June 4, 1929. H. PEIN 1,715,781

METHOD AND MEANS FOR THE ELECTRIC TRANSMISSION OF WRITTEN CHARACTERS

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Fig. 1.

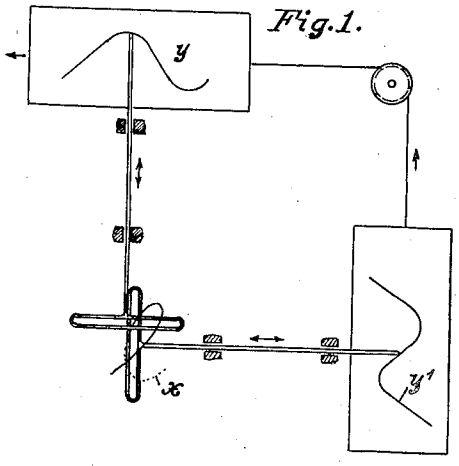


Fig. 2

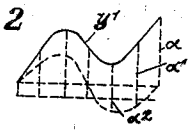


Fig. 4

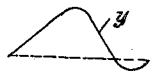


Fig. 4a

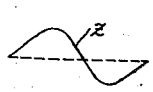


Fig. 5.

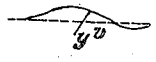


Fig. 5a

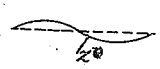


Fig. 6

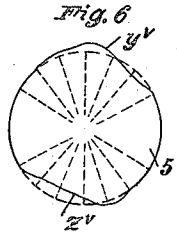
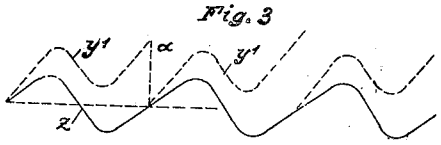


Fig. 3



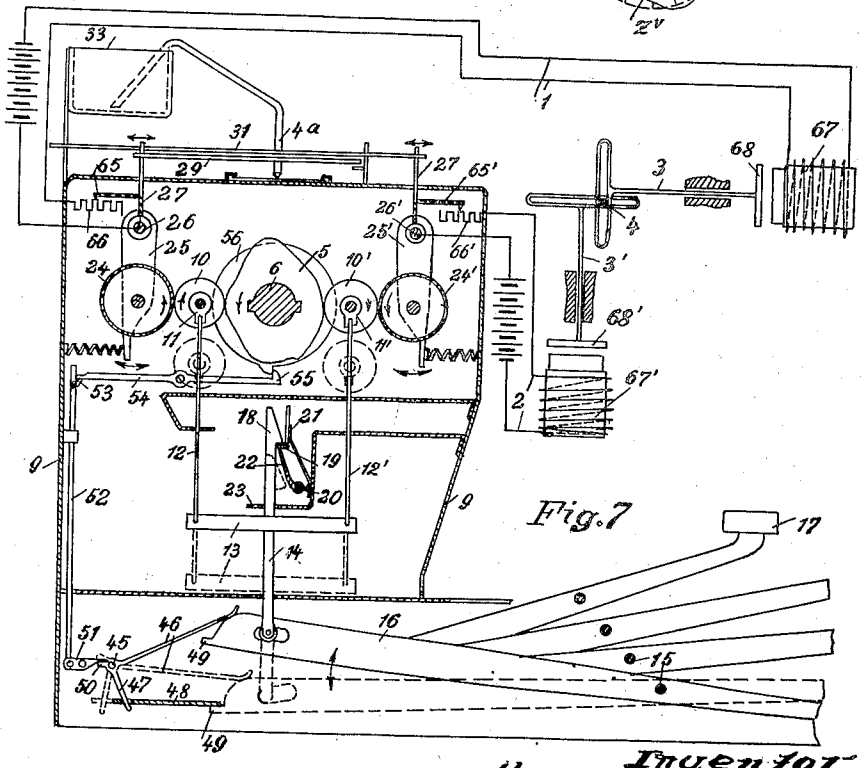


Fig. 7

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Fig. 8

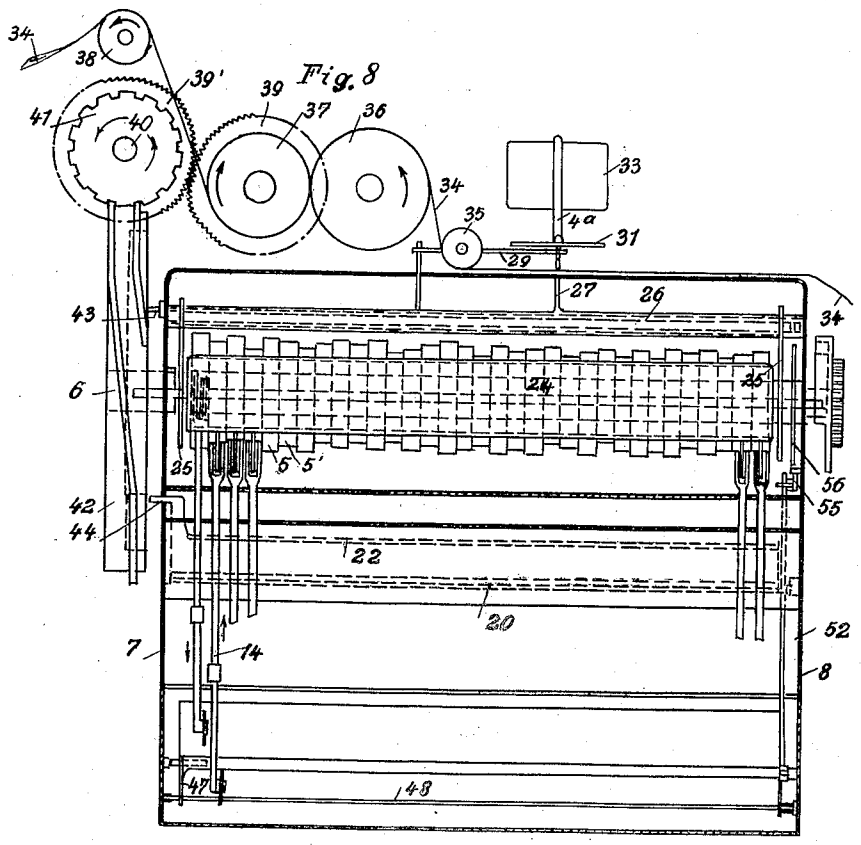
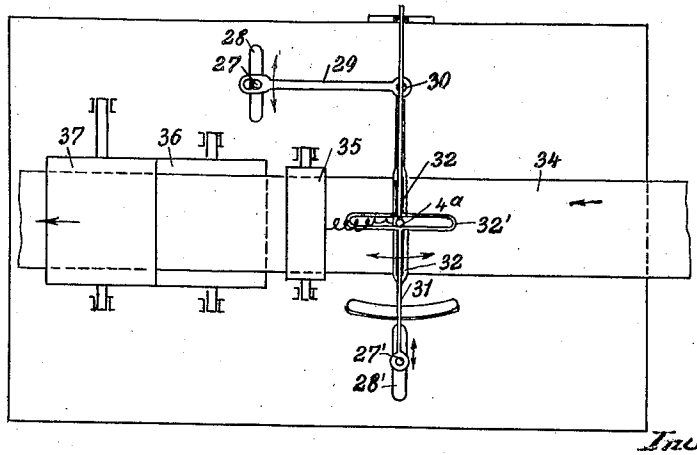


Fig. 9



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Fig. 10.

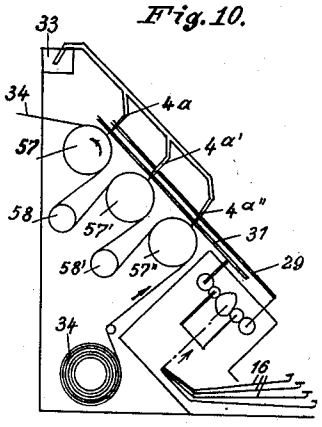


Fig. 11.

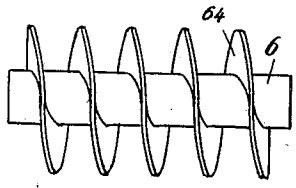


Fig. 12.

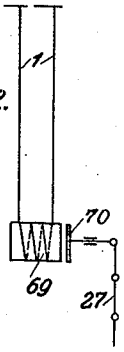


Fig. 13.

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METHOD AND MEANS FOR THE ELECTRIC TRANSMISSION OF WRITTEN CHARACTERS

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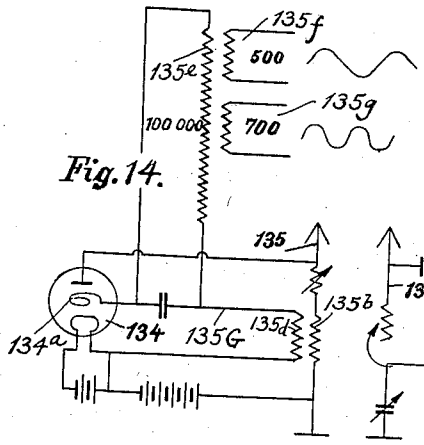


Fig. 14.

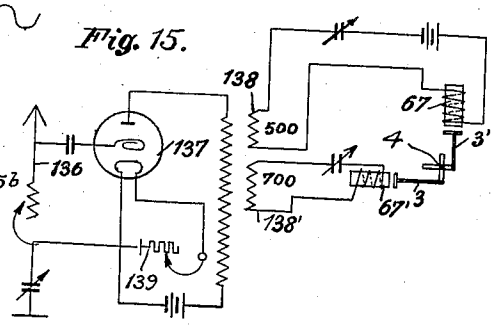


Fig. 15.

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UNITED STATES PATENT OFFICE.

HEINZ PEIN, OF BREMEN, GERMANY.

METHOD AND MEANS FOR THE ELECTRIC TRANSMISSION OF WRITTEN CHARACTERS.

Application filed September 29, 1925, Serial No. 59,410, and in Germany October 3, 1924.

My invention relates to a method and to devices for the electric transmission of written characters. The invention differs from the so-called type-printing-telegraphs hitherto known in that the writing member is moved in strict agreement with any predetermined form of hand-writing by fluctuations of electric energy.

The invention differs further from the known writing telegraphs in that the said fluctuations of energy for transmission of written characters are not produced by writing motions of hand but by curves attached to control-members, which are operated by a keyboard or other mechanical means. The said curves are obtained by the decomposition of a character to its components in a manner exactly set forth lower down, and can be operated at choice by the said mechanical means in order to vary the electric energies in conformity with the curves and to guide a writing member of the receiving apparatus by those varied energies in such a manner that the resultant of the control-curves is obtained, so that the sended character is written in the receiving device.

The curves obtained by the decomposition of a written character can be modified, before being attached to the control-members, in the manner explained in a succeeding part of this specification, and are then used for controlling electric fluctuations in the transmission circuits in a mechanical or electromagnetic or photoelectric way, said fluctuations being then received at the receiving device and used for guiding a system of coordinate rods guiding the writing member.

To write down a character two curves corresponding to the two components of the respective character are necessary. The two curves may be arranged on a common control member or upon a plurality of such members.

The electric energy varied by the control members is transmitted to the receiving station either by means of wires or wireless, and in either case a plurality of sound waves of different frequencies may be superimposed upon one carrying wave, the superimposed waves being then divided out at the receiving station by means of known devices, for instance resonators, in order to become active according to their intensities.

The releasing of the control members at the transmission station can be effected either by a keyboard, for instance that of a writing machine having keys as operating members, as usually, or by intermediate plate of suitable kind. These latter may be designed, for instance, as perforated bands for operating photoelectrically the control members.

In order to observe the proper transmission of the written characters a writing device designed and operating according to this invention is provided preferably also at the transmitting station.

The basic principles and features of my invention are so broad that they may be applied and embodied in many constructions and arrangements differing widely in specific form and details, and in the accompanying drawings I have illustrated only few examples of the many different forms in which my invention may be embodied; but in the broader of the claims that follow, I have pointed out my invention in terms which are intended to include all the different forms in which it may be embodied.

My invention is illustrated diagrammatically and by way of example in the accompanying diagrammatic drawings. Figure 1 shows the decomposition of a letter, which is "E" in this example, into its two component curves which are changed in Figures 2 and 3 with respect to the movement of the paper tape; Figures 4, 4ª, 5 and 5ª show the further rectification of the curves shown in Figs. 2 and 3 with consideration of their arrangement at, and their employment in connection with, the rotatory body shown in Figure 6; Figure 7 is a vertical cross-section through a writing machine designed for the electric transmission of written characters according to this invention; Figure 8 is a front-view of the interior of the writing machine, the front-wall and the key-levers being omitted; Figure 9 is a plan of the members located above the top portion of the casing enclosing the mechanism shown in Figs. 7 and 8, some of the upper members concerned being, however, omitted; Figure 10 is a vertical cross section through a modified construction of a writing-machine, this machine being a multiple writing machine and drawn to a reduced scale relatively to Fig. 7; Figure 11 shows a multiple cam-disk shaped like a worm and intended for the transmission of longer written characters

or of a succession of connected characters, for instance, for the transmission of a name; Figure 12 shows certain modified electric means for producing the fluctuations of the current; Figure 13 shows another modification of the writing machine, also in vertical cross-section; and Figures 14 and 15 disclose how a plurality of frequencies can be superpositioned upon the wave transmitted, and how the respective frequencies can be caused to act upon the writing member of the receiving station by means of suitable resonators.

In order to carry into practice the ideas upon which the invention is based, the curves obtained from the components of the written characters are utilized for the control members of the electric energies which are to be transmitted. It is, first of all, requisite to resolve into its components the curves forming the individual written characters. For this purpose the curve-line of a character,—to take an example—the curve line of the character "e" (denoted with x in Fig. 1) must be decomposed into its component-curves y, y' in any system of coordinates either by a mechanically operated device or by a graphic method. These component-curves if recomposed would form the original curveline as a resultant. Mention must be made here of the fact that the first point and the last point of the component curve y lie equally remote from the appertaining abscissa, it is true, but not also the first and the last point of the curve y^1 (see Fig. 2), and this being so it is suited to the purpose to transform the curve y^1 into a curve z (see Fig. 3), the commencement and the end of which lie at the same height. The modified curve z is obtained by transferring the distances α, α', α^2, . . . which correspond with the travel of the forwardly moved paper on which the characters are written in the receiving device. As the curve obtained in this manner commences and ends on the same height, the characters can be written without difficulty one after the other in a continuous line of successive curves, and no distortion of the respective characters will be caused by the movement of the paper. The transfer of the curves y^1 into the curves z presents, finally, the advantage that the control members designed according to the respective curves either as cam-disks, as in Fig. 6, or as resistance rings, as in Fig. 13, or as light-filtering bands, as in Figs. 16–19, can be given such a shape that the mechanical actions in the form of motion, as well as the electric control actions, proceed free from shocks.

If the paper to be written upon is stationary or is shifted after every written letter etc., as in a writing machine, the curve y^1 need not be modified with respect to the movement of the paper, and to obtain in spite thereof a shockless transmission of the transmitting energies and their actions or effects the curve-disks etc. may be so designed that a slow transition takes place.

If the curves y and z are reduced in size in one of the ordinate directions, as in Figs. 4, 4^a, 5 and 5^a, there are obtained curves y^v and z^v which are attached to the cam-disks, resistance rings, or the like, described in succeeding paragraphs of this specification.

The control members designed according to the components of the characters serve for the generation of current-fluctuations in the circuits 1 and 2 of Fig. 7, whereby the rods 3, 3′ moving the writing member 4 are moved in a certain distinct manner. The current fluctuations in the circuits 1 and 2 can be produced mechanically, for instance by a cam-disk 5.

The theoretically simplest manner to produce fluctuations in the circuits 1 and 2 by mechanical means is shown in Figs. 7, 8 and 9. There are cam disks 5 arranged upon a shaft 6 rotated continuously by a motor or the like. The shaft 6 is supported in the side walls 7 and 8 of a frame 9. In front of, and behind, every cam disk 5 transfer rolls 10, 10′ are provided which are so supported as to be able to swing away laterally in that their bearings 11 11′ are attached to elastic arms 12 12′. The free ends of these arms engage a common transverse bar 13 affixed to a vertical and vertically shiftable rod 14. The lower end of the rod 14 engages a slot provided in the rear end of a key-lever 16 fulcrumed at 15, the arrangement being such that the rod 14 is lifted when the key of the lever 16 is depressed. At the upper end of the rod 14 a tooth-shaped pawl 18 is provided which can engage a ledge 19 forming an enlargement of the edge of a horizontal so-called universal bar 22 that can turn on pivots 20 and is subjected to the pressure of springs 21. The rod 14 is guided in a slot provided in the free rim of a piece of sheet-metal 23 which is bent similarly to a Z. In front of, and behind, the transfer rolls 10, 10′ so-called universal rollers 24 24′ extend along over the entire breadth of the apparatus and are suspended from oscillable arms 25 25′ carried by pivots 26 26′. By the oscillatory motion of the rollers 24 24′ fluctuations are produced in the circuits 1 and 2 by means of sliding resistances described in a succeeding part of this specification. At the same time the oscillating rollers 24 24′ may move guide-arms 27 27′ in their guides 28 28′ (Fig. 9) in such a manner that the bell-crank lever 29 oscillates upon its pivot 30 and the one-armed lever 31 oscillates with the arm 27′. The arrangement and combination of the parts now being described serves for exerting a control over the letters to be transmit-

ted. The levers 29 and 31 terminate in oblong guide members 32 32′ which are arranged at right angles with respect to one another and embrace a writing pin 4^a, at the point where they cross each other. Instead of said writing pin another writing member may be provided which may be supplied with the necessary ink, for instance, from a receptacle 33.

The writing pin 4^a glides upon the paper tape 34 which is fed forward by any suitable feeding device. In the example illustrated the feeding device consists of rollers 35 36 37 38, of which 37 is rotated by a gearing 39 39′ (Fig. 8). The wheel 39′ is secured to the shaft 40 of a worm-wheel 41 which meshes with a worm-disk carried by a projecting end of the shaft 6.

As the shaft 6 carries also the cam disks 5 5′ (Fig. 8), the feed speed of the paper strip depends upon the revolution of said disks. The ordinate curve and the abscissa curve required for the writing of a letter must be rendered active simultaneously for guiding the writing pin 4 or 4^a appropriately. For this purpose the cams representing said curves may be arranged either upon two separate co-operating cam-disks, as in Fig. 13, or upon one cam-disk, as in Figures 6 and 7. In the latter case it is necessary to insert upon the disk 5 two circularly curved intermediate portions between the two curves y^v and z^v in order to obtain proper transitions between the individual written characters, or letters respectively.

If one of the key levers 16, 17 is depressed, the rod 14 is held fast in writing position by the universal rod 22 for one half of a revolution of the cam-disk 5. When this disk has performed one half of a revolution the projection 43 of the worm 42 (Fig. 8) contacts with an outwardly projecting part 44 of the universal rod 22 whereby this latter is turned rearwardly upon its axle 20 so much that the tooth 18 of the rod 14 is released and the depressed key is moved back into its initial position by a spring (not shown.)

When a key 17 is depressed, also a ledge 46 (Fig. 7) carried by pivots 45 and resting with its body-portion upon the rear ends of all keys is lifted; this ledge is provided with downwardly extending fingers 47 by which a check-ledge 48 coupled with them can be shifted so much that it locks rearwardly extending projections 49 of the key-levers whereby all other levers are retained in their position of rest.

When the ledge 46 is lifted, turned on its pivot 45, also a rearwardly extending projection 50 integral with the ledge is shifted whereby a pawl-like member 51 which is coupled with said projection 50 and is movably connected with a vertical rod 52 is so moved that this rod is lifted. At the upper end of this rod a lateral projection 53 is provided by which a two-armed lever 54 is turned whereby a spring (not shown) is put under tension. At the front end of said lever 54 a nose 55 is provided which when rod 52 is lifted releases the cam disk 56 rigidly carried by the shaft 6, and the cam remains so released until the depressed key has returned to its normal position. The shaft 6 can rotate as long as the cam-disk 56 and the nose 55 are out of engagement.

There are as many rods 52 as there are key levers. One of them may be provided with a vertically extending extension (not shown), the purpose of which is to lift the writing pin 4^a off the strip of paper. The key lever to which this rod 52 pertains may be used as idle key lever.

The constructional form of the writing machine illustrated in Fig. 10 is so designed as to render it possible to produce several reproductions of the original writing whereby a drawback otherwise existing is overcome, in that additional carbon copies as made on type writing machines cannot be made by means of the writing pin 4^a. The multiplication is brought about by causing the writing pin rods to actuate a plurality of writing pins 4^a $4^{a'}$ $4^{a''}$ . . . all at a time. The strip of paper 34 must then be conducted over a corresponding plurality of guide rollers 57 57′ 57″ . . . between which tensioning rolls 58 58′ 58″ . . . may be provided, if desired.

The cams need not be provided solely upon disks, as above described, but may be provided, for instance, upon worm-shaped members, as 64 in Fig. 11, whereby the possibility is afforded to provide many or (and) long cams either upon the edge of the threads forming the worm or laterally upon a rim or the rims thereof, so that a succession of connected written characters, for instance a name or the like, can be written down with one depression of a key. It is, of course, necessary in such a case that the contact-disk follows positively the revolutions of the worm-thread so that the curve is transferred to the universal shafts over several revolutions of the shaft 6.

It has already been mentioned that fluctuations of the current are caused in the circuits 1 and 2 by the oscillations of the universal rollers 24 24′ in that contact arms 65 65′ connected with the arms 27 27′ slide over resistance-coils 66 66′ pertaining to the circuits 1 and 2. The magnet coils 67 67′ inserted into these circuits act upon armatures 68 68′ actuating the rods 3 3′ of the writing member 4.

The modification shown in Fig. 12 shows that induction coils 69 may be inserted into

the circuits 1 and 2, instead of the sliding resistances 66 66′, as means for effecting the fluctuations of the current.

In the constructional forms described in the preceding paragraphs the cam-disks are employed to produce the fluctuations of the current in an indirect way, viz, by means of devices inserted into the control circuits. These arrangements and combinations of parts may, however, be simplified in this way that the cam disks are employed directly for producing fluctuations of the current in the control circuits. This is effected, according to Fig. 13, by manufacturing the cam-disks 5^a $5^{a'}$ of a good conductor, as, for instance, brass, and providing them with jackets 71 71′ consisting of a resistance material, as for instance, scheelite or the like, and being arranged concentrically with respect to the shafts 6^a $6^{a'}$. There are obtained in this way resistance rings (which may be subdivided into lamellæ) of different sectional areas which are inserted into the circuits 1 and 2 while the disks 5^a $5^{a'}$ are being rotated, whereby current fluctuations are produced which correspond to the components of a written character. The resistance rings 71 71′ contact with blade springs which slide upon them, as shown. The closing of the circuits may be effected by an arrangement and combination of parts like, or similar to, that of Fig. 7.

In the constructional form illustrated in Fig. 13, the lower portion of which agrees practically with the lower portion of Fig. 7, each key-lever 16/17 is coupled at its rear end with a vertical rod 14 carrying a transverse bar 13^a forming at its ends contact heads 73 73′ by which the circuits 1 and 2 can be closed simultaneously so that the fluctuations of the current can be produced by the cam-disks when these latter are being rotated. A point to be paid attention to in connection with Fig. 13 is that to write one written character two cam-disks 5^a $5^{a'}$ located upon the two shafts 6^a $6^{a'}$ are employed, which are rotated from a common cog-wheel 75 by the intermediary of cog-wheels 74 74′.

The locking mechanism 46 47 48 is coupled with a vertical and vertically shiftable rod 52, the upper portion of which is bent off first horizontally and then vertically downwards, this end serving as a kind of pawl which co-operates with the teeth of the cog-wheel 75 and checks this wheel when the cam-disks have made the rotation necessary to write down a letter etc. By depressing a selected key-lever 16/17 the bar or contact-bridge 13^a is caused to close the circuits controlled by disks 5^a $5^{a'}$ which collectively represent a letter curve indicated by the selected key, and simultaneously therewith the locking end 77 of the rod 52 is lifted off the wheel 75 whereby this latter is free to rotate the cog-wheels 74 74′, the shafts 6^a $6^{a'}$, and the cam-disks 5^a and $5^{a'}$. As soon as the wheel 75 has completed one revolution, an abutment pin 78 provided on the said wheel contacts with the universal bar 22 whereby it is withdrawn from the check-pawl 18 of the rod 14 so that the still depressed key lever is released and returns into its normal position. In order to stop the driving cog-wheel 75 without shocks, a cushioning spring 79 (shown in dotted line) may be attached to the wheel and rides over a suitable projection carried by the frame of the machine prior to the pin 77 engaging the wheel 75 in order to stop it completely.

Instead of cam-disks also transversely magnetized rotatory bodies may be employed, the magnetized portions of which correspond to the component curves of a character, as regards the intensity of the magnetization.

Releasing the control members at the transmitting station may be effected in a variety of manners. Preferably the keyboard shown in Figs. 7 and 13 is employed.

The invention may be used for the remote transmission of written characters either by means of conducting wires or by wireless. The wireless transmission may be effected by means of any of known transmitting and receiving apparatus for wireless telegraphy.

A particularly advantageous method in the transmission of the component curves by wireless resides therein to superimpose on a carrier wave two different oscillations of a definite low periodicity, of which the intensity of one is varied according to the path of the abscissa curve and the intensity of the other is varied according to the path of the ordinate curve. At the receiving station the oscillations forming the abscissa and the ordinate curves which have been superimposed on the carrier wave are again separated out by means of known resonators and caused to act on a writing member in such a manner that it writes the desired writing signal as the resultant of the abscissa and ordinate curves. Particularly suitable for the production of the said oscillations to be superimposed on a carrier wave is the device illustrated in Fig. 13 operating in the photo-electric method, in which the intensity depends on the width of the intervals 106 and the periodicity depends on the number of intervals struck per second by the light ray 95.

In Figs. 14 and 15 there is illustrated diagrammatically a device by means of which two oscillations, which in intensity correspond with the course of the component curve, are simultaneously superimposed on a carrier wave and are again separated at the receiving station.

Fig. 14 shows a diagram for a wireless valve or tube transmitter in which two dif-

ferent oscillations of low frequency for example 500 and 700 periods/sec. are superimposed on a carrier wave of 100000 periods/sec. The diagram of the transmitter consists of valve 134 of which the coupled aerial circuit 135^b is energized for undamped oscillations by means of a back coupling coil 135^d in the grid circuit 135G. On the grid circuit 135G there are superimposed by means of a low frequency transformer, of which the secondary winding 135^e is included in the grid circuit, the low frequency (sound frequency) oscillations. In order to impress on the grid circuit through the same secondary winding simultaneously a number of oscillations of low periodicity, the primary winding is divided into two separate windings 135^f and 135^g. To each separate winding are supplied oscillations of definite frequency, for example of 500 and 700 periods, which are then supplied to the grid 134^a through the winding 135^e. The waves are transmitted by an aerial 135 and received by the receiving aerial 136 of the receiving station shown diagrammatically in Fig. 15. The aerial circuit is tuned to the carrier wave to be received on which the low frequency oscillations are superimposed. The valve 137, arranged as audion, connected thereto rectifies the carrier wave so that the superimposed oscillations of low frequency are received in the anode circuit separate from the carrier wave but still intermingled. In order to separate the separate frequencies from one another there are provided two resonance or sifting circuits 138, 138′ which are tuned to the desired oscillations of low periodicity (500 and 700 periods/sec.). The separate oscillations effect, in accordance with their intensity the setting down of the desired letter in the manner above described by means of the electromagnets 67, 67′, the rods 3, 3′ and the pencil 4. Finally 139 indicates a filament resistance for the valve.

The particular advantage which is obtained by the superimposing of the oscillations corresponding with component curves on a carrier wave resides on the one hand in the considerable simplification of the apparatus, as for the simultaneous transmission of the two component curves only one transmitting and receiving device is necessary and on the other hand therein that the synchronous coming into action on the writing member is effected with certainty.

I claim:

1. A method for the transmission of written characters, consisting in decomposing the curve lines of the written characters with reference to a system of coordinates into their component curves, producing control members in conformity with the path of the said component curves, using said control members in a transmitting device, producing fluctuations of electric energy by said control members in accordance with said component curves, sending said fluctuations to a receiving device and recomposing in the receiver by said fluctuations of electric energy the transmitted characters as resultants of said component curves.

2. A method for the transmission of written characters, consisting in resolving the curve lines of the written characters with reference to a system of coordinates into their component curves, the abscissa of said system being represented by the direction of the movement of a paper tape on which the characters are written in the receiving device, modifying the component curves obtained from the abscissas of the characters by that the individual ordinates are altered by distinct lengths in accordance with the movement of said paper tape, producing control members in conformity with the path of the said component curves, using said control members in a transmitting device, producing fluctuations of electric energy by said control members in accordance with said component curves, sending said fluctuations to a receiving device, and recomposing in the receiver by said fluctuations of electric energy the transmitted characters as resultants of said component curves.

3. An electric device for transmitting written characters, comprising, in the transmitter, control members shaped according to the curves obtained from the decomposition of a character, means for effecting fluctuations of electric energy operated by said control members in such a manner that the electric energy which is to be transmitted is varied in accordance to the said curves, means for selectively releasing the said control members, in the receiver, means adapted to be moved simultaneously by the transmitted fluctuations of electric energy and to recompose the transmitted character, and a writing member supported by said means.

4. An electric device for transmitting written characters, comprising, in the transmitter, cam disks as control members shaped according to the curves obtained from the decomposition of a character, means for effecting fluctuations of electric energy operated by the said cam disks in such a manner that the electric energy which is to be transmitted is varied in accordance to the said curves, means for selectively releasing the said cam disks; in the receiver means adapted to be moved simultaneously by the transmitted fluctuations of electric energy and to recompose the transmitted character, and a writing member supported by said means.

5. An electric device for transmitting written characters comprising, in the transmitter, conductive cam disks as control

members shaped according to the curves obtained from the decomposition of a character, jackets consisting of a resistance material and surrounding the said cam disks concentrically with respect to the axle, conductive members sliding upon the jackets, transmission circuits in which the conductive cam disks, the jackets and the sliding members are inserted, contact members adapted to close the circuits through the said sliding members, resistance jackets and conductive cam disks, means for selectively releasing the said contact members, means for rotating the cam disks; in the receiver means adapted to be moved simultaneously by the transmitted fluctuations of electric energy and to recompose the transmitted character, and a writing member supported by said means.

6. An electric device for transmitting written characters, comprising, in the transmitter, control members shaped according to the curves obtained from the decomposition of a character, means for effecting fluctuations of electric energy operated by the said control members in such a manner that the electric energy which is to be transmitted is varied in accordance to the said curves, key-levers of a key-board for selectively releasing the said control members; in the receiver means adapted to be moved simultaneously by the transmitted fluctuations of electric energy and to recompose the transmitted character, and a writing member supported by said means.

In testimony whereof I affix my signature.

HEINZ PEIN.