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PULSE REGENERATOR

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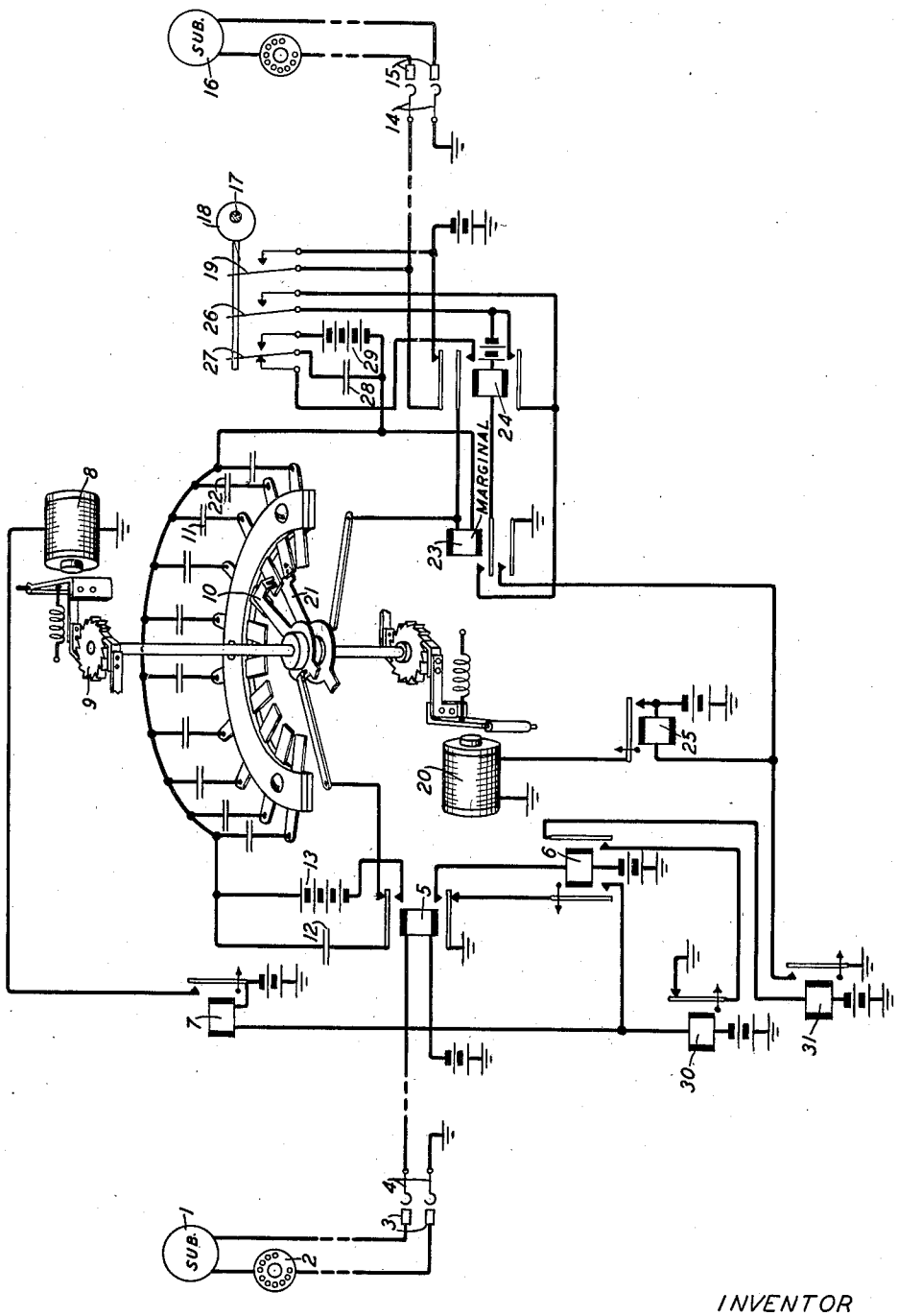

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PULSE REGENERATOR

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8 Claims. (Cl. 177—380)

This invention relates to signaling systems and particularly to impulse regenerating means used in telephone systems.

The object of the invention is to provide simple and economical means responsive to dialed subscriber line impulses for sending out similar trains of impulses regenerated by means which will assure the proper strength, length and timing thereof regardless of any mutilation of the incoming impulses.

A feature of the invention is the use of the so-called pocket and dipper method for measuring both the number of incoming and outgoing pulses. According to this feature the incoming impulses are translated into a corresponding number of increments of energy which are placed one at a time in a receiver capable of holding them until they are again taken out one at a time and counted. Specifically, a comparatively large capacity condenser is provided and this is successively charged by the transfer of the charges from a comparatively small capacity condenser. The level to which this comparatively large capacity is charged is a measure of the number of impulses in the incoming train. When the train has thus been registered, another small capacity condenser is employed to discharge the storage condenser by successively taking therefrom increments of energy until the said storage condenser is practically empty. By properly adjusting the circuits and the capacity of two small condensers employed the number of increments of energy subtracted may be exactly equal to the number added and in this manner the incoming train of impulses may be faithfully reproduced in number. Since the outgoing pulses under precision are machine controlled, their strength and duration may be rigidly controlled.

Another feature of the invention is a simple step-by-step switch for bringing a different large capacity condenser for each digit under the influence of said small condensers.

The drawing consists of a single sheet in which Fig. 1 is a circuit diagram by which the invention will be explained.

A subscriber's station 1 provided with a dial 2 may be connected to the pulse regenerator of the present invention by means of a switch here illustrated by the contacts 3 and brushes 4. By means of this switch the lines are connected to a conventional line relay 5. Relays 5, 6 and 7 are the conventional A, B and C relays used in automatic telephone working. Relay 5 responds to the seizure of the line and releases upon each interruption thereof representing a digit impulse. Upon its operation relay 5 closes the circuit for slow releasing relay 6. Relay 6, therefore, remains operated throughout the connection and keeps its armature closed during the sending of impulses. Relay 7 is operated from the back contact of relay 5 through the contact of relay 6 and, therefore, becomes energized during the sending of a train of impulses but releases during the interdigit pause. Relay 7 controls the stepping magnet 8 which upon energization brings a pawl into position so that upon the release of magnet 8 ratchet 9 will be advanced one step and therefore the brush 10 will be stepped forward from one contact to another. Brush 10 sweeps over a plurality of contacts to each of which a condenser, such as 11, is connected. This condenser is of a comparatively large capacity.

Relay 5, through its upper armature, controls the connection from a comparatively small capacity condenser 12 which is alternately charged by the battery 13 and then discharged through the wiper 10 into condenser 11. Thus when the dial 2 is operated the small capacity condenser 12 will be discharged an equal number of times into the large capacity condenser 11 and at the end of this train of impulses the magnet 8 will advance the brush 10 to another contact.

The balance of the circuit is a precision means for sending out a corresponding number of impulses to set the switch represented by the contacts 14 on to the terminals 15 leading to a subscriber's station 16, by way of example. A power driven shaft 17 is provided with a cam 18 which operates a set of contacts periodically. By means of the machine operated contact 19 a connection to the distant point will be closed periodically and at uniformly spaced intervals. Let it be assumed that the motor magnet 20 has moved brush 21 into connection with a terminal leading to a condenser 22 which has been charged by a series of digit impulses coming from the substation 1. Relay 23 is a sensitive marginal or polarized relay which operates to close its contacts because of the charged condenser 22 now connected to it. When its inner armature is operated, a circuit is closed from the winding of relay 24 through the armature and front contact of relay 23, through the contacts 26 when they are next closed, to battery and thence the winding of relay 24. Contacts 26 which close only when the outpulsing contacts 19 are closed serve to prevent the first pulse of a digit from being fractional in duration as would occur if contacts 19 were effectively connected to the output sometime during the break. When relay 24

operates it provides a locking circuit for itself through its lower armature and front contact. At its outer upper armature and back contact relay 24 opens a contact which normally shunts the pulsing contacts 19 and contacts 19 are now rendered operative. The transfer contacts 27 now operate to periodically charge the condenser 28 from a battery 29 and to discharge it through the circuit completed by the inner upper armature and front contact of relay 24. It will be noted that this battery is reversed in relation to battery 13 so that the charges on the comparatively small capacity condenser 28 are in reversed direction to those on the small capacity condenser 12; therefore, each time the contacts 27 move to the position shown and after relay 24 has been operated, the charge on condenser 22 will be reduced by a corresponding amount. Since condensers 12 and 28 may be accurately matched, the number of charges taken from the condenser 22 may be made exactly equal to the number put in. When the capacity of the condenser 22 is therefore reduced to a critical value the relay 23 becomes released. This in turn releases relay 24 and shunts the pulsing contacts 19 so that the number of machine-made interruptions of the circuit which leads to the switch represented by the brushes 14 will be limited. The release of relay 23 also releases relay 25 which after an interval timed by the slow releasing characteristics of relay 25 to the proper inter-digit pause, releases stepper 20 so that brush 21 is advanced to the next contact.

It should be noted that the means herein disclosed to respond to the charge on condenser 22 is a relay 23. It is important that this be highly sensitive and also of such high impedance that the condenser 22 will not be discharged too rapidly thereby. While this is shown as a conventional relay it is to be understood that it may be of any other type, such as a relay responsive to a vacuum tube which in turn will accurately respond to the raised potential of condenser 22 without dissipating its charge.

In order to prevent the precision outpulsing arrangement overtaking the impulsing arrangement, two additional relays 30 and 31 are provided. Relay 30 is in parallel with relay 7 and therefore attracts its armature when the first digit is dialed. It is made very slow to release and will therefore hold over during the inter-digit dialing period unless the subscriber at station 1 is more than ordinarily slow. Relay 31 is arranged in a circuit including a normal contact of relay 30 and a front contact of relay 6, so that as soon as the apparatus is seized and relay 6 is energized relay 30 will become energized. Relay 31 causes relay 25 to become energized and therefore operates stepping magnet 20. As long as relay 31 remains operated magnet 20 cannot be released to step the brush 21. Relay 31 is very slow to release—of the same order as relay 30 though preferably slightly faster than relay 30. As the subscriber at station 1 begins to dial relay 30 is energized and the circuit of relay 31 is opened but, due to the slow releasing characteristics of relay 31, the relay 25 is not allowed to release. However, after a period which may be adjusted to be somewhat longer than the longest train of digit impulses relay 31 will relinquish its hold over relay 25. Since relay 30 is very slow to release, it will operate at the start of the first train of incoming pulses and not release until a period after the ending of the last train of such impulses as measured by its timing characteristic. Since relay 31 then will remain deenergized until the end of this latter period there will be ample time provided for the outpulsing.

Should the subscriber at station 1 pause too long between digits, which might give the brush 21 opportunity to catch up with or to overtake brush 10, then relay 30 will release and by causing the energization of relay 31 will prevent the further stepping of brush 21 until it is assumed that the brush 10 has advanced.

It will further be understood that the brushes 10 and 21 may have no normal position and that there is no necessary limit to the number of condensers 11 or 22 that may be provided. The terminals to which these condensers are connected may be placed in a complete ring. While this step-by-step switch is shown as a single row of contacts traversed by two brushes, it will be understood that two simple and conventional switches may be used.

What is claimed is:

1. A pulse repeater comprising in combination a condenser, means for charging said condenser in accordance with a series of impulses, a device for controlling a pair of conductors, an interrupter for producing pulses over said pair of conductors, means for connecting said condenser to said device whereby said device is operated from the charge on said condenser, and means controlled by said interrupter for withdrawing from said condenser a portion of the charge with each pulse whereby said device releases after the production by said interrupter of as many pulses over said pair of conductors as were in the series used to charge said condenser.

2. A pulse repeater comprising an energy reservoir, means for recording the number of incoming pulses in a train by adding a predetermined quantity of energy to said reservoir for each said pulse in a train, means responsive to the rise of energy in said reservoir above a given critical level for controlling means for transmitting outgoing pulses, and means for subtracting a predetermined quantity of energy from said reservoir for each pulse transmitted.

3. A pulse regenerator comprising a storage condenser, means for recording the number of incoming pulses in a train by adding a predetermined charge to said condenser for each pulse in a train, means responsive to the rise of the charge in said condenser above a given critical level for controlling means for transmitting outgoing pulses, and means for subtracting a predetermined charge from said condenser for each pulse transmitted.

4. A pulse regenerator comprising a comparatively large capacity storage condenser, means comprising a comparatively small capacity condenser for recording the number of incoming pulses in a train by transferring a charge from said comparatively small capacity condenser to said comparatively large capacity condenser for each pulse in a train, means responsive to the rise of the charge in said comparatively large capacity condenser above a given critical level for controlling means for transmitting outgoing pulses, and means comprising a comparatively small capacity condenser for subtracting a predetermined charge from said comparatively large capacity condenser for each pulse transmitted.

5. A pulse regenerator comprising a comparatively large capacity storage condenser, means comprising a comparatively small capacity condenser for recording the number of incoming

pulses in a train by transferring a charge in one direction from said comparatively small capacity condenser to said comparatively large capacity condenser for each pulse in a train, means responsive to the rise of the charge in said comparatively large capacity condenser above a given critical level for controlling means for transmitting outgoing pulses, and means for subtracting a predetermined charge from said comparatively large capacity condenser for each pulse transmitted comprising a comparatively small capacity condenser for transferring a charge in the opposite direction to said comparatively large capacity condenser.

6. A pulse regenerator comprising a storage condenser, a relay responsive to incoming pulses, means comprising a condenser charged on the release of said relay and connected in parallel with said storage condenser on the operation of said relay for recording the number of incoming pulses in a train, means responsive to the rise of the charge in said storage condenser above a given critical level, precision means for transmitting outgoing pulses of predetermined length, strength and spacing, means controlled by said condenser charge level responsive means for rendering said precision means operative, and means controlled by said precision means while operative comprising a condenser alternately charged and connected in parallel with said storage condenser in cycles corresponding in number to the number of outgoing pulses.

7. A pulse regenerator comprising a storage condenser and two matched condensers one for adding charges to said storage condenser and one for subtracting equal charges from said storage condenser, means for controlling said adding condenser by incoming impulses, means for controlling said subtracting condenser in accordance with outgoing impulses, and means responsive to the rise of the charge in said storage condenser above a given critical level for rendering said last means operative.

8. A pulse regenerator for repeating a plurality of trains of pulses, comprising a plurality of storage condensers each for recording the number of pulses in a train through the rise of the charge therein above a given critical level, a relay responsive to incoming impulses, a condenser controlled by said relay to alternately charge and transfer its charge to one of said storage condensers, a step-by-step switch under control of said relay for advancing the association of said condenser with said storage condensers at the end of each train of pulses, another step-by-step switch under control of said storage condensers and responsive to the charged condition of said storage condensers above said given critical level, machine controlled means for transmitting outgoing impulses, and another condenser controlled by said machine controlled means to alternately charge and transfer its charge to one of said storage condensers whereby the number of pulses in a train of outgoing pulses is measured by the return of the charge of said storage condenser to said given critical level.

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