

May 1, 1934.

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1,956,704

REGENERATIVE SIGNAL REPEATER

Filed July 11, 1933

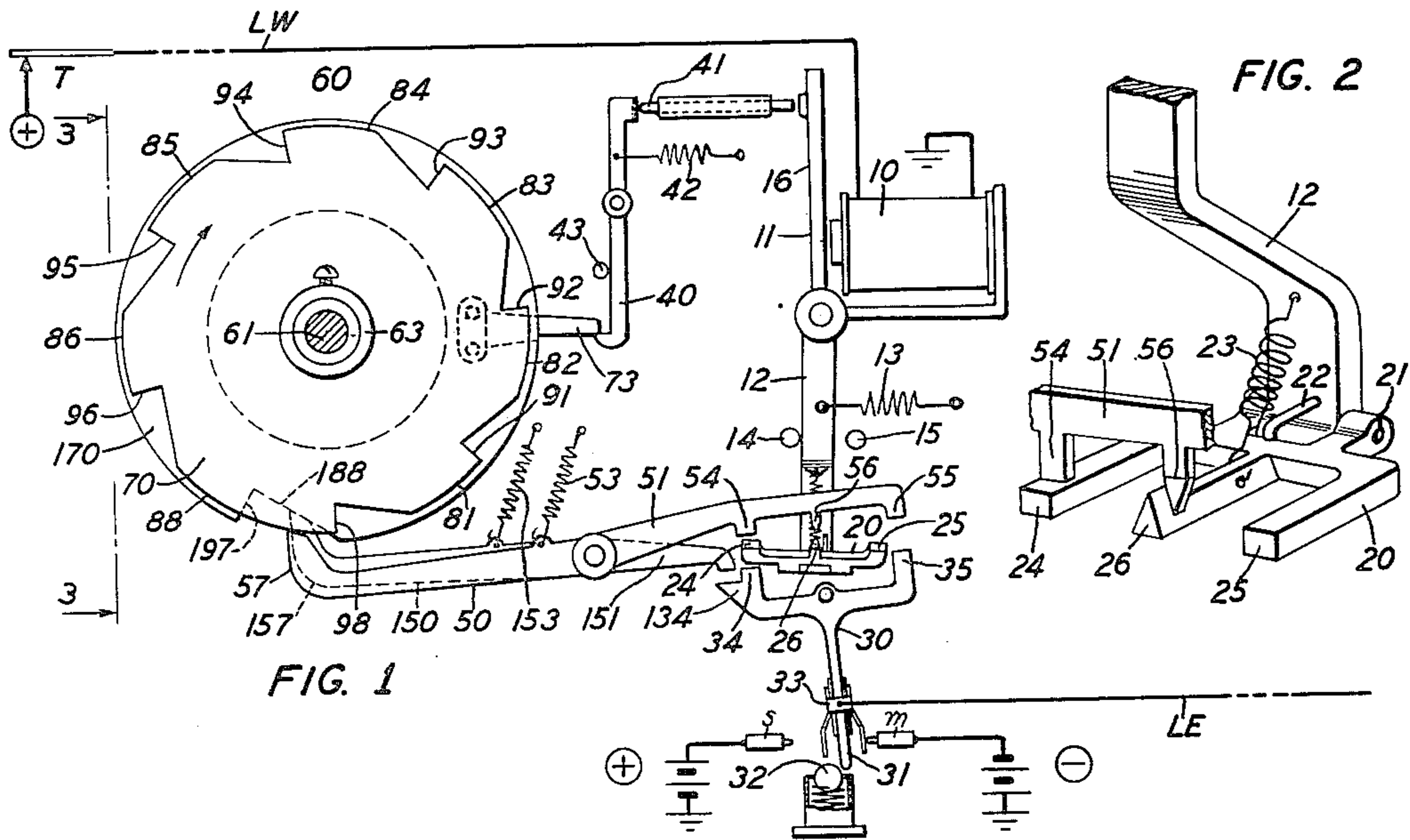


FIG. 4

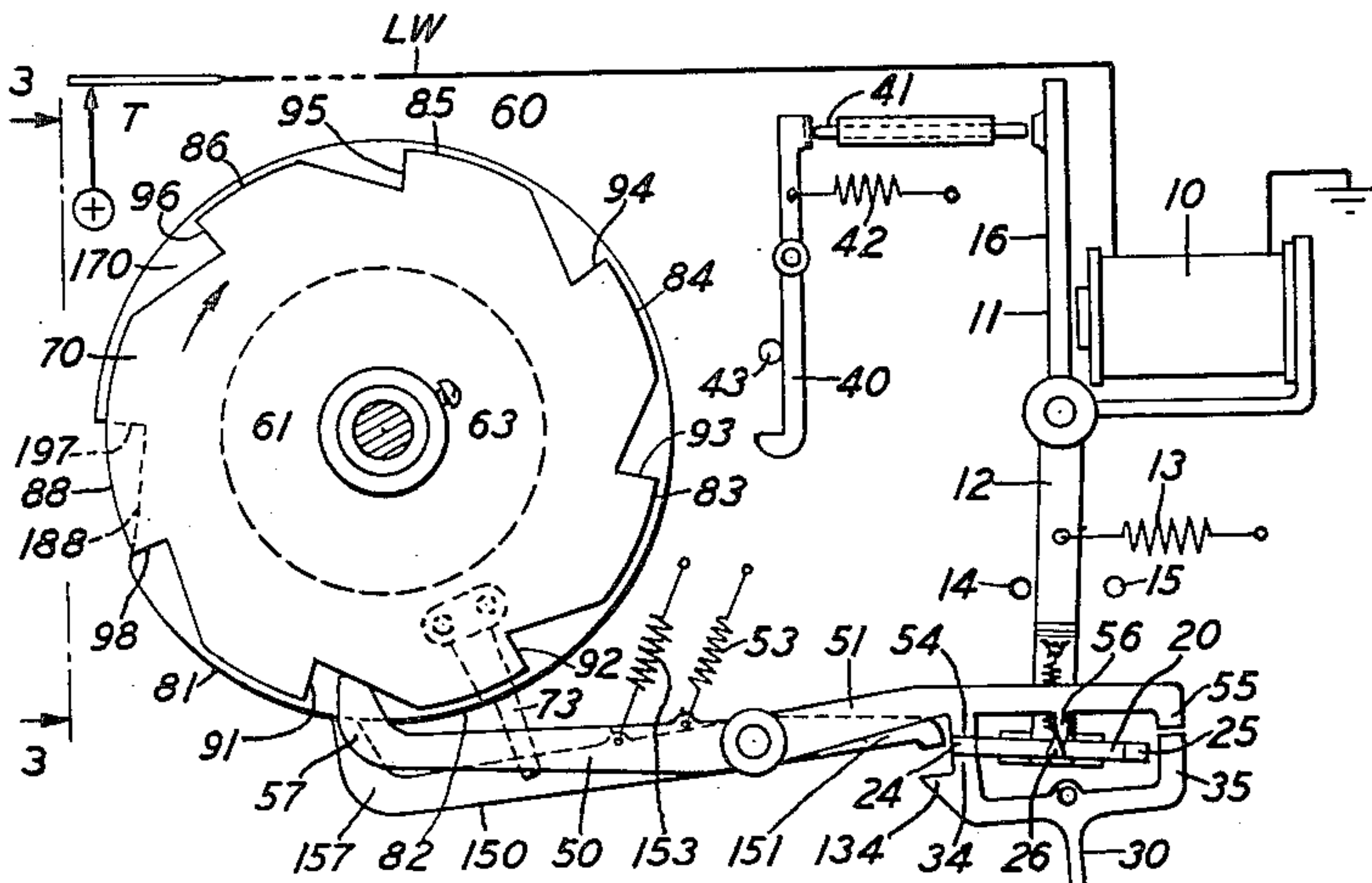


FIG. 3

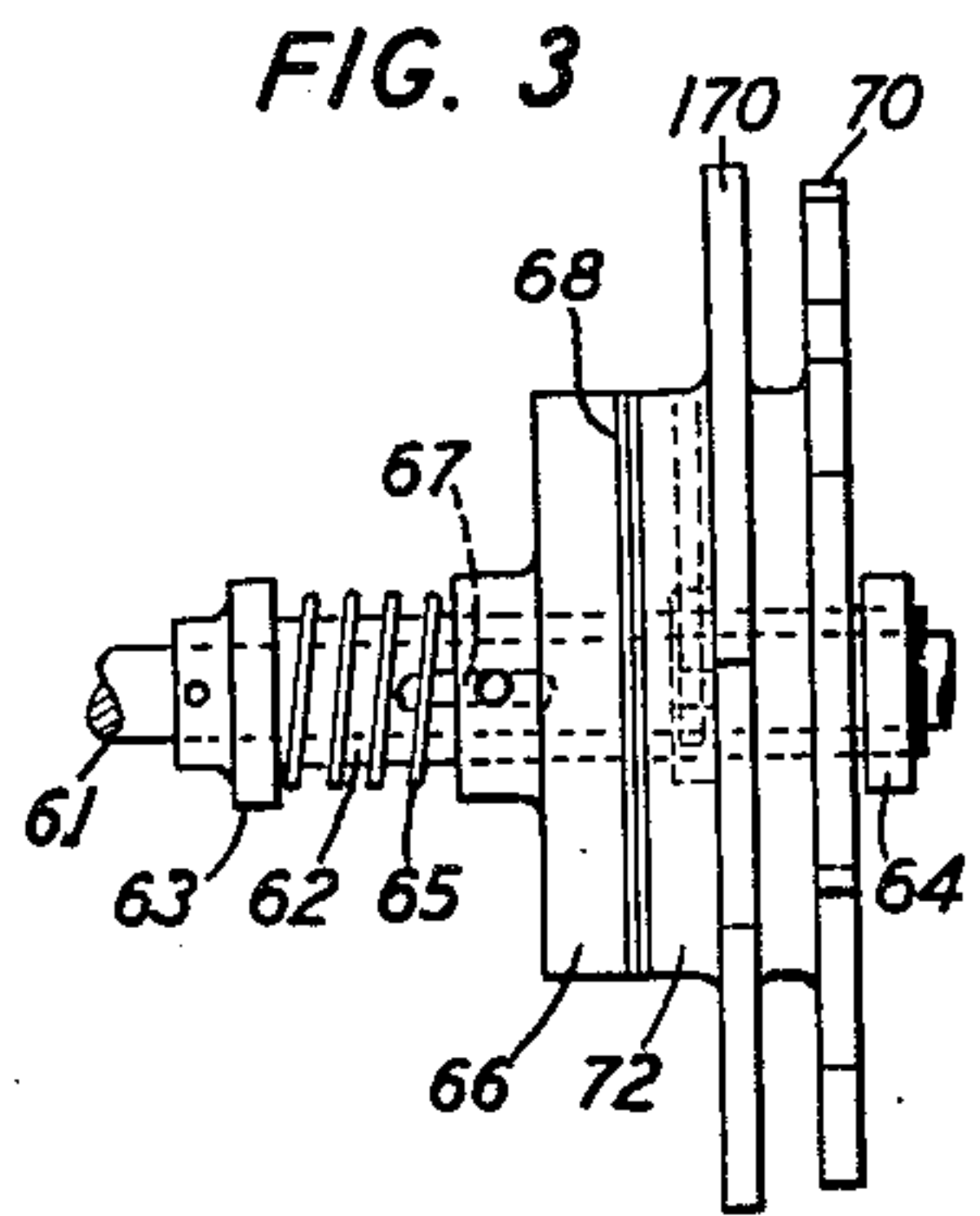
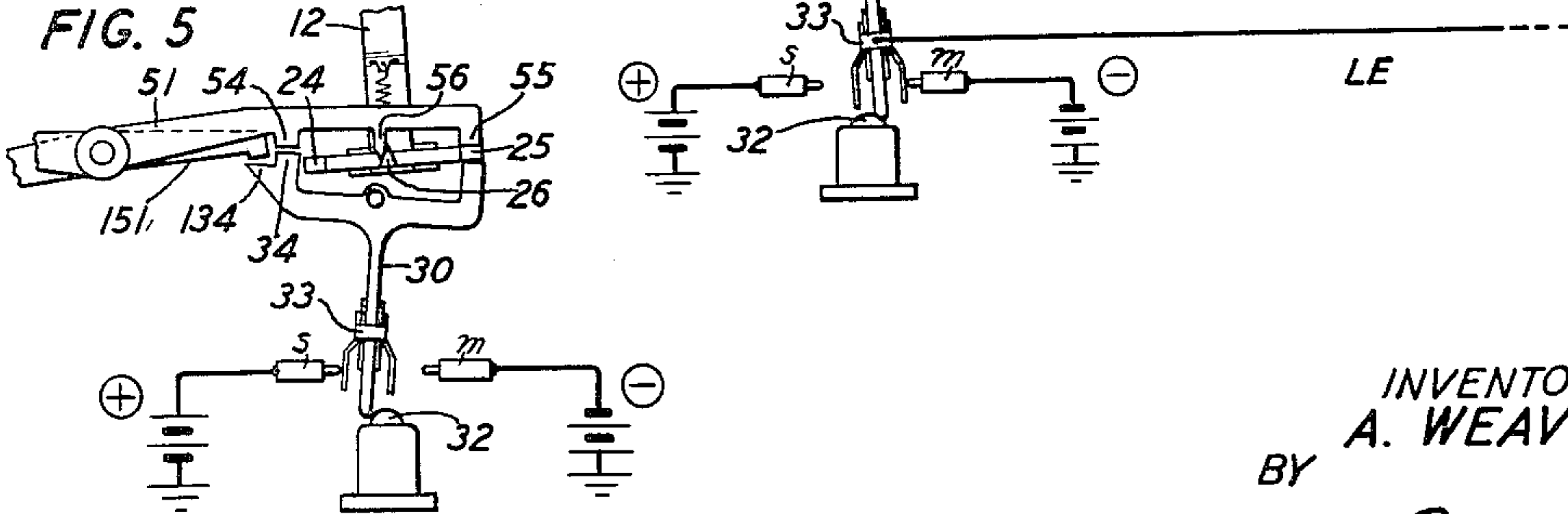


FIG. 5



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1,956,704

REGENERATIVE SIGNAL REPEATER

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Application July 11, 1933, Serial No. 679,964

6 Claims. (Cl. 178—70)

This invention relates to regenerative signal repeaters and more particularly to telegraph repeating devices of the mechanical regenerative type.

5 An object of the invention is to provide an impulse repeater capable of retransmitting signals of a desired wave shape and frequency in response to received signals which will be accurate in operation at high speeds.

10 A specific object of the invention is the provision of a mechanical repeater for accurate operation in start-stop telegraph systems in which the stopping time is reduced to be approximately equal to the impulse time or in which the stop-
15 ping time for any other reason is especially short.

Telegraph repeaters are used in lines where they are inserted between adjacent sections of the line so that signals, which may have become greatly distorted in the transmission over one line
20 section, may be restored for retransmission over the next line section and finally be received by the recording instruments at the end of the line for reproduction of the original message with fidelity. With the ordinary relay repeater the
25 signals are merely boosted up and are retransmitted with most of the distortion of the received signals. The regenerative repeater, besides boosting the signals up, regenerates them to be equivalent to the originally transmitted
30 signal.

The regenerative telegraph repeater most commonly used employs receiving and retransmitting rotary distributors of the segment and wiper type, which require considerable attention for main-
35 tenance and are comparatively expensive, besides occupying large space in the station. However, in recent years telegraph practices have arisen, which involve extensive networks and long subscriber's loops, where less expensive repeaters
40 would be desirable.

In certain types of telegraph systems it is customary to transmit, during the sending of a message, periodically occurring synchronizing impulses of fixed characteristic which of course must
45 be repeated by any repeater in the line circuit just the same as the character impulses. In accordance with a feature of the invention the mechanical repeater has operating parts responsive to the synchronizing impulses for timing the re-
50 peater mechanism and for effecting the retransmission of the fixed synchronizing impulses, and has other operating parts responsive to the character impulses of alternate characteristics for synchronous retransmission thereof.

55 In start-stop telegraph systems the impulse

series representing a letter is usually composed of a series of either 5 or 6 permutated character impulses and 1 or 2 synchronizing or timing impulses which are not subject to permutation. In this type of system it has become customary to
60 reduce the stopping time of the distributors to be substantially equal to the unit impulse time, the consequence of which is that the physical angle occupied by the stop position is smaller than the angle assigned for transmission of each char-
65 acter impulse, and is smaller by the angle which could be traversed during the average stopping time. Whereas this can readily be arranged in the electrical segment-wiper distributor, difficulties arise in mechanical repeaters which, of
70 course, require certain minimum dimensions for effecting each operation. A limiting condition thus will be reached when the signal speed is increased relative to the stopping time.

In accordance with a further feature of the in-
75 vention a start-stop mechanical repeater, therefore, is provided with a power driven mechanism including an oscillating lever for operation of retransmitting contacts into alternate positions under the control of the receiving magnet and in
80 accordance with incoming character impulses; the power driven mechanism also includes separate parts for operation of retransmitting contacts in time with synchronizing or control im-
85 pulses; and since the control impulses are non-selective, that is are of predetermined characteristics, they are retransmitted by the functioning of these mechanical parts with the retransmitting
90 contacts independently of the receiving magnet control. Thus mechanism, otherwise held stationary, may operate in time with a stop impulse to each time set the retransmitting contacts in
95 position for sending a stop impulse, during which period the oscillating lever for functioning in time with the character impulses is held stationary so as not to interfere with the stop im-
pulse operation.

In the preferred form of the invention a set of cam operated oscillating levers is provided for
100 supplying operating power for the setting of retransmitting contacts. The cam action may be obtained in many different ways by camming surfaces, which obviously must have a minimum
105 physical extent, each camming surface occupying a certain minimum angle through which the cam travels during the unit time of an impulse. Since
in the stop-position the angle of travel is reduced below this minimum by an angle corresponding
110 to the stopping time, the camming surface for effecting the retransmission of the stop impulse

cannot be placed on the same cam as the camming surfaces effecting the character impulses. In the preferred form of the invention the cam operated oscillating lever which is timed with the character impulses cooperates with an element which is controlled by the receiving magnet to set the retransmitting or circuit interrupting contacts in either alternate position in accordance with incoming impulses. Since this element must partake in the contact operation the camming surface for each impulse is arranged to provide sufficient mechanical clearance and time for the resetting of the control element between contact operations. This evidently cannot be arranged for in the reduced stop position of the cam provided for the character impulses. In accordance with the invention advantage is taken of the fact that the synchronizing impulses have predetermined characteristics. Thus in the preferred form of the invention a separate cam and oscillating lever is provided for retransmission of the stop impulse, and the lever operates to set the contacts in a predetermined position in time with an incoming stop impulse but independently of the control element of the receiving magnet. By this feature the stop-impulse cam is not required to provide clearance for the control element and the cam action and its angular extent may be reduced sufficiently to be contained within the reduced angle of the stop position.

In general, it may be stated that in accordance with the invention a plurality of contact operating elements may be provided in such a manner that, whereas one element must be arranged to allow in time and space for the operation of a control element, another element, performing a different function, may be arranged to perform independently of that control element, in the retransmission of signals.

The invention is readily adapted to signal codes composed of various numbers of impulses as well as to codes employing both start and stop impulses or only a start impulse in addition to the code impulses.

The repeater in accordance with the invention is adaptable for insertion in standard repeater switchboard equipments; due to their small dimensions several repeaters may be mounted on a single bay of the switchboard and driven by a single motor.

A preferred form of the invention will now be described in detail in connection with the accompanying drawing in which,

Figure 1 is a schematic drawing of a mechanical repeating device arranged in accordance with the invention and particularly adapted for operation in an eight-unit start-stop signaling system;

Figs. 2 and 3 are detail views of certain parts of the device shown in Fig. 1;

Figs. 4 and 5 are schematic views of the device showing different operated positions.

The repeating device comprises a receiving magnet 10 connected into a line west LW. The distant end of the line may be provided with any conventional transmitting device T for impressing signal impulses on the line circuit for the operation of the armature 11 by the magnet 10. The repeating device further comprises a contact operating member 30 having a set of contact springs 33 and being pivoted to oscillate between two positions in which the contact set 33 engages either the marking contact *m* or the spacing contact *s*; negative or positive potential is thereby impressed upon the line east LE,

thus retransmitting in a regenerated form the signals received by the magnet 10, as will be explained hereinafter.

The armature 11 has an arm 12 and is normally, i. e., during the normal energization of the magnet 10, held against the stop 14; when the magnet 10 is deenergized the spring 13 moves the arm into engagement with the stop 15. At the lower end of the arm 12 a selecting member 20 is pivoted by means of a pin 21 to the arm 12 and is normally held in a raised position in engagement with a stop 22 by means of a spring 23; the selecting member 20 has two arms 24 and 25 of which the arm 24 will be aligned with an extension 34 on the contact operating member 30, when the armature 11 is in its attracted position, and the arm 25 will be in alignment with an extension 35 on the contact operating member 30, when the armature 11 is in retracted position. Under the conditions shown in Fig. 1 the selecting member 20 is in the raised position in engagement with the stop 22, so that the arms 24 and 25 may clear the extensions 34 and 35, when the armature moves from one position to the other.

The repeating device further includes a timing device 60 which consists of a cam wheel 70 and an oscillating lever 50, one end 57 of which engages the camming surfaces of the wheel 70, and the other end 51 of which is arranged for the alternate operations of the retransmitting member 30 under the control of the hinged member 20. The timing device 60 furthermore includes a separate stop-cam 170 and an oscillating stop-lever 150. One end 157 of lever 150 engages the camming surfaces of the disc 170 and the other end 151 is arranged for direct engagement with the contact operating member 30. The discs 70 and 170 are mounted in parallel arrangement to form an integral member or timing element, or any desired known provision may be made for their mutual orientation.

The timing device 60 is mounted on a shaft 61, which may be motor driven in any desirable manner and which may be common to a plurality of timing devices similar to the device 60. The timing device comprises a sleeve 62 which serves as a mounting for the device and is fixed on the shaft 61 in any desirable manner; it includes shoulders 63 and 64. Between these shoulders are mounted a spring 65 backed by the shoulder 63 and exerting a pressure on a disc 66, which forms one side of a friction clutch and is positively driven with the sleeve 63 by means of a key and slot arrangement 67 that will permit a slight axial movement of the disc 66. The pressure on disc 66 acts on one or more friction shims 68, which may be of any suitable material, such as cork or felt, for the purpose of driving the timing element 70—170, when the latter is released, and yet permit slippage without undue power loss, when the timing element is held stationary, as is well known in the art. The timing element 70—170 has a shoulder portion 72 which presents a friction surface for receiving the pressure of the friction clutch.

The cam wheel 70 is in the form of a disc or rim of comparatively large diameter and has a plurality of camming surfaces along its periphery which comprise the notches 91 to 96 and 98 and, alternating therewith, the high points 81 to 86 and 88. The cam wheel 170 is also in the form of a disc, which however only has the stop notch 197 cut into its periphery, in a position spaced

from the notch 96 by an angle equivalent to the unit period of an impulse.

The timing or distributor element 70—170 also carries a stop lever 73 which in the stop position of the device engages the catch 40, which in turn is normally held by a spring 42 against a stop 43 to be in the path of the stop arm 73. With the armature 11 of the magnet 10 in attracted position the camming device is prevented from rotating, but when the magnet 10 deenergizes the extension 16 of the armature 11 will act through the slidable rod 41 to remove the latch 40 from the arm 73 to release the timing wheel 70—170.

As already stated it has been found desirable under certain conditions to increase the speed of transmission by including the stop time within the period between the stop signal and the start signal in such a manner that this period will be equal to the period of each of the remaining impulses of a code series, thus providing for uniform intervals for all impulses of a code series. This has before been attained with electrical distributors by reducing the angular relation between the stop and the start segments as compared with the relation between the other segments.

The preferred form of the invention illustrated in the drawing is arranged to include the stopping time within a unit impulse period by reducing the angular relation between the stop and start notches 197 and 98 so that the reduction in time of travel between these notches will compensate for the stopping time and the time of picking up speed at starting.

When the timing wheel is released it will rotate with the speed of the shaft 61 and the lever 50 will be oscillated by its spring 53 in accordance with the passing of the camming surfaces by the end portion 57 thereof. The arm 51 of the lever 50 has at its free end two projections 54 and 55 which are always in alignment with the extensions 34 and 35 of the retransmitting lever 30. Thus when the lever 50 oscillates the projections 54 and 55 will approach the extensions 34 and 35 without being able to engage them directly. However, in either position of the member 30 one of the extensions 34 and 35, with which one of the arms 24 and 25 happens to be aligned, will receive a downward pressure through that arm from the lever 51 for the corresponding operation of the retransmitting element 30; the selecting member 20, being flexibly mounted, partakes in the downward movement of the power lever 51 and returns therewith to its upward position for realignment by the armature 11, in accordance with received signals, during the intervals between the downward strokes of the power lever 51. The high points 81 to 88 of the camming surfaces on cam wheel 70 act to raise the lever 51 sufficiently to provide clearance under the operating surfaces 54 and 55 for the resetting of element 20 between operations by the lever 50, and these high points are of sufficient peripheral extent to provide time for the resetting of element 20.

When the timing element 70—170 is released the lever 150 will have its end 157 in engagement with the camless part of the periphery of cam 170 under tension of the spring 153 until at the end of the rotation the lever will be oscillated once by the passing of the stop notch 197. The other end 151 of lever 150 will thus remain out of engagement with the contact operating member 30 while the lever 50 is active, but will engage extension 134 on the member 30 to operate the contact set

33 to marking position in time with the incoming stop signal while the lever 50 is at rest.

It will be noted by a study of Fig. 1 that in the stop position the lever 51 is fully raised to allow free movement of the control element 20 and the lever 151 is raised sufficiently to permit free movement of the operating member 30.

The contacting member 30 has a lower extension 31 cooperating with a spring pressed ball 32 for locking the member 30 against either of the contacts *m* and *s* and yet permitting operation of the member 30 under the force of power lever 51.

The operation of the device is as follows: Assuming the condition shown in Fig. 1, the timing or interrupter cam 70—170 is held against rotation by the engagement of latch 40 with the lever 73. The power lever 51 is held in raised position by the engagement of the end 57 with the high point 88 of the timing cam 70. The power lever 151 is held partly raised in the notch 197. The armature 11 is attracted due to a normal or marking current in the line circuit LW and through the magnet 10; the selecting member 20 consequently has its arm 24 in alignment with the extension 34 and the projection 54. The retransmitting member 30 is in normal or marking position applying negative potential to the line LE.

The shaft 60 is continuously rotating, carrying with it the sleeve 62 and the disc 66, and thus exerts a steady driving force through the friction shims 68 on the cam wheel 70—170 which, however, is prevented from operating by the engagement between the catch 40 and arm 73.

Assuming now that a start impulse, often termed the eighth impulse, arrives over the line LW, which will be due to the opening of the contact on transmitter T, and causes the magnet 10 to deenergize. The arm 16 of armature 11 removes the catch 40 from the arm 73 of the timing cam 70—170, which thus is set in rotation at the speed of the shaft 61. This speed is such that the notches 98 to 96 will pass by the end 57 of the power lever 50 at the same frequency as that of the arrival of signal impulses over line LW, and the orientation of the cam wheel 70 with respect to the power lever 50 is such that the end 57 will fall into the respective notches at about the center or the undistorted portion of the signals.

When the armature 11 was retracted the selecting member 20 was moved to the spacing position as shown in Fig. 5, in which the arm 25 will intervene between the projection 55 of the power lever 50 and the extension 35 of the retransmitting member 30.

When now the end 57 of the power lever 50 falls into the first or start notch 98 of the cam wheel 70 under the tension of spring 53, the projection 55 in its downward movement will first engage the arm 25 of the flexibly mounted selecting member 20 and then, through that arm, exert a pressure on the extension 35; in its further downward movement it will operate the contact member 30 into spacing position. A plus or spacing potential will thus be applied over the spacing contact *s* and the contact set 33 to the line LE.

After the power lever 50 returns, due to the engagement of the end 57 with the high point 81 on the cam wheel 70, the projection 55 is moved upward and the selecting member 20 moves upward therewith sufficiently for the free operation of the armature 11 by the next impulse. It may be noted by examination of Fig. 5 that projection 54 of the power lever 50 and extension 34

of the contacting member 30 do not engage when the selecting member 20 is in spacing position. A feature may also be pointed out here, according to which interference with the operations just described by premature signal impulses or interfering impulses in the line circuit is prevented. According to this feature two cooperating knife edges 56, forming part of the power lever 50, and 26, forming a part of the selecting member 20, interlock immediately after the power lever has commenced its downward stroke, to prevent movement of the armature 11, thereby insuring that an impulse which corresponds to the impulse whereby the armature was operated, is retransmitted for a full impulse period.

The retransmitting member 30 will remain locked in its new position by means of the locking member 32.

Assuming now that during the travel of the high point 81 by the end 57 of the power lever 50 the first character impulse be impressed upon the line LW by the closing of the contact of transmitter T, making this impulse a marking impulse, the magnet 10 will again energize and attract the armature 11 and, due to the raised position of the selecting member 20, the armature will be free to move and set the arm 24 to intervene between the projection 54 of the power lever and the extension 34 of the retransmitter arm 30. When next the end 57 of the power lever 50 drops into the notch 91, corresponding to the first character impulse, the condition will be as shown in Fig. 4, according to which the projection 54 exerts a pressure through the arm 24 on the extension 34 to operate the retransmitting arm 30 into marking position, thereby retransmitting the first character impulse as a marking impulse over the line east.

After the power lever again has been raised by the high point 82, the member 30 remains locked in its marking position and the selecting member 20 moves into its raised position and the knife edges 56 and 26 ultimately disengage, thereby again leaving the armature 11 free to move.

The second, third, fourth, fifth and sixth character impulses will be received and retransmitted in a manner as described for the first character impulse, the operation of the armature 11 taking place while the high points 82, 83, 84, 85 and 86, respectively, pass under the end 57 of the power lever, for the selective positioning of the selecting member 20; and the retransmitting member 30 will be operated by a quick oscillatory movement of the power lever 50 when the end 57 falls into the notches 92, 93, 94, 95 and 96, respectively.

The last impulse of the code series is the seventh or stop impulse and is always a marking impulse by which the magnet 10 is energized. This impulse arrives while the high point 88 passes by the end 57 of the power lever 50. The notch corresponding to this impulse being on the cam disc 170 instead of on the cam disc 70 the lever 50 will remain in its raised position and when the end 157 of lever 150 falls into the notch 197, the retransmitting member 30 will be operated to marking position and lock in that position while the power lever is being partly raised by the portion 183 of the timing cam 170. Since armature 11 now remains attracted the stop latch 40 will be in the path of the arm 73 and thus cause the timing device to stop. The repeating device consequently has been restored to the condition shown in Fig. 1 and is ready for retransmission of the next series of impulses. When the stop position is reached the power lever 50 will still be fully

raised whereas the auxiliary power lever 150 is only partly raised due to the configuration of the stop notch 197. The arrangement should, however, be such that, upon starting and when the power lever 50 falls into the start notch 98 the auxiliary lever 150 will be raised sufficiently to insure against interference by the lever 151 with the operation into spacing position of the contacting member 30.

It is evident that to the extent of the reduction in traveling distance between the stop notch 197 and the start notch 98 from the uniform distance between the other notches, part of the time of stopping and starting the timing device may be compensated for and that, if desired, the total of this time may be compensated for. Whereas the transmitting device T may be arranged to transmit the stop-start interval with the same speed as the other impulse intervals, it has been customary to slightly shorten the rotating time of the receiving devices with respect to the total time of a code signal series, to insure that the receiving device comes to a stop for each impulse series, thus further insuring accurate isochronism. By the arrangement shown in the drawing, the reduction in time of a revolution may be placed between the stop and the start impulse, so that the settings of the retransmitting lever 30 by the series of notches 98 to 197 may be in exact synchronism with the uniformly spaced impulses of the signal series arriving over line LW.

Whereas the invention has been shown in a conventional form it should, of course, be understood that numerous details may be incorporated to provide a practical commercial structure, which details are unessential to an understanding of the invention and may readily be supplied by one skilled in the art. Thus the impulse cams may be variously notched or grooved to provide efficient and noiseless operation; thus also the mechanical selecting means, corresponding to the member 20 shown in the drawing, through which the receiving magnet exerts its control, need not be attached to the armature, but may be variously modified so long as the selecting positioning thereof is controlled by the armature and so long as at least part thereof partakes in the movements of the power lever; and the operating magnet may be responsive to polarized signals either by being of the polarized type or by being controlled by a polarized relay in the line circuit, as is well known.

What is claimed is:

1. A regenerative mechanical signal repeater for transmission of signals composed of definite series of permuted character impulses and of non-permuted control impulses comprising receiving electromagnetic means, two position retransmitting contact means, two-position control means for said contact means adapted for setting by said electromagnetic means, power driven instrumentalities, first operating mechanism for setting of said contact means by said instrumentalities under control of said control means in accordance with a series of character impulses, and second operating mechanism for setting of said contact means by said instrumentalities independently of said control means and in accordance with a control impulse.

2. A regenerative repeater for signals composed of fixed and permuted impulses comprising receiving electromagnetic means including a control member, retransmitting contact means including an operating member, timing means for operation of said contact means in-

cluding a first power operated mechanism for operating said contact operating member through said control member once for each permuted impulse received by said magnet, and including
5 a second power operated mechanism for operating said contact operating member independently of said control member once for one of said fixed impulses.

3. A regenerative telegraph repeater for signals composed of regularly recurring synchronizing impulses and of series of character impulses which comprises a receiving electromagnet including two-position responsive mechanical means, two-position retransmitting contacts,
10 power driven timing means for synchronizing the repeater action with incoming signals including camming means adapted to be phased with respect to incoming impulses by said mechanical means in response to synchronizing impulses,
15 said timing means also including instrumentalities for operation of said contacts by said camming means synchronously with said synchronizing impulses and said timing means also including separate instrumentalities for cooperation with said camming means to operate said
20 contacts synchronously with said series of character impulses and under control of said mechanical means.

4. A mechanical repeater for regeneration of signals each composed of a permutation series of alternate impulses and of a fixed impulse which comprises electromagnetic receiving means, a control member operative by said receiving means into alternate positions in accordance with incoming signals, retransmitting contact means including an operating member operative into alternate positions for outgoing signals, timing means for synchronizing the repeater action with incoming signals including a cam operated power
30 lever for operating said contact operating member independently of said control member once for one of said fixed impulses, and said timing means also including a second cam operated power lever for operating said contact operating
35 member synchronously with said permutation series of impulses and in accordance with the positions of said control member.

5. A mechanical repeater for start-stop telegraph systems which comprises a receiving mag-

net including a two-position control member, retransmitting contacts operative to impress two different transmission conditions upon an outgoing line circuit, power driven timing means including stop means for intermittent isochronous operation with an incoming impulse series forming a signal in response to an incoming start impulse through said receiving magnet, and said timing means having a camming surface timed with the last impulse of said series and having
80 a set of camming surfaces timed with the remaining impulses of said series, and operating mechanism responsive to said timing means for operation of said contacts and including a first member operative by said last impulse camming surface for direct setting of said contacts and a
85 second member operative by said set of camming surfaces for a series of settings of said contacts through the medium of said control member.

6. A mechanical repeater for regeneration of impulses in a start-stop telegraph system, in which the stop impulse period is reduced to be substantially equal to the period of the remaining impulses, which comprises a receiving magnet, a two-position control member operative by said
90 magnet in accordance with incoming impulses, a start-stop power driven circuit interrupter having release means operative by said magnet in response to an incoming start impulse, said interrupter including a set of circuit controlling
95 contacts, a first operating element for setting of said contacts in alternate conditions through the means of said control member and in accordance with the said remaining impulses, a second operating element for direct setting of said contacts
100 independently of incoming impulses, a first rotatable camming element having a plurality of uniformly spaced camming surfaces for engagement with said first element in isochronism with said remaining impulses and having in its stop
105 position a camless surface of a reduced spacing, and a second rotatable camming element having in the stop position a camming surface for engagement with said second element in time with said stop impulses and having a camless surface
110 corresponding to the time of said remaining impulses.

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