(No Model.) 2 Sheets—Sheet 1.

C. G. BURKE.

SYSTEM OF TELEGRAPHY.

No. 583,026. Patented May 25, 1897.

Fig. 1.

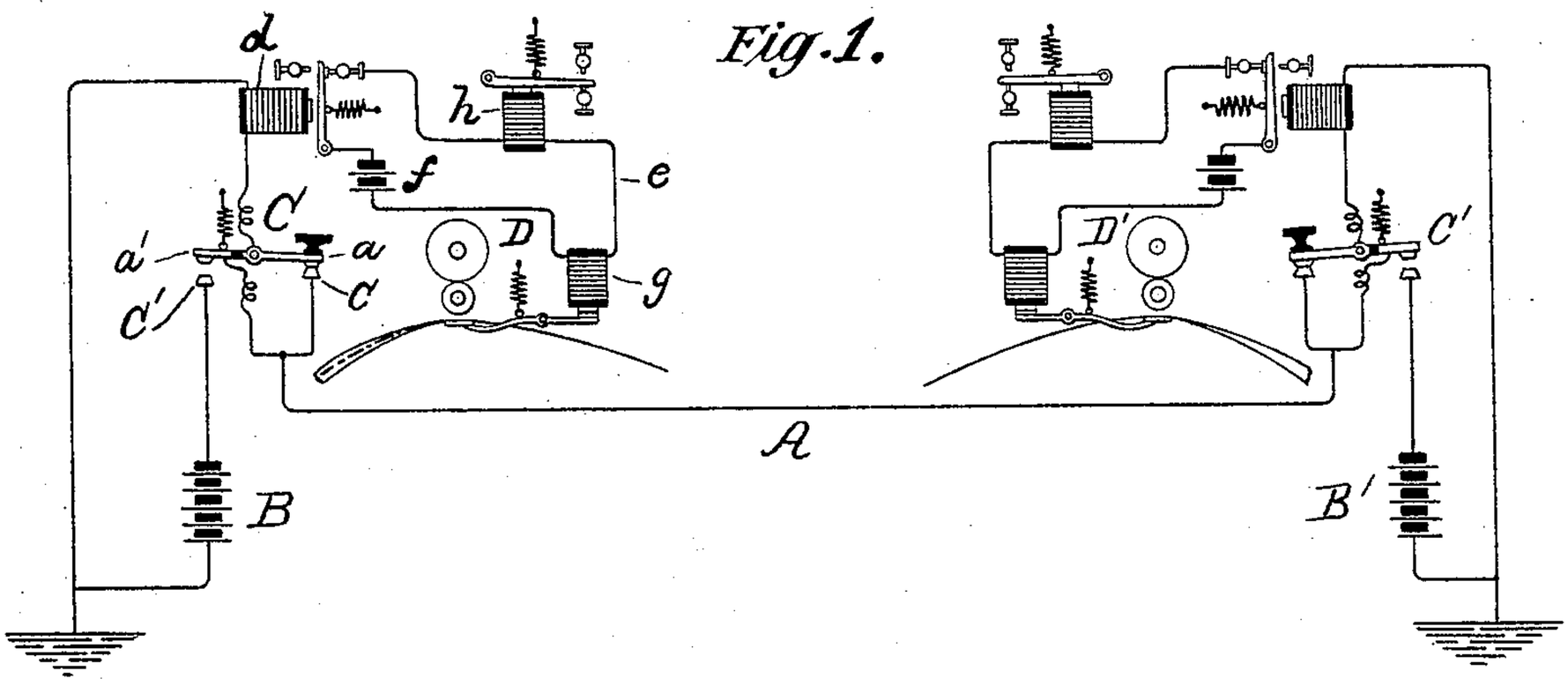


Fig. 2.

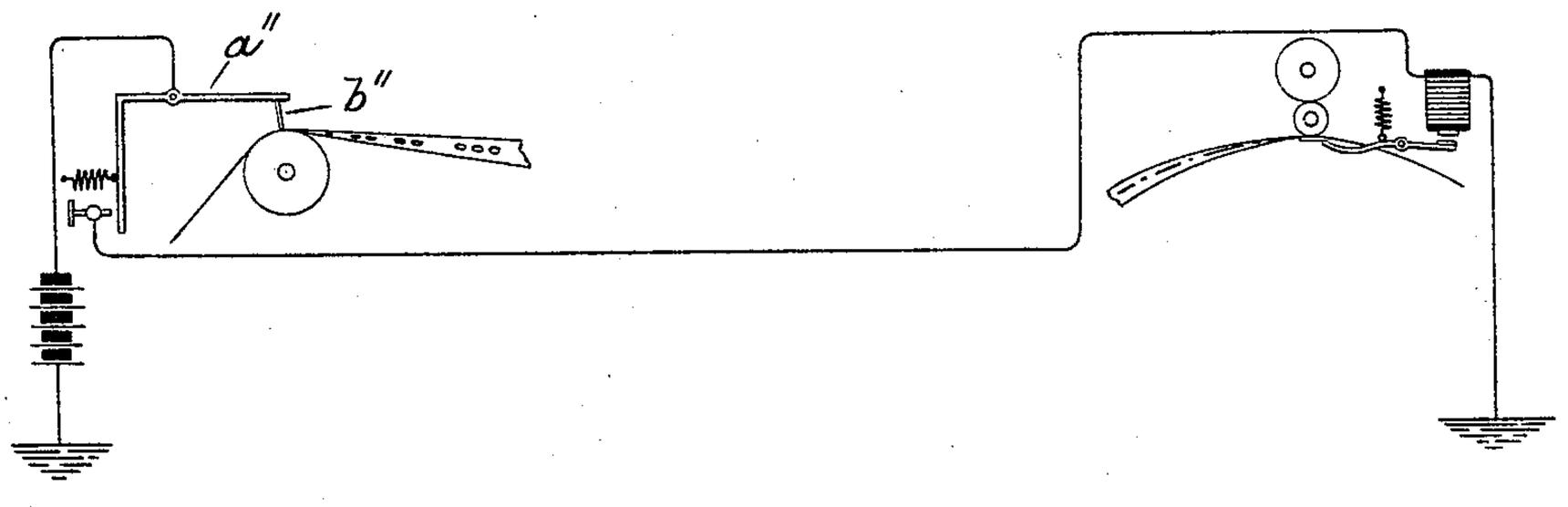
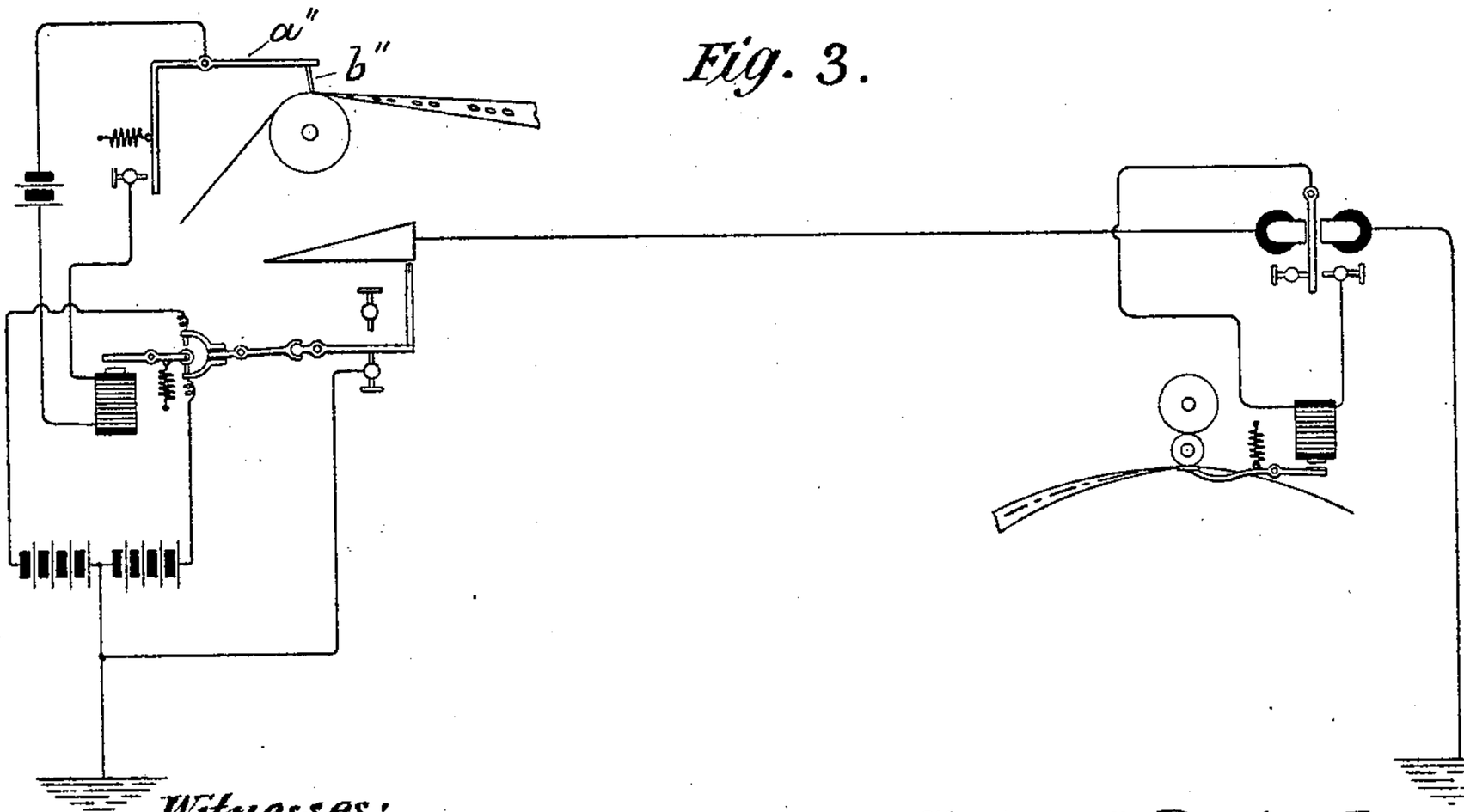


Fig. 3.



Witnesses:
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Edwin B. Hopkinson.

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by Kerr, Curtis & Page Attys.

(No Model.) 2 Sheets—Sheet 2.

C. G. BURKE.

SYSTEM OF TELEGRAPHY.

No. 583,026. Patented May 25, 1897.

Fig. 7.

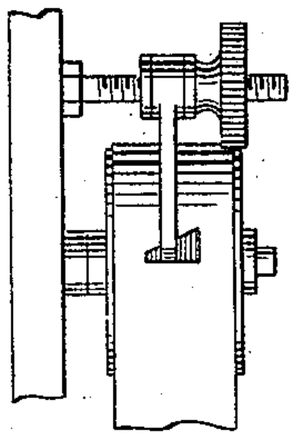


Fig. 4.

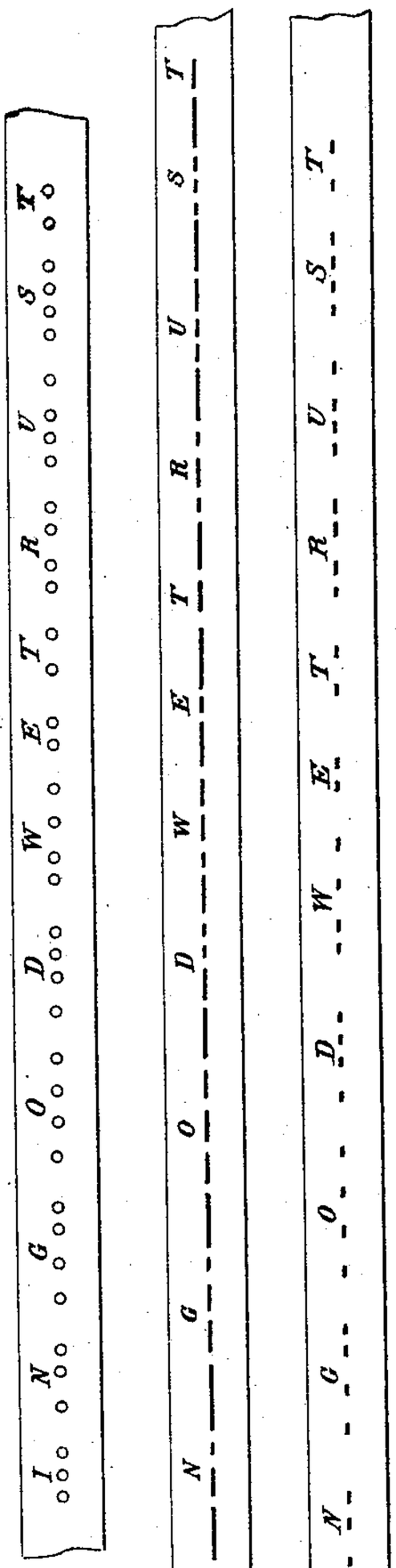


Fig. 5

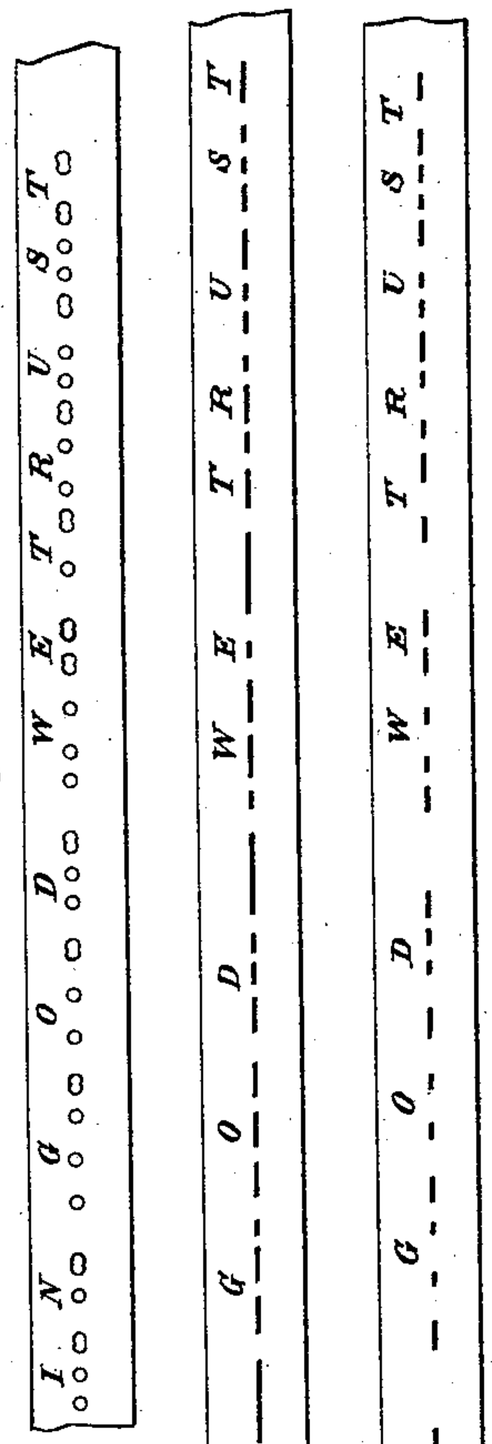
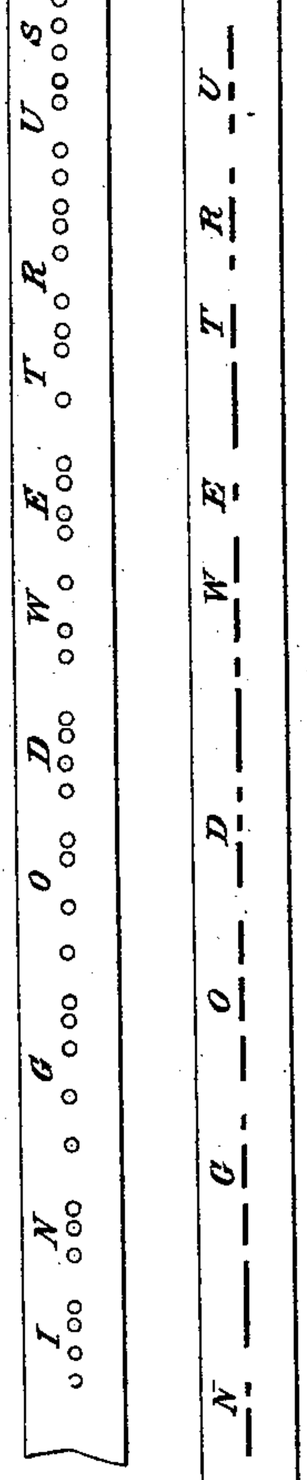


Fig. 6.



Witnesses:
Raphael Netter
Edwin B. Hopkinson

Charles G. Burke, Inventor
by Kerr, Curtis Page Attys.

UNITED STATES PATENT OFFICE.

CHARLES G. BURKE, OF BROOKLYN, NEW YORK.

SYSTEM OF TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 583,026, dated May 25, 1897.

Application filed September 4, 1896. Serial No. 604,859. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. BURKE, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Systems of Telegraphy, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

The invention which forms the subject of my present application for Letters Patent relates to systems of telegraphy in which electric impulses are transmitted from one end of a line and received and recorded at the other in characters distinguished as "dots and dashes," or, in general, those in which the signals are transmitted and recorded in accordance with what is technically known as the "Morse code." It is well known that in long lines, wholly or in part submerged, underground, or, in general, of large static capacity, the effects of induction peculiar to all such lines not only render rapid working a matter of great difficulty, but have heretofore proved an insuperable obstacle to the practical transmission and receipt of distinct signals of sufficient variation in length to be recognizable as those corresponding to the characters of the Morse code. This is due to the fact that the discharge of a cable or a circuit of large static capacity is relatively less rapid and complete after an impulse required to produce a dash than after such momentary impulses as are sufficient to produce Morse dots, so that in the case of mixed signals composed of a succession of dots and dashes this relative inequality in the time and degree of discharge of the line causes such distortion and irregularity in the signals as received or recorded as generally to render them entirely unintelligible. This liability to confusion of signals on long cables and similar lines has been partially corrected by the adoption of various expedients, but up to the present time nothing has been devised or proposed which wholly overcomes the difficulty, and the universal practice is now to send short impulses of one polarity to produce effects in the mirror instrument or characters on the siphon-recorder corresponding to Morse dots and similar impulses of the opposite polarity for dashes. There exists, however, the serious objection to this plan that the signals can only be distinguished by a skilful determination of their direction and extent of deflection from a given point or line, and the records are necessarily more or less illegible, uneven, and uncertain, and therefore unreliable. Moreover, as will be understood, it is very difficult to relay or retransmit signals automatically the elements of which are of opposite polarities, particularly where the line conditions demand the use of very sensitive instruments, such as are now employed on cables.

My present invention has for its object to render feasible and practicable the application of the Morse code to the operation of submarine and similar circuits without regard to their length and inductive capacity, and so that all work may be automatically relayed and repeated with entire facility.

The invention involves a new method of transmitting and receiving the signals and also certain novel instrumentalities for effecting these operations, but in the present application the description and claims will be mainly confined to the method or system in general, the special features of the apparatus devised for the same being made subject of other applications.

Heretofore Morse signals over all kinds of circuits have been reproduced and recorded at the receiving-stations by the effect of electrical impulses transmitted over the line upon instruments connected directly or indirectly therewith or through local instruments controlled by them, but always in such manner or under such conditions that the distinguishing characteristics of the dots and dashes resulted from a corresponding duration or length of the battery contact with the line.

According to my invention the recorded signals at the receiving-station are not caused by the electrical impulses which I transmit over the line, but by mechanical means which operate only in the intervals between the passage of impulses over the line or after such impulses have ceased. These impulses, moreover, are of uniform duration and occupy no longer time than is sufficient for the accomplishment of their purpose. At the sending end of the line I employ means by which electrical impulses of uniform duration may be

transmitted, and by these impulses I define at the receiving-station the beginning and ending of time periods of predetermined lengths. At the receiving end of the line I employ a recording instrument organized to respond to these impulses and to denote and record by mechanical means the time intervals occurring between them. As these intervals may be made shorter to correspond with dots and longer to correspond with dashes, it follows that any desired succession of characters readable as dots and dashes may in this way be transmitted and recorded by current-impulses of uniform duration.

Referring now to the drawings for a more specific description of the method and apparatus comprised in my invention, Figure 1 is a diagram illustrating the system in its simplest form. Fig. 2 is a modification of the same, illustrating the use of an automatic transmitter. Fig. 3 is a diagram illustrating a plan for clearing the line after each impulse. Figs. 4, 5, and 6 are views of perforated tapes to be used in transmitting and the printed record made thereby. Fig. 7 is a plan view of a portion of the apparatus used in transmitting and illustrating an improved perforated transmitting-tape.

Referring to Fig. 1 for an illustration of the principle of the invention, A represents a telegraph-line with transmitting and receiving instruments connected therewith at each end.

B and B′ are the line-batteries, C C′ the transmitters, which in this instance are shown in their simplest form as ordinary keys, and D D′ the receiving instruments.

The keys have front and back contacts *a a′* and stops *c c′*, insulated from each other, and by means of spiral springs or otherwise are normally held down on the front stops *c*. One pole of the line-battery B is grounded. The other pole is connected with the back stops *c′*. The line is branched at each station, one branch leading to the back contact *a′* and the other to the front stop *c* of the key. Between the earth and the front contact of the key is a relay-magnet *d*, which controls a local circuit *e*, containing a battery *f* and the electromagnet *g* of a recording instrument. The local circuits may also contain a repeating or relay magnet *h*, when so desired.

The operation of the system as thus organized is as follows: The operator at the sending end of the line first lifts the key C, so that it rests upon its back stops. This sends a current to line, and the recording instrument which, in the absence of line-current makes a continuous mark, ceases to trace such line and is in condition for recording signals. With the key raised the further manipulation is precisely the same as for sending ordinary Morse. For example, if the letter "I" is to be sent the operator simply makes two dots or short depressions of the key immediately after raising it, and this shuts off the current from the line for two short periods between the three contacts which such movements of the key involve. If the next letter to be sent is, say, "N," which is represented by a dash and a dot, the operator, after permitting the key to remain down and the current thereby cut off long enough for a letter-space, raises and depresses it for a dash, during which operation he connects and interrupts the line-current, thereby producing a dash, and then proceeds for a dot, as before explained.

The record made by the recording instrument will be in ordinary Morse characters, which will correspond not to the presence and duration of electric impulses over the line but to the absence of such impulses and the intervals between them.

Ordinarily the transmission of signals would not be effected by a hand-key, as the manipulation of such an instrument would be difficult, but by a perforated tape or some other automatic means. For example, a tape like that shown at T in Fig. 4 is prepared by punching out of a paper strip a line of holes the position and number of which determine and correspond to the number of impulses to be sent and the intervals between them. If this tape be drawn through a transmitting instrument provided with a pivoted contact-lever *a″* with a trailer-point *b″*, the movements of the lever due to the trailer dropping through the perforations will make and break the circuit and send impulses to line corresponding to the perforations.

On the diagram illustrating the tape T are shown a series of letters, and beneath them the perforations are indicated which would be necessary to produce such letters. At T′ is shown a tape with the record thereon which would be produced by the recorder of Fig. 1, and on which the regular Morse characters of the Continental code are seen between the longer lines which indicate spaces. At T″ in Fig. 4 is shown a tape with marks thereon which correspond in number and position with the number and time of the actual impulses transmitted over the line.

It will be understood that in my improved system, the current being off the line during pauses in transmission—such, for instance, as are necessary between individual letters and complete words—the recording instrument at the receiving end will produce a continuous ink line or mark upon the tape. To avoid this, it would be necessary to employ a special form of self starting and stopping recorder or to send independent impulses over the line between letters and words, which might be either shorter than dots or longer than dashes. Ordinarily, however, the perforated strip for transmission is so prepared that a difference in the spaces between perforations equal to the distance which it is intended to separate letters and words in the record is provided, so that these distances will be indicated by marks on the receiving-paper longer than those which represent dashes. By this plan all letters are isolated or separated from one

another by marks distinctly longer than that for a dash, while words are separated by marks distinguishably longer than those between letters. This method of spacing between letters and words is particularly valuable in all code-messages in which the words often consist of arbitrary combinations of letters or figures arranged singly or in groups or of unfamiliar and foreign words, as well as effectually preventing the vexatious errors which arise from imperfect spacing so common under present methods, and whereby the elements of approximate letters are made to assume misleading combinations. I have, however, devised a special and novel plan for spacing between letters which produces a record more in conformity with that of the present Morse system, and this consists in slightly elongating the perforation which concludes each letter. This addition to the length of the perforation is preferably shorter than that of a regular impulse-perforation, though it may be equal to these without departure from the purpose for which it is designed. This is illustrated in Fig. 5, in which a tape perforated to produce the same signals as in the former figure is shown at T. The final perforation for each letter is seen to be somewhat elongated. The record which such a tape would produce in the recording instrument of Fig. 1 is shown in the same figure at T', where, it will be observed, there are no lines or marks shown between the successive letters of a word, but a space-mark appears between words. The prolonged contact of the transmitter in passing over the final perforation holds the recorder out of action during such period of contact which is sufficient to indicate clearly a letter-space. T'' in Fig. 5 indicates by the marks thereon the current-impulses as they actually pass over the line. In lieu of elongating the final perforation the same result may be secured by making two independent perforations side by side and very close together, as shown in Fig. 6. The final perforation in this case is composed of two holes so close together that their effect is the same as one long one, but as a partial discharge of the line occurs between them the static effect is not so great.

In order to provide for clearing the line after each impulse sent by a perforated strip by directing into it a current of opposite direction to the marking-current and at the same time avoid the difficulties which arise from the too prolonged action of such clearing-current, I have devised the apparatus shown in Fig. 3. In this figure the transmitter proper is the same as in Fig. 2, but is included in and controls a local circuit containing an electromagnet *e*, that operates a pole-changer of special character. This device consists of a lever *m*, pivoted to move between two stops *m' m''*, the latter of which is grounded and also connected with one pole of the clearing-battery B''. The lever *m* carries a contact-strip *n*, which, by the movement of the lever, is caused to slide over a triangular or tapering plate *n'*, connected to line and adjustable transversely to the strip *n*.

Connected with the short arm of lever *m* is a lever *o* with a bifurcated end, between which plays the contact-making armature *o'* of the relay-magnet *l*. These parts are so arranged that when the magnet *l* is energized its armature leaves the contact *p* of lever *o* and engages contact *p'* on the other branch or fork of said lever. At the same time it turns the lever *o* on its pivot, and thereby imparts an amplified movement to lever *m*. The effect of this is as follows: When the lever *m* is turned so as to bring the strip *n* onto the plate *n'*, the line-battery B, one pole of which is grounded, is connected through the armature *o'*, the levers *o* and *m*, strip *n*, and plate *n'* with line. When the current in magnet *l* ceases, its armature is retracted and comes over into contact with the stop on arm *p*, and as the armature is in electrical connection with lever *o* through the metallic frame or a wire *t* the first effect is to connect the clearing-battery B'' to line, but this continues only while the strip *n* is in contact with plate *n'*, for as soon as these are out of contact by the movement of the levers *o* and *m* the clearing-battery is disconnected from the line.

The relative duration of the periods of charging and discharging the line are thus made unequal, the clearing-current being sent only after contact of the armature *o'* with stop *p* and until the separation of the strip *n* and plate *n'*. By a transverse adjustment of the plate *n'* the duration of contact between the strip *n* and plate *n'* after the beginning of the impulse may be adjusted.

I have found in practice that it is frequently a matter of great importance to be able to regulate the duration of the periods of contact of the transmitter, which are directly determined by the perforations in the paper strip and which send the impulses to line. I have accomplished this in a very simple manner by cutting the perforations in the paper of varying width, so that by a transverse adjustment of the style or trailer with reference to the paper, or conversely, the duration of actual contact may be adjusted to meet the best requirements of working. This I have shown in Fig. 7. Inasmuch as the duration of contact should be determined solely with reference to its inception, the initial edge of the perforations is at right angles to the line of the paper, while the opposite edge is inclined thereto, as shown.

I am aware that signals have been produced in or by a telegraphic receiver both by the closing of an open circuit and the breaking of a closed circuit.

I am further aware that a perforated strip of substantially the kind herein described has been employed as the means for operating a transmitter for sending impulses of the usual character; but the novel feature of my im-

provement is in the operation of a line or circuit by impulses of uniform duration directed over said line at variable intervals and to a receiving or recording instrument which indicates or records all of the intervals between such impulses but none of the impulses themselves.

I am further aware that it has heretofore been proposed to utilize electric impulses of uniform duration at varying intervals, some of such impulses being grouped so as to produce a continuous current of a duration corresponding with the aggregate length of all the impulses in such groups. These impulses have been sent from one end of a telegraph-line for the purpose of effecting at the other end of the line by means of two recording-pens a record in Morse dots and dashes, one of such pens being made responsive to the individual and the other to the grouped impulses, and to record the presence of such individual and grouped impulses according to the time of their respective durations, the other pen recording the intervals between such individual and grouped impulses, the action of either pen depending upon a previous action of the other, and the complete record depending upon the conjoint action of both as governed by the electric impulses and the intervals between them.

What I therefore claim is—

1. The method of telegraphing herein described, which consists in transmitting over a line electrical impulses of uniform duration at variable intervals and indicating or recording at the receiving-station the intervals between impulses or the periods of no current on the line, as set forth.

2. The method of telegraphing herein described, which consists in transmitting over a line electrical impulses of uniform duration at intervals corresponding to the length of the elements of the characters and spaces of the Morse code, and interrupting by such impulses the action or operation of an electromagnetic recording instrument, whereby the said instrument will produce marks or lines during intervals between successive impulses only, or after such impulses have ceased, as set forth.

3. In a telegraph system, the combination with a main line a transmitter and a perforated strip for operating the same, provided with a single line of perforations of uniform length but at variable intervals, which perforations determine the periods of current on the line, of a recording instrument at the receiving end of the line operated or controlled by the transmitted impulses and adapted in its operation to record the intervals between such impulses, as set forth.

4. A perforated strip or band for telegraphic transmitters in which the perforations have their initial edges at right angles to the length of the strip, and their opposite edges inclined thereto, whereby the duration of the periods of contact of a style under which the strip is drawn may be varied or adjusted by a transverse adjustment by the style with reference to the line of movement of the strip, as set forth.

5. In a telegraph system the combination with an instrument adapted to make and break an electric circuit by means of a perforated strip, of an instrument controlled or operated thereby and adapted to transmit over the line two immediately successive alternating impulses corresponding to each of the unidirectional impulses produced by the passage of the trailer over the perforated strip, as set forth.

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