said pulses on said transmission system for control of said impulses outgoing from said transmission system.

3. A signal regenerating system including circuit means for receiving successive series of inaccurately spaced impulses each including a start impulse, continuously rotating pulse generating means connected to said receiving circuit means for producing series of accurately spaced pulses corresponding to said series of impulses in response to said start impulses, and an output circuit connected to said pulse generating means and said receiving circuit means and responsive to said pulses for accurately spacing said impulses.

4. A start-stop impulse regenerative system

comprising impulse receiving means, impulse retransmitting means responsive to said receiving means and continuously moving pulse producing means connected to be responsive to said receiving means for accurate timing of the response of said retransmitting means by the produced pulses.

5. A start-stop impulse regenerating system including circuit means for receiving unevenly spaced series of inaccurately spaced impulses and continuously operating pulse generating means connected to said circuit means to correct the spacing of said impulses within each series outgoing from said circuit means by the pulses from said pulse generating means.

6. A start-stop telegraph repeater for signals of code impulse series comprising impulse receiving means, impulse retransmitting means connected to be responsive to said receiving means, continuously moving pulse producing means responsive to the start impulse of each impulse series from said receiving means to produce a series of accurately spaced timing pulses in isochronism with the signal impulses and circuit means connected between said pulse producing means and said retransmitting means for correct timing by said timing pulses of the impulses of each series as retransmitted by said retransmitting means.

7. A start-stop regenerative telegraph repeater having an input circuit and an output circuit and including a continuously operating device connected between said circuits for timing of the individual outgoing impulses of each character signal, said device comprising a uniformly moving element adapted to receive a start impulse impression and stationary pulse producing means responsive to said impression in passing to produce a series of equally spaced timing pulses for control of said outgoing impulses.

8. A start-stop regenerative telegraph repeater having an input circuit and an output circuit and including a continuously operating device connected between said circuits for timing of the individual outgoing impulses of each character signal, said device comprising a plurality of stationary responsive means and a uniformly moving element adapted to receive a start impulse impression from said input circuit and to produce a series of spaced timing pulses for control of said output circuit by the passing of said impression by said responsive means.

9. A start-stop regenerative telegraph repeater having an input circuit and an output circuit and including a continuously operating device connected between said circuits for timing of the individual outgoing impulses of each character signal, said device comprising a uniformly moving element presenting a retentive magnetizable track and adapted to continuously move said track longitudinally at constant speed for reception by said track of a magnetic impression at any instant in response to an incoming impulse, and a plurality of stationary electromagnetic elements distributed with equal spacing in succession along said track to produce timing pulses in response to the passing of the said magnetic impression for control of said outgoing impulses.

10. A start-stop regenerative telegraph repeater for repeating incoming signals having a constant number of code impulses into an output circuit and including a continuously operating device for timing the individual outgoing impulses, said device comprising an exposed strand of magnetizable material, a rotary element for longitudinal movement of said strand

at an uninterrupted constant speed, a recording electromagnet responsive to the start impulse of said incoming signals for producing a magnetic impression on said moving strand, and a plurality, equal to said number, of reproducing electromagnets evenly distributed in succession along said strand to produce a series of timing pulses under the influence of said impression in passing, said repeater further comprising common circuit means for impressing said timing pulses upon said output circuit.

11. A start-stop regenerative telegraph repeater comprising receiving relay means, retransmitting relay means responsive to said receiving relay means, and a continuously operating timing device for timing of the operations of said retransmitting relay means which includes a continuously moving element of magnetizable material driven at constant speed, a recording electromagnet responsive to said receiving relay means for producing a magnetic impression on said moving element, a plurality of reproducing electromagnets evenly distributed adjacent to said element to produce a series of evenly spaced timing pulses in response to the passing of said impression, and other electromagnetic means disposed adjacent to said element and responsive to the passing of said impression for control of said recording electromagnet to exclude all impulses but one of each incoming signal from said recording electromagnet, said repeater further comprising circuit means for impressing said timing pulses upon said retransmitting relay means.

12. A start-stop regenerative repeater comprising receiving relay means, retransmitting relay means responsive to said receiving relay means, and a continuously operating timing device responsive to the start impulses from said receiving relay means to time the operations of said retransmitting relays means, said timing device including a constant speed moving element of magnetizable material, a recording electromagnet connected to said receiving relay means for making a magnetic record on said element in response to each of said start impulses, a plurality of reproducing electromagnets evenly distributed alongside said element to be successively responsive to the passing of each said record to each produce a timing pulse, and a control electromagnet disposed alongside said element and responsive to the passing of each said record for producing a control pulse, said repeater further comprising circuit means for impressing said control pulses upon said receiving relay means to disconnect said recording electromagnet from said receiving relay means except during the said start impulses, and common circuit means for impressing said timing pulses upon said retransmitting relay means for timing all outgoing impulses of each signal.

13. A start-stop regenerative repeater comprising receiving relay means, retransmitting relay means responsive to said receiving relay means, a continuously operating timing device for timing the impulses retransmitted by said retransmitting relay means and including a uniformly

moving element adapted to store an impression, impulse responsive means responsive to an impulse from said receiving means for making said impression on said element, a plurality of pulse producing means evenly distributed alongside said element to each produce a pulse in response to interaction with the passing impression, said repeater further comprising circuit means for admitting to said impulse responsive means only an impulse from said receiving relay means corresponding to the first impulse of each start-stop signal, and other circuit means for admitting each pulse from said reproducing means to said retransmitting relay means for timing of each response to said receiving relay means.

14. A start-stop regenerative telegraph repeater comprising receiving relay means, retransmitting relay means responsive to said receiving relay means, and a continuously rotating timing device responsive to each start impulse from said receiving relay means to produce a series of timing pulses for timing the responses of said retransmitting relay means, said timing device including a rotating member continuously driven at constant speed and having a circular magnetizable track closed upon itself, a recording electromagnet connected to said receiving relay means to record an impression on said track in response to each of said start impulses, a plurality of reproducing electromagnets distributed at even spacing alongside said track to produce a plurality of evenly spaced timing pulses corresponding to the plurality of code impulses in the repeated signals in response to the passing of said impression successively by said reproducing electromagnets, a pair of control electromagnets disposed alongside said track for producing two control pulses in response to the passing of said impression and magnetic erasing means for continuously restoring successive portions of said magnetic track to its normal recording condition, said repeater further comprising a control circuit including a pair of mutually extinguishing gaseous discharge tubes and connected for control of said receiving relay means in response to said control pulses to admit to said recording electromagnet only impulses corresponding to the start impulses, and a selective circuit including another pair of mutually extinguishing gaseous discharge tubes and connected to receive said timing pulses under control of said receiving relay means for selective operation of said retransmitting relay means at predetermined uniform intervals and in accordance with the code of the incoming signals.

15. A continuously driven member, means for fixing a reference point thereupon incident to each reception of a start pulse of start-stop code pulse combinations, means mechanically moving said reference point in timed relation to the code pulses past points corresponding to the correct timing of the subsequent pulses of the code, and pick-up means establishing conditions in an outgoing line as marking and spacing incident to such movement past said code points and under control of the received code pulse combinations.

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