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SIGNALING

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Fig. 1

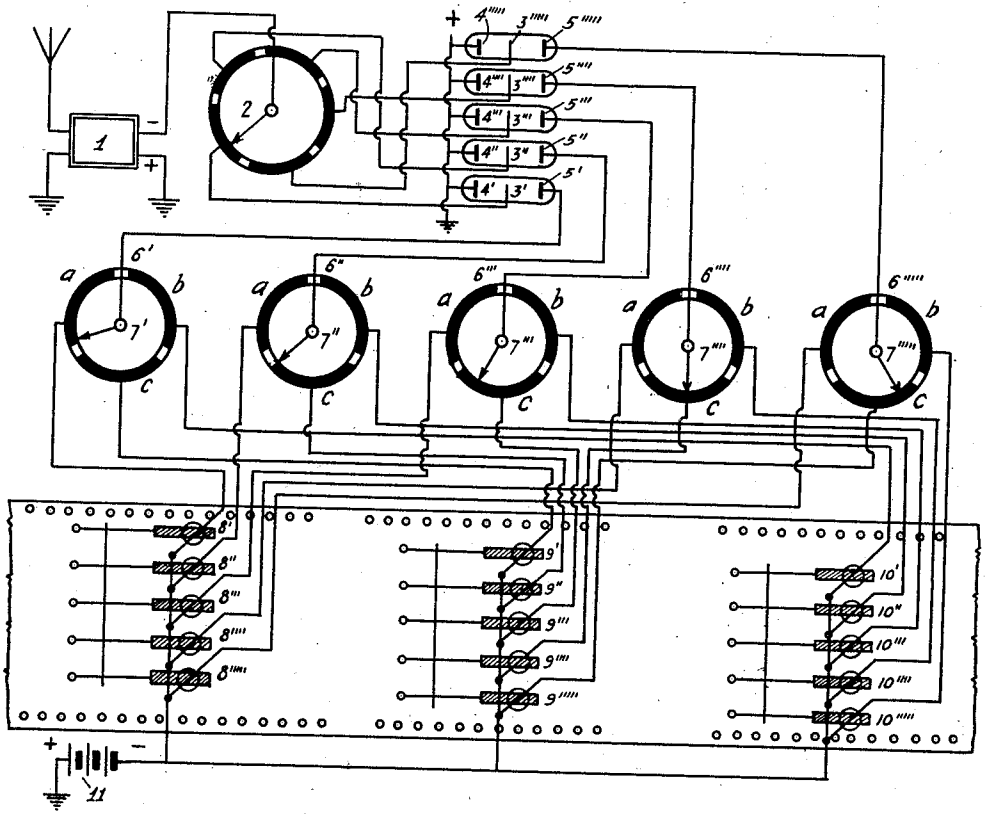

Fig. 2

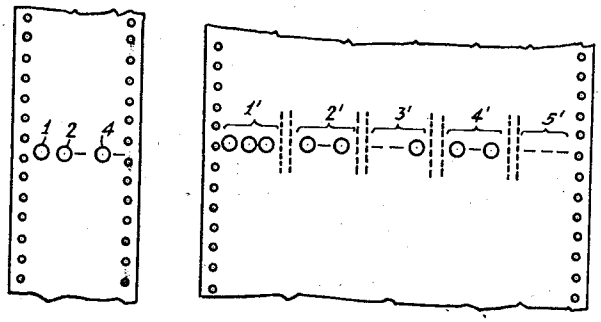

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Fig. 3

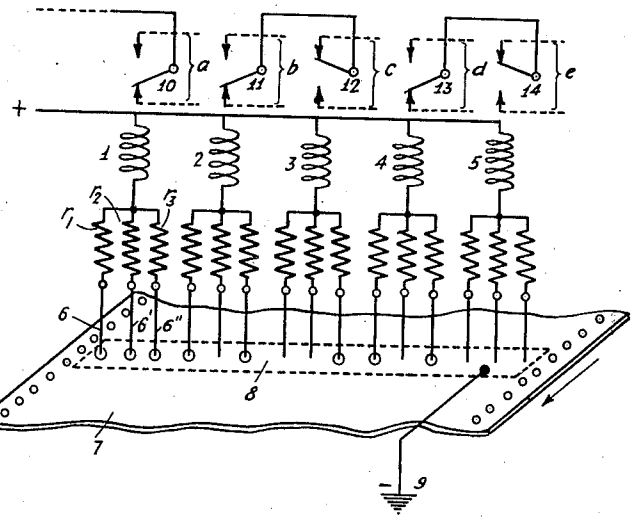

Fig. 4a

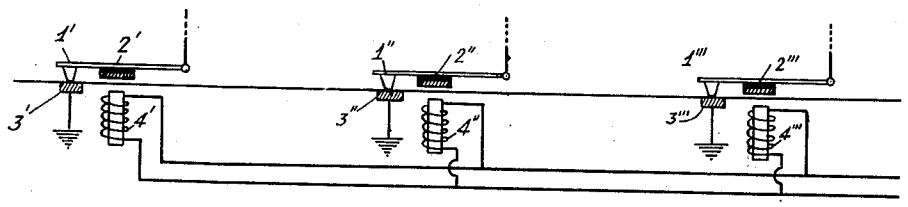

Fig. 4b

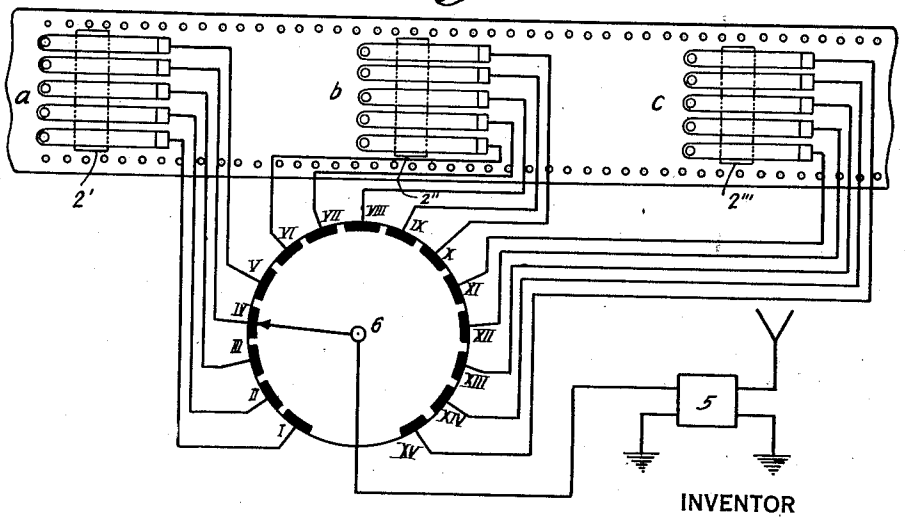

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Fig. 5a

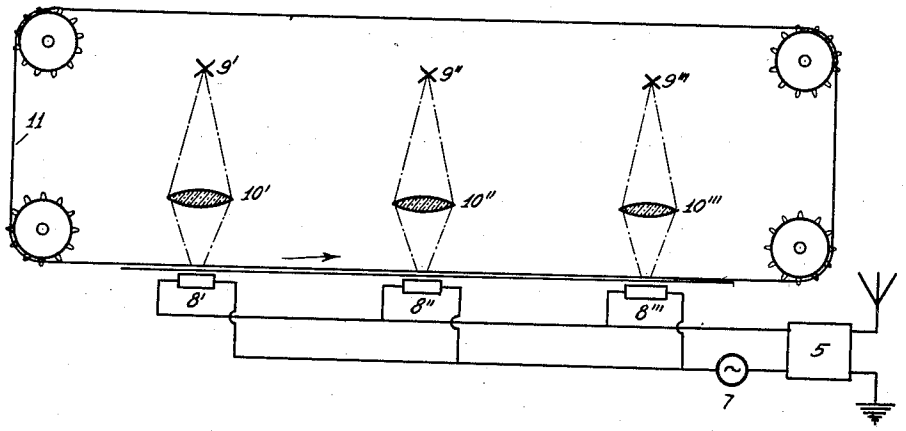
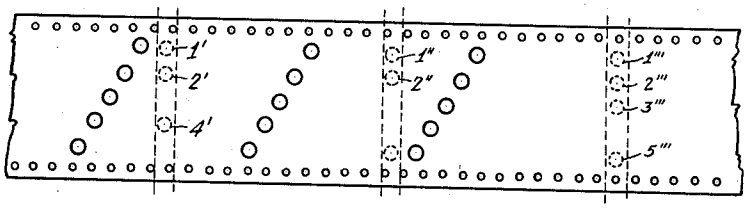


Fig. 5b



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UNITED STATES PATENT OFFICE

2,023,446

SIGNALING

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Application March 12, 1930, Serial No. 435,044
In Germany March 13, 1929

4 Claims. (Cl. 250—8)

The present invention is concerned with high-speed telegraph apparatus adapted particularly for short-wave transmission work and which operates with several repetitions and accumulation of the signal impulses at the receiving end, with the end in view of neutralizing fading actions and atmospheric disturbances in reception.

The present disclosure allows of the accumulation and summation or integration of the recorded incoming signals or impulses by mechanical means operating, for instance, according to the principles underlying the telegraphone; or, by the setting of switch groups or punching of perforated strips or tapes, even in cases where the operating speed is very high. The basic idea of the invention is that the impulse (being considerably abbreviated for reasons of the requisite repetitions) in the case of a punctiform signal element (dot for example) would be unable to result in a reliable mechanical action. For accumulation upon uniformly travelling steel wires or steel rings, as will be noted, it would be necessary to provide a certain minimum length of the magnetized zone in order that the signal or the impulse may be safely perceived and evaluable. This demand would require extremely inconvenient dimensions for the accumulator means. In the case of ratchet and pawl accumulator means, or when using perforated strips or tapes, the duration of the incoming impulse would be insufficiently long in order to cause actuation of the releasing or the perforator magnet in a reliable manner.

The invention therefore provides a retarding device which is rendered operative by the brief incoming impulses of current and which, as a result, extends the duration and therefore the impressed magnetizing length or the time of energization of the switch, ratchet electromagnet or the perforator electromagnets. For this purpose there may be employed retarding means of well-known kind, or similar means known in the prior art. One exemplification is illustrated in Figs. 1 to 3 as applied to perforated strip accumulation.

The presupposition is made that the transmitter is adapted to produce repeated five-unit impulses by the aid of normal perforator strips (as shown in Fig. 2 on the left-hand side), more or less long periods elapsing between the transmissions of one and the same signal ement (order of magnitude of 1–2 seconds). The assumption shall be made that the strip travels intermittently. By the rate or rhythm of the feed, uniform travel of the incoming strip can be controlled, though other auxiliary synchronizing means may be provided. The use of an ordinary and simple perforated transmitter tape for signal repetition is shown in connection with Figs. 4 and 5 to be discussed further below. The scheme here selected is based upon triple repetition and transmission of each signal, the speed of operation to be 10 letters per second or 120 words per minute, which means an impulse duration of an order of magnitude of 1/150th second per step of the perforated tape.

Since this duration, as pointed out before, is inadequate for the reliable operation of a perforator electromagnet, recourse is had to a receiving arrangement as shown in Fig. 1: The incoming reinforced impulses are fed by a switch 2 revolving at a definite rate of speed (in dependence upon the forward feed of the strip) to five similar retarder devices comprising parts 3', 4', 5'; 3'', 4'', 5'', etc. Retardation could be insured, for instance, by the aid of sensitive electromagnetic relays comprising holding contacts rendered operative by the incoming impulses. However, since such mechanical means have a limiting responding time, the scheme shown in Fig. 1 comprises inertialess relays in the form of glow-discharge tubes. The anodes of the latter are denoted by 4', 4'', etc., the cathodes by 5', 5'', etc., while the auxiliary electrodes serving for receiving the releasing current impulse are designated by 3', 3'', etc.

The operation of this scheme is based upon the utilization of the well-known fact that the igniting or striking potential of glow-discharge tubes is higher than the normal burning or operating potential. If the working potential lies somewhere between these two values, then the discharge is unable to set in spontaneously. But when an impulse of sufficient potential is fed to a distinct electrode (3', 3'', etc.), then the discharge initiated by ionization between anode and cathode will persist as long as the circuit of this current is closed.

Hence, the potential impulses each of around one-one hundred fiftieth of a second distributed by switch 2 in Fig. 1 will be able to consecutively strike or ignite the discharge paths 4'—5', 4''—5'', etc. The ensuing powerful glow-discharge current then flows from the grounded positive pole of current source 11 by way of the said electrodes, then through a line 6', 6'', etc., a distributor arm (wiper) 7', 7'', etc., one of the three segments *a*, *b*, *c*, and finally through the perforator electromagnet associated therewith (groups 8', 8'', etc., 9', 9'', etc., 10', 10'', etc.) to the negative

pole of 11. Since the distributor arms 7', 7'', etc., of each of the segments *a, b, c,* make contact during the transmission time of a complete fire-unit signal it will be seen that the time of flow of current for the perforator electromagnet is quintupled, in other words, is raised to a value sufficient for reliable punching. Owing to a slight lateral displacement of the three groups containing five punches each in relation to one another it is possible to obtain for each hole of the sending tape (Fig. 2 left-hand side) an accumulator group of three adjacent holes (Fig. 2 right-hand side) in the receiving strip, provided that all of the three impulses are received.

In Figure 1, therefore, it should be clear that for every revolution of apparatus 2, the strip will be jumped from a position under one group of punches to a position under the next group of punches and from the last position to the final group of punches. In this manner for three revolutions of apparatus 2, all of the punch marks for the three groups of punches will be aligned as shown in Figure 2 on the right.

If the glow-discharged current flowing across the discharge gaps, Fig. 1, should prove inadequate in order to render the perforator electromagnets operative, then supplementary relay or amplifier means controlled thereby must be provided.

In the case of Fig. 1 the assumption is made that the perforator strip between the punching zones forms loops adjustable in length in accordance with the time interval of repetition at the sending end. By virtue of the simple and reliable guiding by marginal perforation the elements of an accumulator group, in case of synchronism, will come to fall exactly adjacent to one another (see Fig. 3). If the distributers 2, 7', 7'', etc., as shown in Fig. 1, are free from angles or times during which no signal elements or impulses are received, then the forward stepping of the perforated strip does not occur everywhere in the same phase, but in separate perforation zones at different times so that in each zone there is a lag behind the transmission amounting to the duration of a five-unit signal. When this mode of operation is resorted to, the artificial extension or prolongation of the impulse, which is the object of this invention, results in no idle or no-load periods. Indeed, the repetition method makes it feasible to produce the three alternating actions; 1. release of combination; 2. perforation; and 3. forward feed of strip conjointly as to time, but at different places, the phase displacements of the strip step or feed associated therewith being permissible by virtue of the yieldingness of the loops.

The case in which the perforated strip travels forward en bloc (integrally) in phase coincidence and which is different from the foregoing case, shall be dealt with again in connection with Fig. 4*b* where the rotation of the current distributer 6 contains an interval free from transmission for extension of the impulse and forward feed of the strip. For cooperation with this arrangement, to be sure, the revolving change-over switches 2, 7', 7'', etc., Fig. 1 should have a different division of their circumference or altered contact angles. For the arm 2, which rotates three times as fast as 7', 7'', etc., it would therefore, similarly as for 6, Fig. 4*b*, be necessary to provide 15 segments within the same angle, and of these the segments I, VI, XI, are united with the first discharge tube, II, VII, XII, with the second discharge tube, and so on. This distributer thus would run at a constant rate of rotation and in synchronism with 6.

Fig. 2 illustrates the effects of signal fading and pseudo impulses in the form of atmospheric disturbances in connection with an arbitrarily chosen signal. It is assumed that upon the sending strip the places 1, 2, and 4 are perforated, 3 and 5 are not. After the signal elements have been keyed three times (with intervening time intervals or spaces), what has been recorded at the receiving end (right-hand side) is as follows: The three recordings or markings (accumulator group 1') corresponding to element 1 are all existing. Of the three transmissions of element 2, only the first and the third have become operative in accumulator group 2', while the second one is missing owing to fading. In accumulator group 3' no marking should really have happened; however, a stray impulse has occurred with the result that a hole has been perforated. In accumulator group 4', element 4 of the sending strip has been transmitted only in the first instance and the third repetition, while fading has caused its disappearance in the second. In accumulator group 5', which, like element 3, is non-perforated at the sending end, no marking has been produced either at the receiving end, in other words, during the corresponding three periods there have been no atmospheric disturbances of sufficient intensity.

The evaluation of the ensuing record for the suitable and direct operation of a translator apparatus combined with a printing telegraph is shown in Fig. 3. Engaging through the holes of the insulating tape 7 and making contact with a common conductive base or support 8 are the metallic pins 6, 6', 6'', etc., and each one of the latter is connected in series with a variable resistance *r*1, *r*2, *r*3. Five of such three-element groups, as illustrated, are connected in series with the coils 1, 2, 3, 4, 5 which serve for the adjustment or setting of the instant of printing in the translator. The principle underlying this adjustment is supposed to be known to the expert, the adjustment being effected by bringing five keepers 10, 11, 12, 13, 14 into one position or the other for governing the flow of the current in collector lines *a, b, c, d, e,* for type selection, or for forming, if desired, current-impulse combinations for the simple reforwarding by keying of the signal over wires. The working potential, the threshold of response of the electromagnets 1 to 5, and resistances *r*1, *r*2, *r*3 are so chosen that the parallel connection of at least two resistances is necessary in order that the keeper may be caused to move into the lower position where a positive transmitter signal or impulse is occasioned. But if only one resistance is in circuit, then the keeper will preserve its upper position. In this manner there is obtained the position of the five keepers 10—14 shown in Fig. 3 in evaluating the incoming strip, and this results in accurate reproduction of the elements 1, 2, 4 upon the sending strip, in spite of fading and pseudo signals. Hence, the device acts selectively in regard to these two kinds of disturbances in short-wave reception. In the instance here dealt with the assumption has been made that but one impulse has been missing and that at least two impulses have come through safely, while, on the other hand, only one pseudo impulse has happened. In practice, of course, this scheme could be chosen in any desired other manner, for instance, so that 3 failures or missings could happen in seven transmissions of the

signal. In other words, the element in question is supposed to exist whenever at least 4 individual impulses have been stored up, so that three failures in each accumulating group can be admitted as permissible.

It is an easy thing to change these values in service, for instance, in such a manner that the resistances r1, r2, r3, etc., Fig. 3 or the sensitiveness of the electromagnets 1, 2, 3, 4, 5, are varied. The adjustment or dimension of these quantities is governed by the question as to which one of the two sources of disturbance prevail. However, a better idea is to regulate the amplification in the short-wave receiver itself, the latter being usually provided with a compensating device for the intensity of the signals to be recorded. The greater the "input" amplification, the rarer the case of missing of impulses owing to fading, but the more frequent the occurrence of faulty or erroneous (stray) signals. Hence, it is thus feasible inside certain limits to obtain the desired relationship in the frequencies of positive and negative disturbances. Indeed, this is accomplishable by the aid of automatic regulators being governed by the average value of incoming energy.

The selector hereinbefore described is adapted to cooperate not only with the well-known step or start-stop telegraphs, but also with continuously acting and continuously synchronized printer apparatus.

Figs. 4a, 4b and 5a, 5b represent several exemplifications of the signal transmitter, Figs. 4a and 4b showing an electro-mechanical and Fig. 5 an electro-optical transmitter. Fig. 4b illustrates three groups a, b, c, each comprising five current-making keys in the form of springs comprising contacts 1', 1'', 1''' (Fig. 4a), which by engaging through the hole of a sending strip of the usual kind come to make contact with a conductor plate 3', 3'', 3'''. To insure circuit closure, electromagnets 4', 4'', 4''' are provided which by the agency of keepers 2', 2'', 2''' secured in an insulated manner serve to firmly apply by pressure simultaneously all of the spring contacts as long as the perforated strip is stationary.

This arrangement, because of the short duration of closure, acts more reliably than systems known in the prior art in which yielding grippers having their anterior end positioned obliquely in relation to the perforated strip make contact consecutively with the support or base as the strip travels. It will be understood that in the arrangement here shown a distributor must be provided so as to make sure that the different signals or impulses will be given off successively in the proper sequence. For this purpose there serves the rotating switch 6. Tracing the different paths consecutively closed thereby, it will be noted in what way repetition of the impulses proceeds entirely automatically at time intervals determined by the space or distance of the three contact-maker groups a, b, c. The angle of the distributor element which contains none of the segments I, II, III, etc., is utilized for the operation of the retarding (time-lag) relays in the receiver and for the forward feed of the strip which here occurs en bloc (integrally). The ensuing current impulses control the short-wave transmitter 5. As pointed out before, the pitch or division of the revolving switches 2, 7', 7'', etc. of the receiver must be adapted to that of switch 6 as before described.

Fig. 5a illustrates means adapted to insure extremely rapid operation and which are free from contacts of a mechanical nature, as these would here prove a failure. The holes of the transmitter strip, in well-known manner, act as diaphragm openings for luminous pencils which control the transmitter photo-electrically. For transmitting each signal element three times, there are provided three luminous radiators having a filamentary, slit or cylindrical shape, most simply glow-lamps 9', 9'', 9''' furnished with an elongated or stretched-out wire or filament, and these are thrown through cylindrical lenses 10', 10'', 10''', in the form of narrow light strips transversely across the width of the perforated strip. Below the latter are three photoelectric cells 8', 8'', 8''' which produce the outgoing current impulses. The distance of these three similar keying elements governs, in turn, the time interval for the repetition. The telegram is rearranged in the proper time-sequency of impulses by that immediately above the transmitter strip (which is most suitably made from non-translucent paper) there is displaced parallel to the former and in opposite direction an endless perforated tape 11 acting as an "alternate" diaphragm. The said tape 11 is provided with equidistant oblique groups of five openings each. As can be readily seen from Fig. 5b, the punched holes of the singly perforated transmitter strip are consecutively scanned photo-electrically. The three zones which are illuminated are indicated by dotted (dash) lines. After the instant which is shown in the drawing, that is, after tape 11 has moved a small distance towards the right-hand side, first element 1', then a brief time afterwards the element 2', and then the following elements, will be illuminated. Alternate scanning in the different repeating zones is thus accomplished by the use of a very simple means. If a carrier frequency is to be produced for the amplification of the photo-electric impulses, then an a. c. source or a d. c. interrupter 7, for instance, could be inserted in the circuit of cells 8', 8'', 8'''.

I claim:

1. A wireless communication system for overcoming fading and atmospheric disturbances having, in combination, a transmitter arranged to repeat five-unit impulses a predetermined number of times, said repetition being effected by means of intermittently travelling perforated tape having the signals appearing thereon, a receiver comprising five inertialess relays, a distributor for successively distributing received unit impulses to said inertialess relays in succession, individual additional distributors for each inertialess relay, and translating mechanism under control of said additional distributors responsive to the operation of said inertialess relays.

2. A wireless communication system for overcoming fading and atmospheric disturbances having, in combination, a transmitter arranged to repeat multi-unit impulses a predetermined number of times, a receiver comprising a plurality of electric tube relays one for each unit impulse, a distributor for successively distributing received unit impulses to said electric tube relays in succession, individual additional distributors for each of said relays, and translating mechanism under control of said additional distributors responsive to the operation of said relays.

3. A system in accordance with claim 2 characterized in this, that said electric tube relays comprise grid controlled glow discharge devices.

4. In a radio signalling system, apparatus for

overcoming fading and atmospheric effects comprising a transmitter arranged to repeatedly transmit multi-unit signal impulses a predetermined number of times, and a receiving system comprising means for receiving the transmitted impulses, a punching element for each unit impulse and for each repeated unit impulse for recording on tape the receipt of said unit impulses; means including grid controlled glow discharge devices, one in common for each unit impulse and its repeated unit impulses, responsive to the received signal impulses, for energizing the punching elements associated with said glow devices, for a period of time greater than the duration of time of each unit signal impulse, and translating means responsive to the repeated recording of the same ones of said unit impulses on said tape for more than half of said repetitions.

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