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PULSE REGENERATOR

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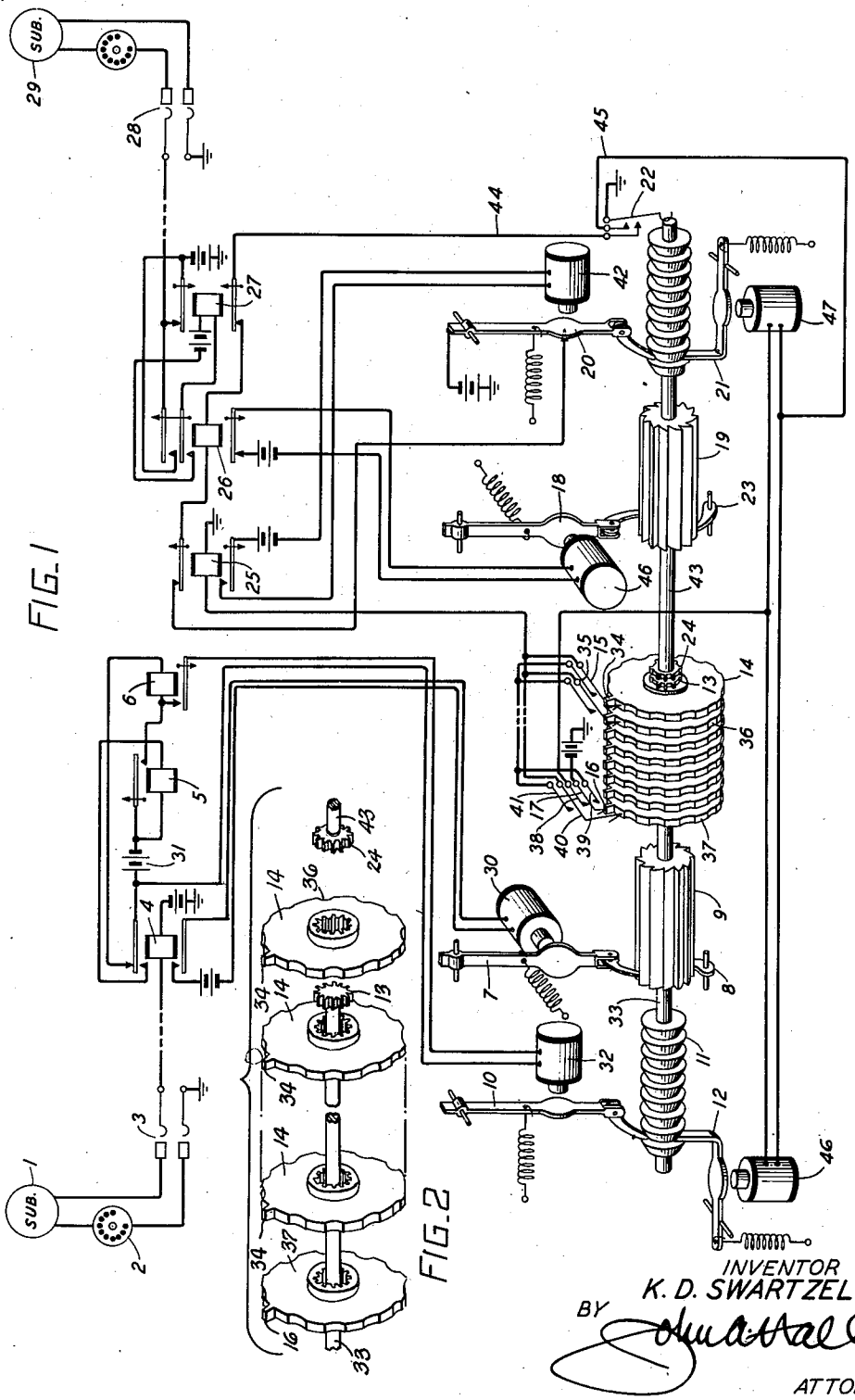

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PULSE REGENERATOR

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7 Claims. (Cl. 179—18)

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. Means of this nature may be used at an intermediate point in a long line where the incoming impulses may not be seriously mutilated but would be if they traversed the entire length of the line, and where simple relay repeating means would be inadequate since such means have no correcting action but would tend to aggregate any mutilation.

In accordance with this invention a plurality of number discs are provided, one for each digital train of impulses to be repeated. The incoming impulses of a train will rotate a disc as many steps off normal as there are impulses in the train. Later this disc will be returned to normal and during this return movement outgoing impulses of proper strength, length and timing will be transmitted, the number being governed by the distance the disc had been rotated off normal.

A feature of the invention is a splined shaft which may be given a step-by-step longitudinal movement whereby it will be moved into engagement with a separate disc on each step. While in engagement with each separate disc this shaft may be given a step-by-step rotary movement to rotate that disc with which it is engaged. Thus the said discs may be each rotated selectively so that when all the discs have been so set a complete telephone designation will be recorded.

Another feature of the invention is a splined shaft which may be moved in like manner but rotated in the opposite direction, in combination with means for automatically stopping the rotary movement when a disc reaches its normal position and for then giving the shaft a single longitudinal step to bring it into engagement with the next disc.

In accordance with another feature of the invention the first or recording shaft retreats step by step from the first to the last disc and the second or transmitting shaft advances step by step from the first to the last disc.

Another feature is a releasing means whereby after the first or recording shaft has retreated to its ultimate position and the second or transmitting shaft has followed and advanced to its ultimate position, whereupon the device has completed its function, both shafts will simultaneously and automatically be returned to normal.

A further feature is a train of slow-operating relays which control the action of the transmitting shaft to govern its speed so that the transmitted impulses and the interdigit pause between trains of impulses will be properly timed.

The drawing consists of a single sheet containing two figures.

Fig. 1 is partly in the form of a circuit diagram and partly in the form of a schematic perspective drawing of the mechanical arrangements; and

Fig. 2 is an exploded view of the number discs and the cooperating shafts, showing schematically the relation between the shafts and the number discs.

The invention is illustrated as being included in a telephone system. Here a subscriber at substation 1 is establishing a connection to a subscriber at substation 29. The subscriber at substation 1 removes his receiver and in the usual manner a line finder 3 or other automatic switching arrangements extend his line to the apparatus illustrated in the body of this drawing. A circuit is then established from ground over the line and through the substation dial 2 and the circuit of substation 1, the winding of relay 4 to battery. Relay 4 attracts its armatures and closes a circuit through the winding of the rotary stepping magnet 30 to cause the energization of this magnet. At the same time a circuit is closed from battery 31 through the winding of slow-releasing relay 5, the front contact and upper armature of relay 4 to battery 31, whereby relay 5 becomes operated. When the subscriber at substation 1 dials, the train of impulses consists of a plurality of breaks in the line circuit. Upon the first of these breaks, the armatures of relay 4 return to their normal position whereupon a circuit is established from battery 31 through the armature and front contact of slow-releasing relay 5, the winding of slow-releasing relay 6, the back contact and upper armature of relay 4 to battery. The winding of relay 5 is opened but this being slow to release does not return its armature to normal over the period measured by the dialing impulse. Relay 6 thereupon establishes a circuit from battery 31 through the armature and front contact of relay 5, the front contact and armature of relay 6, the winding of the stepping magnet 32 and thence back to battery 31. Magnet 32 attracts the armature

10 preparatory to stepping the shaft 33 in a longitudinal direction to the left.

Upon each break in the line the circuit of stepping magnet 30 is broken, whereupon the armature 7 under spring control returns to normal and thereby rotates the shaft 33 in a counter-clockwise direction (when facing the mechanism from the right end).

A plurality of number discs like the right-hand disc 14 and the left-hand disc 37 are mounted in any appropriate manner with a shaft 33 extending through them but not in physical contact therewith. Each disc is provided with a female formation cooperating with the splines 13 on the right-hand end of the shaft 33 whereby the shaft may engage and rotate the number discs separately. The number of discs provided will correspond to the number of digits to be registered.

The shaft 33 is provided at its extreme right-hand end with a plurality of splines 13 which are only long enough to engage a single disc 14. Therefore, as the magnet 30 operates, the disc 14 will be rotated in a counter-clockwise direction a number of steps equal to the number of impulses in this train of impulses.

It should be noted that the disc 14 is provided with a camming formation 34 which causes the contact spring 15 to close a circuit to the contact spring 35 as the disc 14 is stepped off normal. Similarly, as the disc 14 is returned to its normal position as will be hereinafter described, a circuit is established between the contact spring 15 and the contact spring 35. On the forward movement, that is the movement caused by the counter-clockwise rotation of the shaft 33, the closing of this contact will be ineffective but upon the return movement this contact will become effective.

It should also be noted that the disc 14 is cut in such a way that the spring 15 will drop into a serration at the end of each step to properly center the disc and hold it in position.

After the proper number of steps of the shaft 33 has been taken under control of the dial 2 there will be a pause, spoken of as the interdigit pause, during which the relay 4 will hold its armatures attracted for a period of time long enough to allow the relay 6 to become deenergized. Upon this action, the magnet 32 will become deenergized and the armature 10 under spring control will cause a longitudinal movement of the shaft 33 whereby the splined end 13 will now come into engagement with the second number disc 36. Thereafter, the subscriber at substation 1 will dial and cause the disc 36 to be rotated in a counter-clockwise direction a number of steps equal to the digit dialed.

In this manner each of the eight number discs will be set and thereby a telephone number will be recorded on such discs.

Upon the setting of the last of these discs 37 another contact arrangement will be operated. This consists of a contact spring 17, normally resting on the camming surface 16, whereby a back contact 38 is closed and a front contact 39 is opened. As the disc 37 is moved off normal the contact spring 17 will now transfer its contact from the spring 38 to the spring 39. During the first off-normal step a spring 40, similar to the spring 15, will be operated whereby a momentary contact is made to the spring 41. At this time a circuit may be traced from battery, the spring 17, the spring 39, the spring 41, the spring 40 to the winding of a slow-releasing relay 25, to ground. At the end of this first step the momentary contact between the springs 40 and 41 will be broken and therefore the circuit for relay 25 will be opened. During the energization of relay 25 a circuit for the energization of stepping magnet 42 will be closed through the lower armature and front contact of relay 25. After a period of time, equal to the proper interdigit pause, has expired, relay 25 will release its armatures whereupon the magnet 42 will release its armature 20 and cause the shaft 43 to be given one longitudinal step toward the left. This will bring the splined end of the shaft 43 into engagement with the first disc 14 and at the same time will allow the off-normal spring 22 to move to the left to ground the two conductors 44 and 45. At the completion of this longitudinal movement a circuit will be established from battery, the armature 20 of magnet 42, the back contact and upper armature of relay 25, the winding of relay 26, the back contact and lower armature of relay 27, conductor 44, to ground on the off-normal spring 22. Relay 26 becomes energized in this circuit and a normally closed circuit for magnet 46 is thereby opened whereby the armature 18 releases and causes the shaft 43 to take one step in a clockwise direction. At the same time relay 26 closes a circuit for the relay 27 through its inner upper armature and front contact, so that relay 27 now becomes energized. Normally, a circuit is closed from battery through the upper armature and back contact of relay 27 to the apparatus controlled by outgoing impulses and here represented by the switch contacts 28. When relay 26 becomes operated the upper armature and back contact of relay 27 are bridged, so that the front contact and upper outer armature of relay 26 substitute for the upper armature and back contact of relay 27. Relay 27 opens the circuit of relay 26 and, therefore, after an appropriate interval, relay 26 releases its armatures, so that the circuit for magnet 46 is again established. During this period the circuit toward the switch 28 is opened and this constitutes a timed pulse transmitted by this apparatus. The proper timing is achieved by the proper construction and adjustment of the two slow-releasing relays 26 and 27. After relay 26 has been restored for a sufficient time then relay 27 releases, whereupon the circuit for relay 26 is again established and the magnet 46 allows the armature 18 to rotate the shaft 43 another step in a clockwise direction.

In this manner the disc 14 is returned, step by step, to its normal position and a corresponding number of impulses are transmitted toward the switch 28. As the disc 14 reaches its normal position the spring 15 rides up over the camming surface 34, so that a connection is now established from battery contact 17, contact 39, contact 35, contact 15, winding of relay 25 to ground. Relay 25 operates and causes the energization of magnet 42 which, moving its armature 20, prepares to step the shaft 43 from engagement with the disc 14 to engagement with the disc 36. At the same time the battery connection to the armature 20 and thence to the back contact and upper armature of relay 25 is broken, so that relay 26 is deenergized for the interdigit pause caused by the proper timing adjustment of slow-release relay 25. At the end of this timing period the connection between contacts 15 and 35 now being open, relay 25 releases, causing the shaft 43 to be stepped into

engagement with disc 36, ready to initiate the clockwise movement of the disc 36.

In this manner each of the number discs in turn is rotated back to normal and properly timed trains of impulses are transmitted to the switch 28 representing a train of automatic switches.

As the last disc 37 returns to normal a connection is established from ground, off-normal contact 22, conductor 45, the two release magnets 47 and 48 in parallel, spring 38, spring 17 to battery. These release magnets become energized and attracting their armatures 12 and 21 release the shafts 33 and 43, respectively, which thereupon return to normal in the usual manner employed in the working of such two-movement step-by-step mechanisms. Upon the full return to normal of the shaft 43 the off-normal spring 22 opens the ground connection to the conductors 44 and 45 and the apparatus is now in its normal position awaiting use in some other connection.

What is claimed is:

1. A pulse repeater for repeating a plurality of trains of pulses comprising a like plurality of rotatable members mounted on a common center line, a shaft mounted on said common center line provided with means for rotating each said member separately, means responsive to trains of pulses for successively moving said shaft into engagement with said members, means responsive to the pulses of said trains of pulses for rotating said members, a second shaft mounted on said common center line provided with means for rotating each said member separately, automatic means for successively moving said second shaft into engagement with each of said members and for rotating each of said members a distance corresponding to the distance each had been rotated by said first shaft, and means controlled by said last-named means for transmitting pulses.

2. A pulse repeater for repeating a plurality of trains of pulses comprising a like plurality of rotatable members mounted on a common center line, a shaft mounted on said common center line provided with means for rotating each said member separately in one direction, means responsive to trains of pulses for successively moving said shaft into engagement with said members, means responsive to the pulses of said trains of pulses for rotating said members, a second shaft mounted on said common center line provided with means for rotating each said member separately in the opposite direction, automatic means for successively moving said second shaft into engagement with each of said members and for rotating each of said members a distance corresponding to the distance each had been rotated by said first shaft, and means controlled by said last-named means for transmitting pulses.

3. A pulse repeater for repeating a plurality of trains of pulses comprising a like plurality of rotatable members mounted on a common center line, a shaft mounted on said common center line provided with means for rotating each said member separately in one direction, means responsive to trains of pulses for successively moving said shaft into engagement with said members, means responsive to the pulses of said trains of pulses for rotating said members from a normal position, a second shaft mounted on said common center line provided with means for rotating each said member separately in the opposite direction, means for successively moving said second shaft into engagement with each of said members, means for rotating each of said members back to normal, contact means operated by each of said members as said members reach normal position for controlling said movements of said second shaft, and means controlled by said means for moving said second shaft for transmitting pulses.

4. A pulse repeater or repeating a plurality of trains of pulses comprising a like plurality of rotatable members mounted on a common center line, a shaft mounted on said common center line provided with means for rotating each said member separately in one direction, means responsive to trains of pulses for successively moving said shaft into engagement with said members, means responsive to the pulses of said trains of pulses for rotating said members from a normal position, a second shaft mounted on said common center line provided with means for rotating each said member separately in the opposite direction, means for successively moving said second shaft into engagement with each of said members, means for rotating each of said members back to normal, contact means operated by each of said members as said members reach normal position for controlling said movements of said second shaft, means responsive to the return to normal of the last of said members to be set by said first shaft for automatically returning both of said shafts to normal, and means controlled by said means for moving said second shaft for transmitting pulses.

5. A pulse repeater for repeating a plurality of trains of pulses comprising a like plurality of rotatable members mounted on a common center line, a shaft mounted on said common center line provided with means for rotating each said member separately in one direction, means responsive to trains of pulses for successively moving said shaft into engagement with said members, means responsive to the pulses of said trains of pulses for rotating said members from a normal position, a second shaft mounted on said common center line provided with means for rotating each said member separately in the opposite direction, means for successively moving said second shaft into engagement with each of said members, means for rotating each of said members back to normal, contact means operated by each of said members as said members reach normal position for controlling said movements of said second shaft, contact means operated by the movement of said second shaft off normal, means including said last means and said contact means operated by the last of said members for returning both said shafts to normal upon the arrival of the last of said members at its normal position, and means controlled by the said means for moving said second shaft for transmitting pulses.

6. A pulse repeater for repeating a plurality of trains of pulses comprising a like plurality of rotatable members mounted on a common center line, a shaft mounted on said common center line provided with means for rotating each of said members separately in one direction, means responsive to trains of pulses for successively moving said shaft into engagement with said members, means responsive to the pulses of said trains of pulses for rotating said members from a normal position, a second shaft mounted on said common center line provided with means for rotating each said member separately in the opposite direction, means for successively moving said second shaft into engagement with each of

said members, means for rotating each of said members back to normal, a train of slop-operating relays for controlling the means for moving said second shaft in both its longitudinal and its rotary directions, said relays being adjusted and arranged to operate in time intervals to properly time the length of outgoing pulses and the interdigit pause between trains of pulses, and means controlled by said relays for transmitting outgoing pulses.

7. A pulse repeater for repeating a plurality of trains of pulses comprising a like plurality of rotatable members mounted on a common center line and each having a grooved internal cylindrical formation coaxial with said common center line, a shaft mounted on said common center line provided with splines long enough only to engage one of said members at a time, means responsive to trains of pulses for successively moving said shaft into engagement with said members, means responsive to the pulses of said trains of pulses for rotating said members in one direction, a second shaft provided with like splines mounted on said common center line, automatic means for successively moving said second shaft into engagement with each of said members and for rotating each of said members in the opposite direction a distance corresponding to the distance each had been rotated by said first shaft, and means controlled by said last means for transmitting pulses.

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