

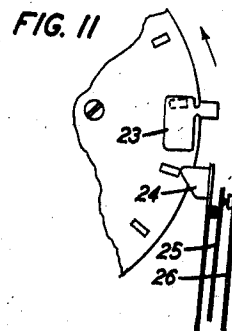
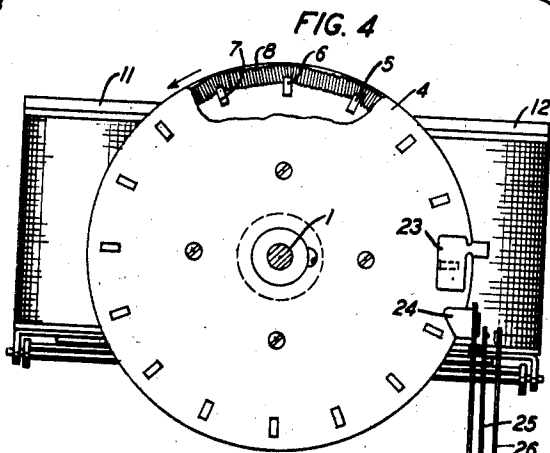
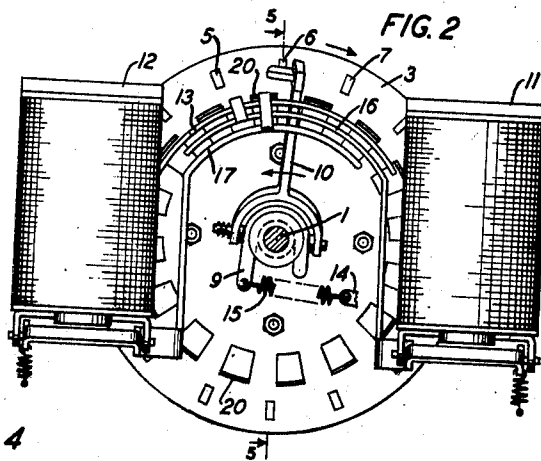
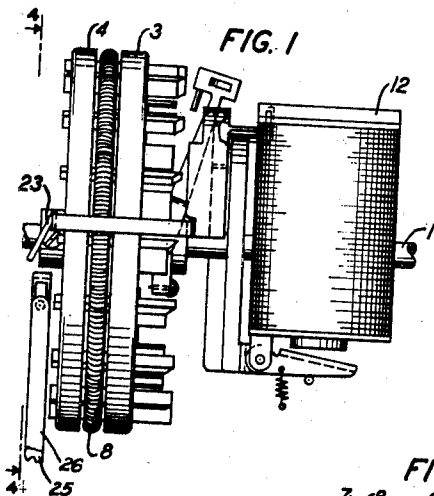
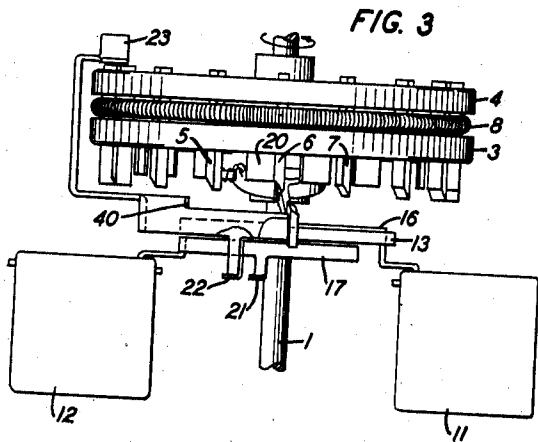
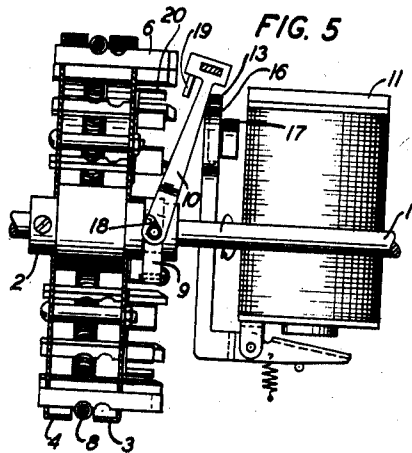
Nov. 10, 1942.

J. O'D. SHEPHERD
IMPULSE DEVICE

2,301,822

Filed May 6, 1941

2 Sheets-Sheet 1



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Nov. 10, 1942.

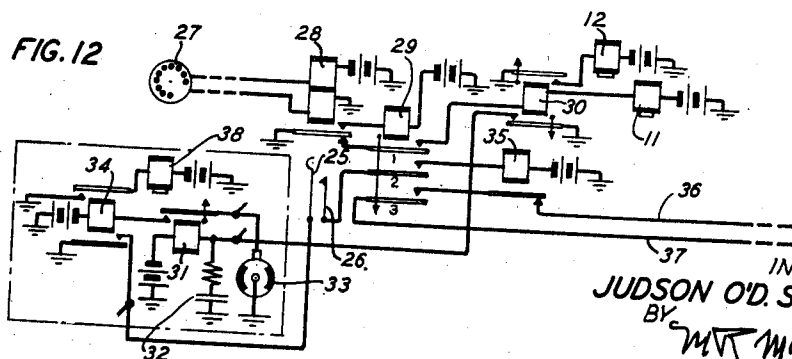
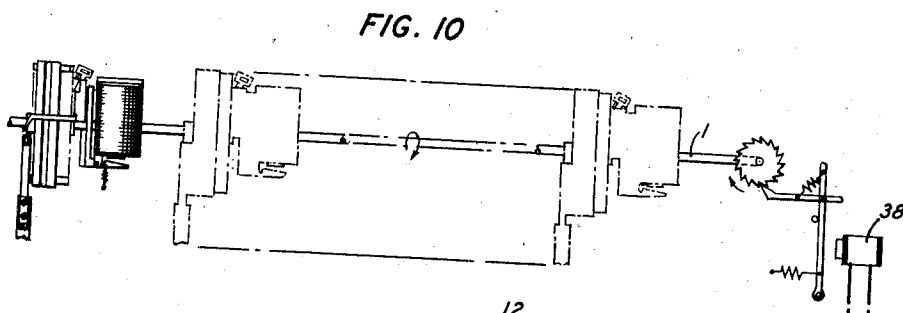
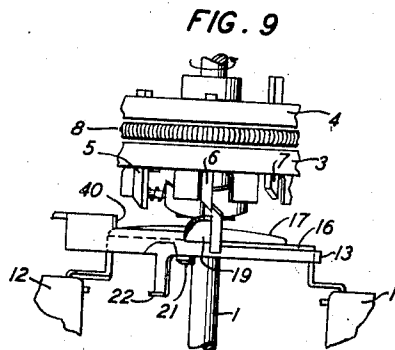
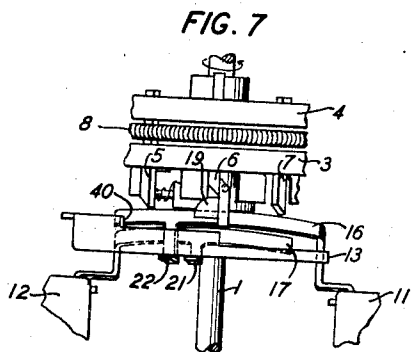
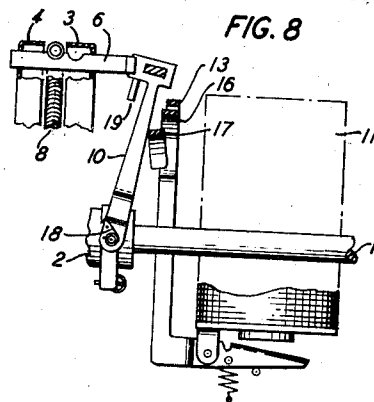
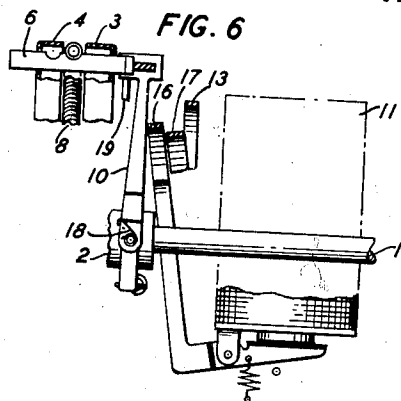
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2,301,822

IMPULSE DEVICE

Filed May 6, 1941

2 Sheets-Sheet 2



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2,301,822

IMPULSE DEVICE

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11 Claims. (Cl. 179-16)

This invention relates to pulse regenerators particularly useful in telephone systems where the length and condition of a line may introduce distortion in signaling pulses of a character which must be accurately timed.

The object of the invention is to provide a simple and economical device which will respond to incoming impulses which if transmitted much further might be too badly distorted to affect the receiving apparatus at the distant point properly, and to transmit to such distant point pulses regenerated and thus corrected as to timing and strength.

A feature of the invention is a moving device having a plurality of movable members which in their normal position produce no circuit change but when displaced will each cause the transmission of a regenerated pulse. As the movable members of this moving device pass a certain point they may be displaced in response to incoming impulses and as they pass another point further on in their travel they will affect a circuit to transmit a regenerated pulse. Thus if a train of seven impulses is to be regenerated, seven of these movable members will be displaced in succession as they pass this first certain point and later they will cause the transmission of seven regenerated pulses as they pass the said second point.

A feature of the invention is a means to move the displacing means in accordance with the difference in the rate of movement of the said device and the rate at which the incoming pulses are received.

Another feature is an automatic means for properly aligning the movable member displacing means through the uniform and properly timed advance of said moving device.

Another feature is an escapement connection between the movable member displacing means and the movable members whereby the displacing means is held in the correct position to carry out its function until it has completed such function and is then escaped to the next movable member. The movable members thus act as part of an escapement mechanism.

Another feature is the use of a common prime mover for advancing the series of movable members for a plurality of regenerators. Since the speed or rate of outpulsing must be accurately timed and uniform for all regenerators where a plurality are used, the movement of the various moving devices may be controlled by a common means.

Other features will be apparent from the following detailed description.

The drawings consist of two sheets bearing twelve figures.

Figure 1 is a side view of the essential elements of a pulse regenerator;

Fig. 2 is a front view of the same;

Fig. 3 is a top view of the same;

Fig. 4 is a rear view of the same;

Fig. 5 is a side view, partly in section, with the register magnet removed so that the action of the impulse magnet may be seen;

Fig. 6 is a schematic side view showing positions of the parts with the impulse bail and register bail fully operated;

Fig. 7 is a schematic top view with the impulse bail and the register bail in the same positions as in Fig. 6;

Fig. 8 is a schematic side view showing positions of the parts with the register bail still operated after the impulse bail has been returned to normal;

Fig. 9 is a schematic top view with the impulse bail and register bail in the same positions as in Fig. 8;

Fig. 10 is a schematic side view showing how a plurality of impulse generators may be operated on a single shaft;

Fig. 11 is a rear view of a small part of the apparatus showing how the impulse springs may be operated by a camming movement; and

Fig. 12 is a circuit diagram showing how the magnets of the impulse regenerator may be operated.

The impulse regenerator consists essentially of a rotating drum carrying a plurality of displaceable elements which may be successively moved from their normal to their operated positions by the operation of an impulse magnet. As these displaced elements move into another position, they cause the operation of a pair of contact springs which will so affect an associated circuit as to transmit regenerated impulses. A shaft 1 is provided which may be constantly rotated at a uniform speed as by a constant speed motor or which may be rotated step-by-step at a uniform speed as indicated in Fig. 10. A collar 2 is secured to the shaft 1 in any appropriate manner and the drum is built onto the collar by means of a pair of shallow, flattened, circular, saucer-shaped elements 3 and 4. Through appropriately sized rectangular holes punched in these elements, a plurality of displaceable pins, such as 5, 6 and 7, are mounted. Each pin or displaceable element, such as 6, has a pair of practically semicircular recesses cut in it for cooperating with a spiral spring 8 for holding the element in either its normal or its displaced position. By means of a yoke 9, a hammer 10 is movably mounted on the collar 2.

An impulse magnet 11, a register magnet 12, a limit bail 13 and a spring support 14 are rigidly mounted on a frame (not shown) and held in spaced relation to the shaft 1. By means of a spring 15, mounted between an extension of the yoke 9 and the spring support 14, the hammer 10

is impelled in a counter-clockwise direction as viewed in Fig. 2.

The impulse magnet 11 operates an impulse bail 16 and the register magnet 12 operates a register bail 17. The three bails 13, 16 and 17 are shown in cross-section in Fig. 5 in their normal positions, and in this position the hammer 10, impelled in a clockwise direction by a spring 18, is in such position that it will not interfere with the free passage thereby of the displaceable elements. The head of the hammer 10 and the co-operating ends of the displaceable elements such as 5, 6 and 7 are bevelled in such a manner that if the hammer should be caused to strike a displaceable element while the two are practically aligned, the displaceable element will not be moved but the hammer will be cammed to the left or in a counter-clockwise direction which is the direction in which it is pulled by spring 15. Thereupon, a cam member 19 forming part of the head of the hammer will come into contact with a camming surface 20 formed of an upturned portion of the saucer-shaped element 3, one of these camming surfaces being provided for each displaceable element.

In operation magnets 11 and 12 will both be energized simultaneously. Magnet 11 will respond separately to each impulse of a series and magnet 12 will respond once for the entire series of impulses. Thereupon the register bail 17 will move to the position shown in Figs. 8 and 9 and will be limited in its travel by a stop member 21 integral therewith coming into contact with the limit bail 13. During each impulse the impulse bail 16 will move to the position indicated in Fig. 6 and will be limited in its movement through the movement of a stop member 22 coming into contact with the limit bail 13.

If the impulse and register magnets are energized when the parts are in the positions shown in Fig. 3, then the head of the hammer 10 will pass the right-hand face of the displaceable member 6 as indicated in Fig. 9 and the cam 19 will push the displaceable member 6 into its operated position as shown clearly in Fig. 7. Due to the fact that the shaft 1, and therefore the drum, is moving in a clockwise direction as seen in Figs. 2, 3, 7 and 9, the hammer 10 will then be carried in this clockwise direction until the impulse magnet 11 releases it. At this time the hammer 10 will retract to the position where it will escape contact with the displaceable element which it has just moved as indicated by the element 7 in Fig. 9 and will spring counterclockwise to come into contact with the right-hand face of the next element 6 as indicated in Fig. 9. Thereupon, the hammer is again moved in a clockwise direction by the displaceable element with which it is now engaged until the impulse magnet 11 again impels the hammer 10 to move such element. Thus, a number of displaceable elements are placed in their operated position in succession, the number corresponding exactly to the number of times the impulse magnet 11 is operated.

It should now be noted that the limit bail 13 has a narrow portion seen more clearly in Fig. 7 extending from about the normal position of the hammer 10 toward the right and a widened portion extending from the normal position of the hammer 10 toward the left. If the incoming impulses have been at a faster rate than the corresponding rate of movement of the drum, then after the last impulse of a series has been registered and the register bail has been retracted

the hammer will come to rest against the widened portion of the limit bail and here will engage the right-hand face of the next displaceable element. By this means the hammer is impelled in a clockwise direction until it reaches its normal position, whereupon it drops back into its normal position and thus escapes contact with the displaceable element. The hammer then comes to rest against the shoulder of the limit bail formed by the difference in width of the limit bail at that point.

Likewise, if the incoming impulses have been at a slower rate than the corresponding rate of movement of the drum, then after the last impulse of a series has been registered the hammer will come to rest against the narrow portion of the limit bail 13 and, since in this position it escapes engagement with any one of the displaceable elements, it will be moved by the spring 15 to its normal position.

A shoulder 40, as best seen in Figs. 3, 7 and 9, is provided on limit bail 13. This will limit the counterclockwise travel of hammer 10 as, for example, by receipt of impulses at too rapid a rate or receipt of impulses with shaft 1 not rotating. Should the incoming impulses be at too slow a rate or should the register bail be operated by inadvertence or struck without receipt of suitable impulses, hammer 10 will be carried clockwise by the member, such as 6, with which it is engaged. When it passes the end of register bail 17, it will be sprung out of engagement with member 6 and back against limit bail 13, where it will be held by the shoulder formed by the right-hand end of the register bail. When the register bail is restored to normal, the hammer will be permitted to spring back to its normal position. By these means, effective protection is provided against travel of hammer 10 in either direction beyond its operative range.

A cam 23, here shown as being formed out of the same piece of metal as the limit bail 13 is placed in such a position on the side of elements 3 and 4 opposite to that of the hammer 10 that it will return all displaced elements to normal as they move past it by camming action. Just before these displaceable elements engage the face of the cam 23, however, a cam 24 will ride up on the edge of any displaced cam and cause a connection to be made between contact springs 25 and 26. This is indicated in Figs. 4 and 11.

The manner in which this device may be operated will be apparent from a consideration of the circuit diagram shown in Fig. 12. Here a dial 27 represents a telephone station. The dial operates the relay 28 in the usual manner, that is, when the line is seized, the relay 28 is operated and when the dial 27 is operated, the relay 28 releases once for each impulse to be sent. Upon the seizure of the line and the operation of relay 28, a slow-releasing relay 29 is operated and this remains operated throughout the sending of impulses. Upon the sending of the first impulse and after relay 29 is operated, a circuit is established from the armature of relay 28 through its back contact, armature 1 and front contact of slow-releasing relay 29, through the winding of slow-releasing relay 30 and the winding of impulse magnet 11. The impulse magnet 11 responds separately to each impulse and the relay 30 responds to the series of impulses as a whole. Relay 30 through its upper armature operates the register magnet 12 which thus also responds to the series of impulses as a whole. The impulse magnet in the manner hereinbefore described dis-

places a number of elements corresponding to the number of impulses in an incoming series.

Upon the operation of relay 30, and through its lower armature, a circuit is closed for a slow-releasing relay 31 in a common circuit. This relay, through appropriate means, here indicated by a condenser 32, may be caused to remain operated for an appreciable period (for instance, three seconds) after its energizing circuit has been opened. During the operation of relay 31 an interrupter 33, which is mechanically finely adjusted to give open and closed periods of exactly the duration needed for producing outgoing impulses, is connected to the winding of a relay 34. Relay 34, through its lower armature, completes a circuit through the contact springs 25 and 26 to operate relay 35. Relay 35 opens the outgoing loop which may be traced from conductor 36, through the back contact and armature of relay 35, the front contact and armature 3 of relay 29 to the conductor 37. It should be noted that the contact springs 25 and 26 will be closed for a longer period than any operation of relay 34 and that the time during which these springs are operated by the cam 24 may be adjusted so that the response of relay 35 will completely reflect an operation of relay 34. Thus, the common relay 34 will accurately control the timing of the outgoing pulse.

Where a single pulse regenerator is employed on a shaft, a stepping magnet 38 is operated by the relay 34 to position its pawl, so that upon subsequent release the shaft is advanced the angular pitch between pins. This results in the advancement of the shaft between pulses to provide rotation thereof at uniform speed in a series of steps.

Where a number of impulse regenerators are mounted on a single shaft as indicated in Fig. 10, then a single stepping magnet 38 may be employed for all of them. The individual regenerators will have to be accurately positioned circumferentially on the shaft. When shaft 1 is driven continuously from some other power source, such as a motor, then the stepping magnet 38 may be eliminated. This will require that the operation of interrupter 33 be coordinated with rotation of the shaft so that the make interval of the interrupter will occur only during the period in which contact springs 25 and 26 of the regenerator or regenerators may be closed by a projecting pin. To effect the latter the interrupter may be driven by the shaft or it may be mounted thereon. With this arrangement it is important that shaft 1 be rotated at a uniform rate and interrupter 33 be finely adjusted and accurately coordinated therewith to create outgoing impulses of the proper length and spacing.

With the motor driven arrangement the motor may be normally stopped in which case another spring and contact will be provided on relay 31 to start said motor upon seizure of a regenerator circuit by a call being routed therethrough and maintain it running as long as relay 31 remains operated.

In practicing the invention, the interrupter may be omitted where the shaft 1 is driven continuously by a motor. In this case spring 25 may be connected to ground so that upon each closure of it and spring 26, relay 35 will be operated to produce a pulse. This will require careful design of cam 24 to cause the production of pulses of accurate length. This alternative may, of course, be similarly practiced where shaft 1 is driven in a series of steps, as by a magnet 38 in the manner described above.

Since the outgoing impulse circuit does not include any element of the incoming circuit, the outgoing impulses will be of proper length and accurately spaced.

It should also be noted that the showing of the dial 27 for operating the relay 28 is merely by way of example. The line between the dial 27 and the relay 28 may be long and instead of the dial a pair of conductors extending from some other type of pulse transmitter may be connected thereto so that the relay 28 may be operated in any appropriate manner.

It should further be noted that the number of displaceable elements 5, 6 and 7 is merely a matter of engineering design. The interval between the operation of a displaceable element and the creation of a regenerated outgoing impulse through the operation of cam 24 may be altered to suit the circumstances. Thus, the outgoing impulses may be caused to follow the incoming impulses by a very short interval or they may be delayed for an appreciable interval. In practicing this invention, cam 24 with springs 25 and 26 may be mounted for circumferential adjustment around shaft 1 as a center so that the interval between receipt of a pulse and its transmission may be varied between wide limits. The slow release of relay 31 may be arranged so that the circuit for relay 34 will be closed until the last displaced element of a registered train of pulses has passed the cam 24.

What is claimed is:

1. A pulse regenerator comprising a device for passing a plurality of displaceable members before means for displacing such members, means at one point responsive to each pulse of a train of incoming pulses for displacing one of said displaceable members for each pulse in said train, a constant speed interrupter to produce a continuous train of accurately spaced and timed electrical circuit interruptions, and means at a second point responsive to displaced members passing such point to control the transmission of a pulse from said interrupter for each displaced member.

2. A pulse regenerator comprising a continuously moving device for passing a plurality of displaceable members before a plurality of given points at a uniform rate, a displacing member at a first given point responsive to incoming pulses for displacing one of said displaceable members for each pulse in a train, means for automatically adjusting the position of said displacing member at said first given point to compensate for the difference between the speed of said continuously moving device and the rate at which the pulses of said train are received, means at a second given point responsive to displaced members passing such point for generating a pulse for each said displaced member and a restoring means at a third given point for restoring all displaced members passing said point.

3. A pulse regenerator comprising a continuously moving device for repeatedly passing a plurality of displaceable members before a plurality of given points at a uniform rate, a plurality of displaceable members greater in number than the largest number of pulses in a train which said device may be called upon to handle, a displacing member at a first given point responsive to incoming pulses for displacing one of said displaceable members for each pulse in a train, means for adjusting the position of said displacing member at said first given point to compensate for the difference between the speed of

said continuously moving device and the rate at which the pulses of said train are received, said adjusting means comprising an escapement device including as parts thereof said displacing and said displaceable members, means at a second given point responsive to displaced members passing such point for generating a pulse for each said displaced member and a restoring means at a third given point for restoring all displaced members passing said point.

4. A pulse regenerator comprising a device moved forward step by step at a uniform rate for repeatedly passing a plurality of displaceable members before a plurality of given points, a displacing member at a first given point responsive to incoming pulses for displacing one of said displaceable members for each pulse in a train, means for adjusting the position of said displacing member at said first given point to compensate for the difference between the speed of said moving device and the rate at which the pulses of said train are received, a set of contacts at a second given point for generating and transmitting outgoing pulses and means associated therewith coacting with said displaced members for operating said contacts once for each said displaced member passing said point and means at a third given point for restoring all displaced members passing said point.

5. A plurality of pulse regenerators comprising a common driving means and a common prime mover, each pulse regenerator comprising a device for passing a plurality of displaceable members before a plurality of given points, a displacing member at a first given point responsive to incoming pulses for displacing one of said displaceable members for each pulse in a train, means for adjusting the position of said displacing member at said first given point to compensate for the difference between the speed of said device and the rate at which the pulses of said train are received, means at a second given point responsive to displaced members passing such point for generating a pulse for each said displaced member and a restoring means at a third given point for restoring all displaced members passing said point.

6. A plurality of pulse regenerators comprising a common driving means and a common prime mover, said prime mover comprising means to continuously drive said regenerators in a step-by-step motion at a uniform rate, each pulse regenerator comprising a device for passing a plurality of displaceable members before a plurality of given points, a displacing member at a first given point responsive to incoming pulses for displacing one of said displaceable members for each pulse in a train, means for adjusting the position of said displacing member at said first given point to compensate for the difference between the speed of said device and the rate at which the pulses of said train are received, means at a second given point responsive to displaced members passing such point for generating a pulse for each said displaced member and a restoring means at a third given point for restoring all displaced members passing said point.

7. A pulse regenerator comprising a continuously moving device for passing a plurality of displaceable members before a plurality of given points, a displacing member at a first given point responsive to incoming pulses for displacing one of said displaceable members for each pulse in a train, means for adjusting the position of said

displacing member at said first given point to compensate for any difference between the speed of said continuously moving device and the rate at which the pulses of said train are received, means at a second given point responsive to displaced members passing such point for generating a pulse for each said displaced member, means for adjusting the distance between the said first and second given points to adjust the time by which the outgoing pulses are delayed beyond the incoming pulses and means at a third given point for restoring all displaced members passing said point.

8. A pulse regenerator comprising a continuously moving device for passing a plurality of displaceable members before a means for displacing such members, a displacing means at one point responsive to each pulse of a train of incoming pulses, means for moving said displacing means along the line of movement of said displaceable members and for holding said displacing member in exact alignment with a displaceable member until the displacing movement thereof has been completed, and means for generating an outgoing pulse for each said displaced member as said members in their movement pass another point.

9. A pulse regenerator comprising a device for passing a plurality of displaceable members before a means for displacing such members at a uniform rate, a displacing means normally at one point responsive to each pulse of a train of incoming pulses, means responsive to a train of incoming pulses for moving said displacing means from said normal position and into engagement with one of said moving displaceable members whereby said displaceable member partakes of the movement of said engaged displaceable member, means responsive to the separate impulses of said train for escaping said displacing member from one to another of said displaceable members and for displacing each said displaceable member so engaged, and means at a second point responsive to displaced members passing such point for controlling the generation of a pulse for each said displaced member.

10. A pulse regenerator comprising a device for passing a plurality of displaceable members before means for displacing such members, means at one point responsive to each pulse of a train of incoming pulses for displacing one of said displaceable members for each pulse in said train, a constant speed interrupter, means controlled by said interrupter for driving said device at a uniform and unchangeable rate, and means at a second point responsive to displaced members passing such point to control the transmission of a pulse from said interrupter for each displaced member.

11. A pulse regenerator comprising a device for passing a plurality of displaceable members before means for displacing such members, a constant speed continuous motion means for operating said device, means at one point responsive to each pulse of a train of incoming pulses for displacing one of said displaceable members for each pulse in said train, a constant speed interrupter to produce a continuous train of accurately spaced and timed electrical circuit interruptions, and means at a second point responsive to displaced members passing such point to control the transmission of a pulse from said interrupter for each displaced member.

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