D. S. HULFISH.

PRINTING TELEGRAPH.

APPLICATION FILED OCT. 23, 1909. RENEWED DEC. 30, 1913.

1,108,580.

Patented Aug. 25, 1914.

2 SHEETS—SHEET 1.

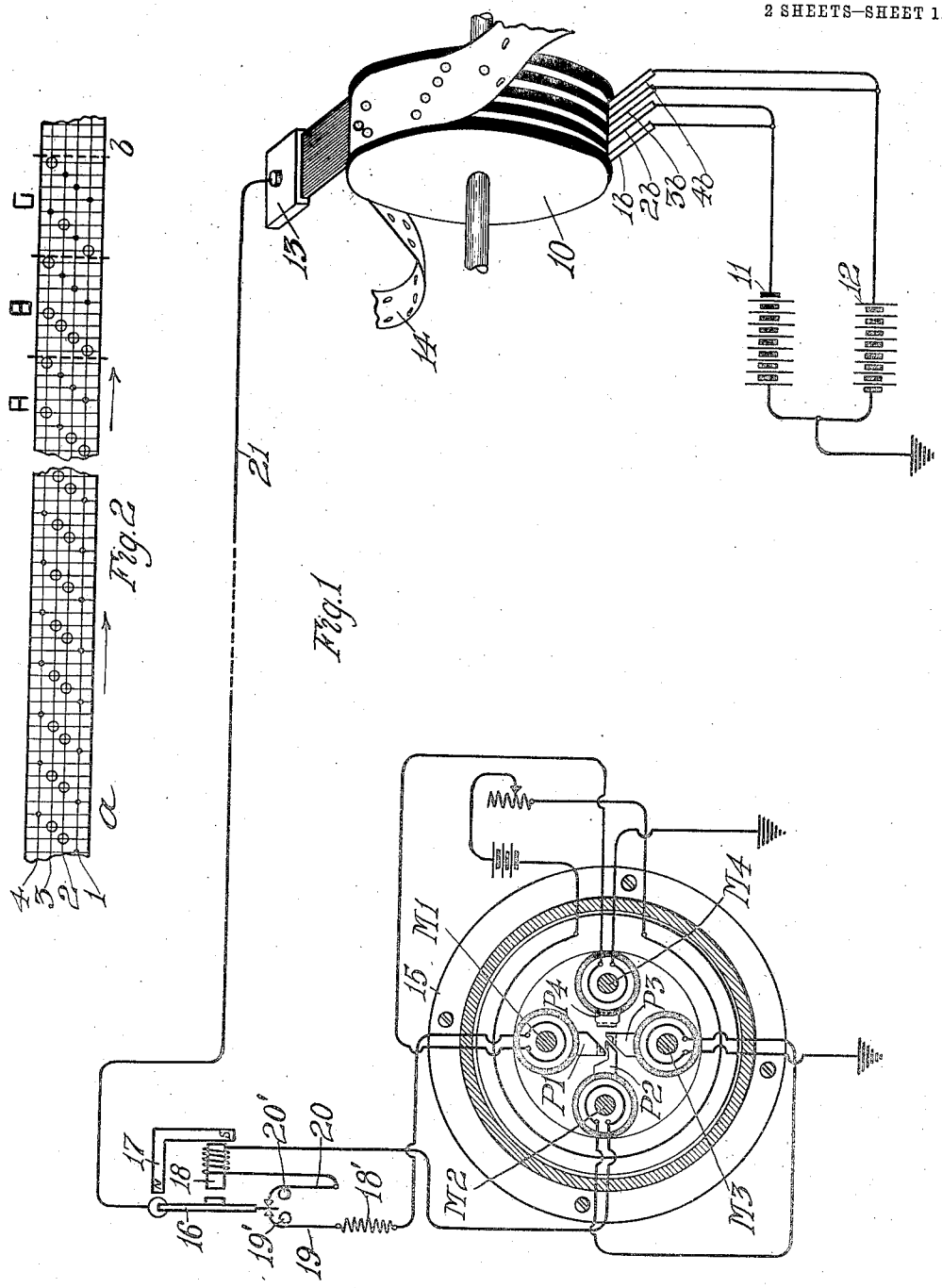


Fig. 2

Fig. 1

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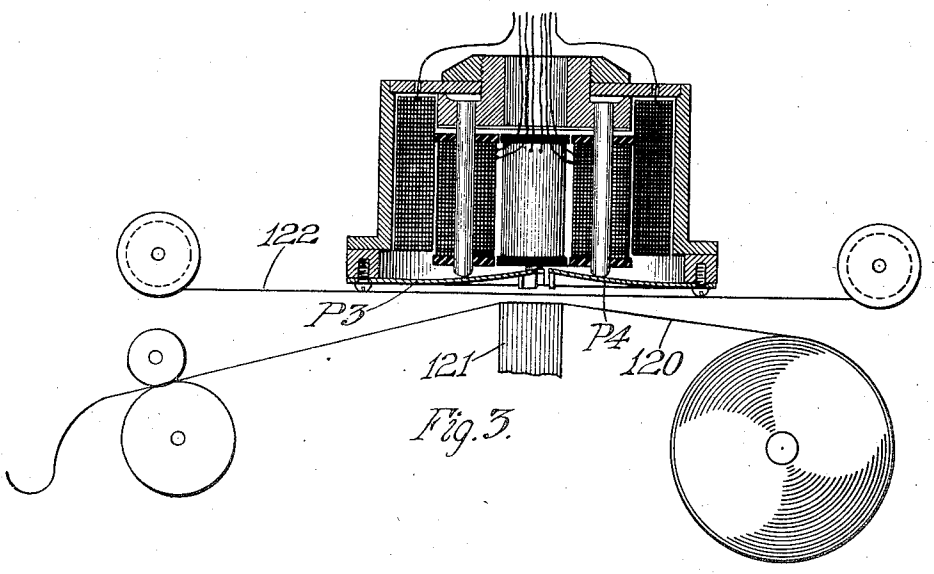


Fig. 3.

Fig. 4.

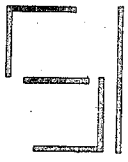
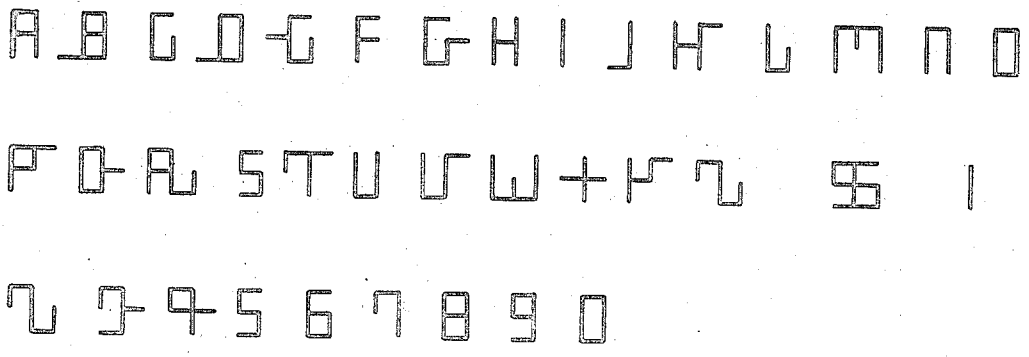


Fig. 5.



Witnesses

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UNITED STATES PATENT OFFICE.

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PRINTING-TELEGRAPH.

1,108,580. Specification of Letters Patent. Patented Aug. 25, 1914.

Application filed October 23, 1909, Serial No. 524,146. Renewed December 30, 1913. Serial No. 809,588.

To all whom it may concern:

Be it known that I, DAVID S. HULFISH, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Printing-Telegraphs, of which the following is a specification.

My invention pertains to systems of automatic rapid electric printing telegraphy. By automatic telegraphy, I mean a system of conveying intelligence to a distance electrically by a transmitting or signal sending device in which the signals are not directly controlled manually, but are sent to the line conductors by some mechanical or so-called automatic device. Particularly I have reference to devices in which signals are sent by perforated insulating tapes, signaling contact being made by transmitting device through the perforations of the tape. By printing telegraphy, I mean a telegraph system in which the receiving device, when controlled by signaling currents from the line conductors, produces a record in the legible characters of some accepted language, such as the letters of the English alphabet. I would except from this classification systems in which the English language is written automatically in the code of manual Morse transmission. By rapid telegraphy, I mean telegraphic systems in which speed of transmission is an important factor, and systems in which speeds higher than manual speeds are attained by reason of the automatic nature of the transmitting and receiving devices.

Printing telegraph systems considered in regard to the method of producing the printed characters may be divided broadly into two classes: the first of these classes includes systems employing a plurality of printing types, each type representing a complete letter or character and controlled electrically over the telegraph transmission conductors so that the types are operated singly and successively to print on the receiving surfaces. The action of the receiving device in this class of printing telegraphs may be likened to the action of an ordinary typewriter.

The second class of printing telegraph systems includes systems having a comparatively small number of printing types or equivalent devices, each of such types representing one or more component parts or elements, each common to a number of letters or characters. In such systems, the greater number of letters and characters are produced by printing in proper relation, a plurality of the smaller number of component printing types representing respective component parts or elements of the complete characters. The systems differ among themselves in the number of printing types, in the conformation of the printing faces thereof, and in the methods of combining the component strokes to form a complete letter or character.

My invention pertains to the second of these classes of systems. While it involves certain limitations in the matter of type faces from which the characters are produced, its points of novelty lie principally in the mechanical and electrical means by which the various printing elements are actuated to produce a legible received record, the elements themselves being adapted to a method of printing which is amenable to my method of electrical and mechanical control.

With reference to the method of combining the component types, systems of the second class may be sub-divided into those systems in which each type may appear but once in the resultant letter or character and those systems in which each component may be printed a plurality of times in different positions in the resultant character.

An alphabet and the component symbols going to make up the alphabet have been designed, involving but four component symbols or pen-face forms. The simplest form of receiving and printing device for this system of symbols is found in the second subdivision, namely, that in which the same printing pen may be used repeatedly in the same character, this application permitting the reduction of the number of printing pens to four. With such a system, the receiving tape may move intermittently in step-by-step fashion or it may move continuously, the strokes of the printing types being properly timed to secure their relation to each other.

In the four-pen printing telegraph system herein contemplated and disclosed, some of the pens are straight lines and some of them are composed of a plurality of elements, as by combining two straight line elements to form a single type face. When the type

carrying a plurality of elements is printed, another type may be printed upon the portion of them. This method of combining the elements is an important feature in the reduction of the total number of elements to a number so low as four. Inasmuch as each printing type or pen, in a printing telegraph system, must be operated selectively from the transmitting station, a reduction in the number of such pens will result in a corresponding reduction of the line control requirements and in consequent simplification of the devices of the system. In a system having but four printing pens, and having a continuously moving receiving tape, but four operating magnets are required for operating the pens selectively, whereby the component imprints are selected and are placed properly upon the receiving surfaces to combine into letters and characters, forming intelligible records.

A complete system embodying my invention would comprise, as a whole, (1) a punching device for perforating transmitting tape in accordance with the predetermined code; (2) an electrical transmitter or contact-making device which makes and breaks electrical circuits in accordance with the holes punched in the transmitting tape; (3), a line conductor and a return conductor, the latter of which may be the earth, and proper sources of electric current; (4) an electromagnetic receiving device comprising four printing pens and four printing electromagnets, each of which controls a printing pen; said magnets being classified into two pairs, each pair comprising a positive and a negative printing magnet; (5) mechanical means for moving the receiving tape continuously in front of the printing pens, a moving surface thus being presented for printing; (6) a device for connecting the line conductor, first, to one pair of the printing electromagnets, and then to the remaining pair disconnecting the first pair and so alternating between the two pairs of printing electromagnets in synchronism with the received pen controlling electric impulses and under the control of those impulses.

The specific feature of improvement in the system here shown, and which is my invention, is the device for switching the circuit of the line conductor to the return conductor through one pair at the time of the two pairs of printing electromagnets, and for obtaining and maintaining proper synchronism of the sending and receiving units in order that the receiving units connected to the line at any instant may be those units adapted to respond properly to signals possible of transmission from the automatic transmitter at that instant.

My invention pertains to printing telegraph systems, and provides a novel receiving system for single wire printing telegraphy where the transmission is accomplished by successive pulsations of current having a predetermined relation to current direction and time intervals.

My object is to provide a self-synchronizing receiving device for translating into printed symbols electrical impulses received over a transmission line from a uniformly operating transmitter such as a tape transmitter. At the receiving end I provide a tuned reed with propelling electromagnet, and circuits therefor whereby signal currents from the transmission line operate to set the reed in vibration and to continue its vibration throughout he ensuing transmission; local circuits controlled by the reed contain the printing units of the equipment. At the transmitting end I provide special means for setting the reed in vibration preparatory to printing signal transmission, but I shall show that the special starting provision at the transmitting end may be dispensed with, thus showing the device of my invention to be automatically self-synchronizing.

The punch for perforating the tape I have not illustrated. Such devices are well known and may be adapted to my system by a proper arrangement of cutting parts. Furthermore my system may be operated by tape punched manually with a device such as a conductor's ticket punch. The remaining elements of an improved system embodying my invention I have shown or indicated in the following drawings which accompany and form a part of this specification:

Figure 1 shows complete circuits of an automatic rapid electric printing telegraph embodying my improvement; Fig. 2 shows two pieces of perforated transmitting tape, one for preliminary impulses for synchronism, and another for transmission of an alphabet; Fig. 3 shows detail of the receiving device; Fig. 4 shows arrangement of printing faces; Fig. 5 shows an alphabet composed from combined imprints of the pens of Fig. 4.

In Fig. 1, 10 is a revolving, transmitting drum containing four conducting rings connected to two batteries, 11 and 12. The brush 13 is held out of contact with the rings by non-conducting tape 14, except as contact is permitted by holes punched in the tape 14. The arrangement of the holes in the tape 14 is shown in Fig. 2. The holes are in four rows, 1—2—3—4, and occur as indicated by circles in the tape. The holes in rows 1 and 2 permit contact of brush 13 to conducting rings and thence to brushes 1^b 2^b and thus to battery 11, which is positive to line and negative to ground, while the holes in rows 3 and 4 in similar manner permit connection of brush 13 to battery 12, which

is negative to line and positive to ground. The device 15 is a printer, having four magnets, M^1, M^2, M^3, M^4, connected in pairs in series with the line through contacts controlled by the tuned reed 16; the function of the tuned reed 16 is to remove from the line alternatively the pairs of printing magnets M^1 M^4 and M^2 M^3. The vibrating reed 16 is of magnetic material, is polarized by the permanent magnet 17 and is propelled by the electromagnet 18. Its contact springs 19 and 20 have fixed stops 19′ 20′ which prevent the springs from following the reed. The springs 19—20 are flexible and yield to the reed so that one or the other always is in electrical connection with the line 21, and at the central position or normal position of rest of the reed both springs are thus in connection.

The transmitting drum 10 has a fixed speed, and the transmitting tape of Fig. 2 therefore has a fixed speed. The transverse lines on the tape represent time units in the movement of the tape and the reed 16 shall be tuned to one cycle per four time units of the transmitting tape. In transmission each strip of perforated tape preferably is prefaced by a series of punchings similar to that shown in the tape *a* of Fig. 2. This tape, moving in the direction of the arrow, operates first through its hole on row 3 to connect battery 12 to line, giving an impulse through 12, 3^b, 13, 21, 16, 20, 18, M^2, M^3 and earth, and also through the shunt path 19, 18′, M^1, M^4, earth, the direction of current being through the elements in the reverse order from their enumeration. This results in strengthening the south pole of the electromagnet 18 and in attracting the magnetic reed 16. This impulse immediately is followed by one through a hole in row 2, the impulse flowing over the circuit 11, 2^b, 13, 21, 16, 20, 18, M^2, M^3, earth, but, being in the reverse direction, this impulse causes electromagnet 18 to repel magnetic reed 16. As the lapsed time of these two impulses is but half of the period of the tuned reed, and as the effect of the impulses has been to draw the reed from its center position and again to drive it back to its center position, an interval of two similar time units is permitted to lapse, giving time for the reed to pass beyond its center and into contact with spring 19 on the third time unit and to return to center on the fourth time unit. On the fifth time unit a hole on row 3 again permits an impulse through 20 and 18, attracting the reed, and on the sixth time unit a hole in row 2 permits an impulse over the same path, repelling the reed, and during the two following impulses, when by the motion of the reed the line circuit is switched from 20 to 19, no impulses are sent. The reed-starting holes of tape *a* are repeated, attracting the reed on the last half of its swing approaching 18, and repelling it on the first half of its swing receding from 18, until the reed has time to gain full amplitude, after which signal tape of the nature of *b* of Fig. 2 may be passed through the transmitter. The operation of the reed 16 is maintained by this signal tape by reason of the repeated though intermittent recurrence of holes on rows 3 and 2. Every such hole occurs at such time as to give the reed 16 an additional impulse, and the currents in holes in rows 4 and 1 do not interfere with the operation of the reed since impulses through these holes pass through resistance 18′ and not through electromagnet 18. The resistance 18′ is introduced into the circuit to balance electromagnet 18.

If a tape of the character of *b* were started through the transmitter 10 without the preliminary impulses of the tape *a*, the starting of the reed 16 would occur by reason of the intermittent impulses from all the perforations, and it would occur in proper synchronization for the following reasons: It would be attracted only by impulses from battery 12, which could come only through holes 4 and 3. An impulse through hole 4 would be neutralized by the next succeeding hole 3, thus stopping the reed, while an impulse from hole 3 would be supplemented by the next succeeding hole 2, thus continuing the motion of the reed. Preferably the starting of the tuned reed 16 should be definitely provided for by preliminary control, as provided by tape *a*. The tuning of the reed to the transmitter speed, or the adjustment of the transmitter speed to the frequency of the reed should be as close as is practicable, but an exact adjustment is not required, as the reed will vibrate in unison with its propelling power if within a sufficiently close margin of adjustment. It will be observed that the first letters received will be mutilated if the reed is started from rest by the introduction of the message tape B. However, after the normal rate of vibration of the reed is attained, either by the use of a synchronizing tape A or by passing a portion of tape B through the transmitter, the characters become perfectly legible. It is, therefore, as has been stated before, preferable to use a synchronizing tape such as A preliminarily to the use of the message tape B. In synchronizing by the use of a tape A, certain pens will be printed on the receiving surface, but these in no way interfere with the legibility of the record obtained when tape B is passed through the transmitter after such synchronization has been attained.

The operation of the transmitting device shown at 10 and associated parts in Fig. 1, and of the receiving device shown in vertical section in Fig. 2 and in horizontal section in Fig. 1—considering those devices aside from any circuit through which they

may be associated, is as follows: Four polarized magnets hold in suspense under tension four printing pens having printing faces adapted to form imprints of the shapes shown in Fig. 6 are arranged as they are shown. An alphabet may be produced, shown in full in Fig. 5, and shown in part in supplemental letters adjacent the tape *b* of Fig. 2, by imprinting the pens selectively and at proper intervals, upon a moving tape. Referring to Fig. 3, the tape 120 moves with uniform speed toward the left across the face of anvil 121. Inking ribbon 122, similar to the ribbon of a typewriter, also moves but preferably at a slow speed. The impact of any pen through the ribbon 122 upon the tape 120 supported by the anvil 121, will produce upon the tape a print whose shape is determined by the shape of the pen face. The printing pens may be actuated by the line currents direct, without relays, and are operable selectively in two features,—that of the selection of the pen and that of the selection of the proper instant for imprinting it upon the moving tape. The letter "A" of Fig. 2 is composed of four imprints, two from pen P^4, one from pen P^1 and one from pen P^2. The letter "C" is printed by pens P^1, P^3, P^4 successively at proper instants. The letter "H" is formed by two P^4's and one P^2. An acceptable alphabet and numerals for recording intelligence in the English language may be formed; such an alphabet is illustrated in Fig. 5.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. In a printing telegraph system, a vibrating reed; electrical switching contacts controlled by said reed; a circuit including two printing magnets and closed by said reed during one-half of the vibrating period of said reed; and another circuit including two printing magnets and closed during the alternative half of the vibrating period of said reed, substantially as described.

2. In a printing telegraph system, a single line wire; two groups of printing magnets; a switching member adapted to bring said groups alternately into operative relation with one end of said line; a magnet associated with said line controlling said switching member; a perforated tape transmitter at the other end of said line; said transmitter including means for sending periodic impulses over said line for the operation of said switching member and also including means for sending aperiodic impulses over said line for controlling said printing magnets.

3. In a printing telegraph system, a line wire; two groups of printing magnets; a vibratory member adapted to bring said groups alternately into operative relation with one end of said line wire; a magnet, receiving its current from said line wire, for controlling said switching member; a perforated tape transmitter at the other end of said line wire; means controlled by the tape of said transmitter for sending current impulses to maintain the rapid vibration of said switching member, and means also controlled by said tape for sending impulses for operating said printing magnet selectively to form printed characters.

4. In a printing telegraph system, a vibrating reed connected to the telegraph line; alternative paths through receiving printing magnets; electrical contacts on said reed whereby said reed connects the telegraph line to said paths alternatively when said reed is in vibration; and a propelling magnet for said reed and included in one of said paths, substantially as described.

5. In a printing telegraph system, a polarized vibrating reed; a propelling electromagnet therefor; and a line circuit including the telegraph line, said propelling electromagnet and electrical contacts controlled by said reed, substantially as described.

6. In a printing telegraph system, a polarized vibrating reed; a propelling electromagnet therefor; electrical contacts controlled by said reed; a circuit including the line wire, said contacts and said propelling magnet, said circuit being closed by said contacts during one-half of the period of vibration of said reed, substantially as described.

7. In a printing telegraph system, a polarized vibrating reed; a propelling electromagnet therefor; electrical contacts controlled by said reed; a circuit including the line wire, said contacts and said propelling magnet, said circuit being closed by said contacts during one-half of the period of vibration of said reed, said one-half being the time period while said reed is moving from its center of vibration toward said propelling magnet and thence returning; and means for transmitting electrical impulses over the telegraph line to cause said propelling magnet to attract said reed during the first half of said closed-circuit interval, and to repel said reed during the second half of said closed circuit interval, substantially as described.

8. In a printing telegraph system, a polarized vibrating reed; a propelling electromagnet therefor; electrical contacts controlled by said reed; a circuit including the line wire, said contacts and said propelling magnet, said circuit being closed by said contacts during one-half of the period of vibration of said reed, said one-half being the time period while said reed is moving from its center of vibration toward said propelling magnet and thence returning; and means for transmitting printing signal currents over said line during said closed cir-

cuit interval of said propelling magnet, said circuits being always in direction to cause said magnet to attract said reed during the first half of said closed circuit interval, and to repel said reed during the second half of said closed circuit interval, substantially as described.

9. In a printing telegraph system, a line wire; a vibrating switching member controlled over said line wire; two pairs of printing magnets adapted to be alternately brought into operative relation with said line wire by said switching member; means for sending impulses over said line wire for the selective operation of said printing magnets, some of said impulses being so timed as to aid in maintaining the constant vibration of said switching member.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

DAVID S. HULFISH.

Witnesses:
LEONA EKSTROM,
EDITH F. GRIER.