

July 8, 1941.

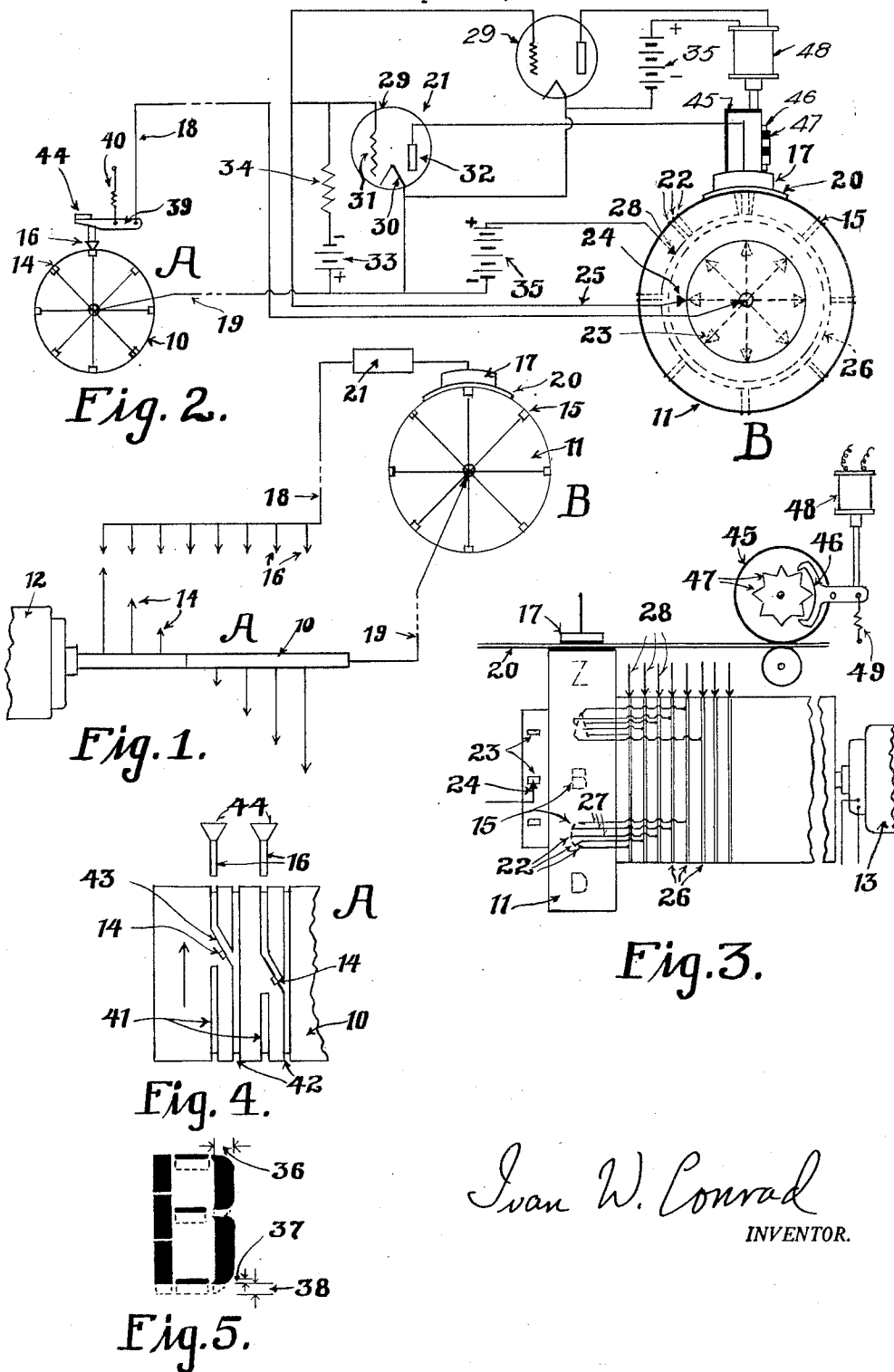
I. W. CONRAD

2,248,522

AUTOMATIC TELEGRAPHY

Filed April 18, 1939

2 Sheets-Sheet 1



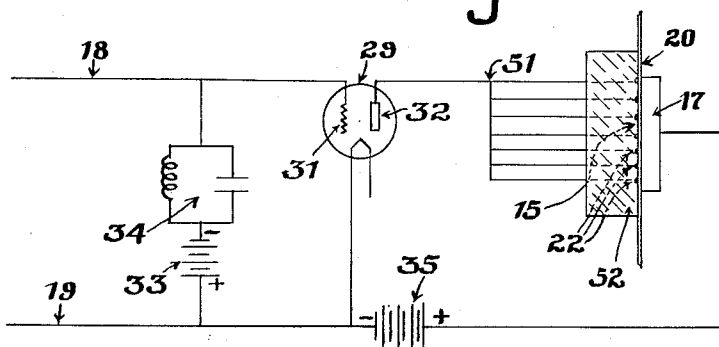
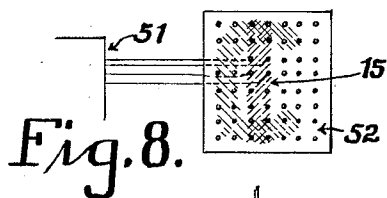
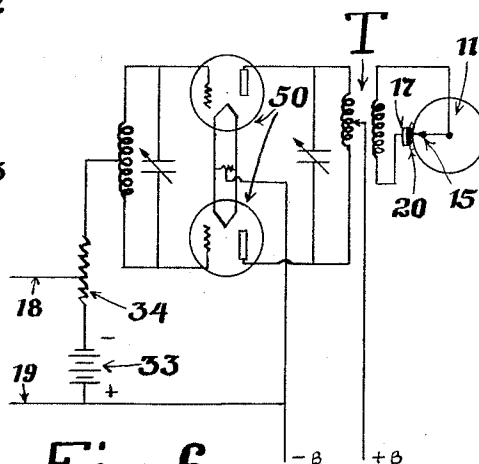
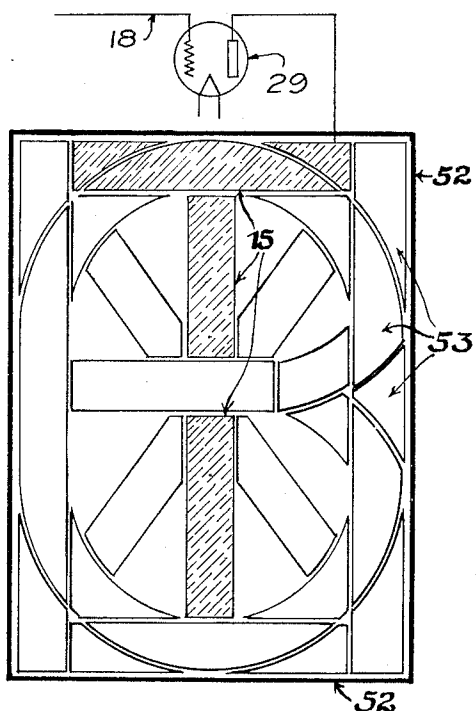
Ivan W. Conrad
INVENTOR.

I. W. CONRAD

AUTOMATIC TELEGRAPHY

Filed April 18, 1939

2 Sheets-Sheet 2



Ivan W. Conrad
INVENTOR.

UNITED STATES PATENT OFFICE

2,248,522

AUTOMATIC TELEGRAPHY

Ivan W. Conrad, Washington, D. C.

Application April 18, 1939, Serial No. 268,591

7 Claims. (Cl. 178-62)

The present invention relates to automatic telegraphy and has for its principal object to provide simple, practical, extremely high speed means for recording at a receiving station characters selected at a sending station.

Selection of characters at the sending station may be accomplished manually as by keyboard, mechanically as by perforated tape, or in any other desired manner and transmission of signals to the receiving station may be carried out by radio as well as by wire. Essentially the invention contemplates the use of electrochemical means for translation of the signals into characters of the alphabet or any other desired symbols, as distinguished from such translation by instantaneous spark discharge recording means which latter means is the subject of petitioner's copending application #154,511 filed July 19, 1937.

Prior art discloses the auxiliary use of electrochemical means for the purpose indicated in conjunction with mechanical means which because of inertia is necessarily relatively slow in operation, as reflected in Letters Patent #275,339 issued to A. F. Johnson and B. F. Johnson and #316,689 issued to H. Van Hooenbergh. It is therefore a further object of this invention to eliminate all mechanical inertia in the printing process and thereby take full advantage of the high speed of which electrochemical action is inherently capable.

With the foregoing general object in view the invention consists in the novel combinations and arrangements of features as will be hereinafter more fully described, illustrated in the accompanying drawings and defined in the appended claims.

In the accompanying drawings wherein are illustrated different, non-limiting, practical embodiments of the invention and wherein like characters of reference denote corresponding parts in related views:

Figure 1 is a diagrammatic view illustrating the general principle of the invention.

Figure 2 is a diagrammatic view illustrating one practical embodiment of the invention.

Figure 3 is a side elevation of the receiving station mechanism diagrammatically illustrated in Fig. 2.

Figure 4 is a side elevation of the sending station mechanism diagrammatically illustrated in Fig. 2.

Figure 5 is a view of character formation utilized to give uniform thickness of line to final printed character.

Figures 6 and 7 are diagrammatic views illustrating alternative forms of recording means which may be used in lieu of the recording means shown in Figs. 2 and 3.

Figure 8 is a side elevation of character matrix shown diagrammatically in Figure 7.

Figure 9 is a side elevation of an alternative character matrix which may be used in lieu of the matrix shown in Figure 8.

Referring to the drawings in detail, A and B designate generally, and respectively, sending and receiving station mechanisms including rotatable elements 10 and 11, respectively, which, in accordance with the invention, are driven at high speeds and partake of equal, or substantially equal, angular increments of movement during any given period of operation of the system. In this connection the synchronous or the substantially synchronous driving of said elements 10 and 11 may be effected in any suitable manner, as, for example, through the instrumentality of synchronous electric motors designated as 12 and 13, respectively, which may derive their power either from a common A. C. source or from separate frequency sources. If said motors derive their power from a common A. C. source this A. C. source may, for example, be a 1000 cycle oscillator located at the sending station controlling the transmitting motor, and by transmission of the 1000 cycle frequency over interconnecting wires, controlling the receiving motor as well. Said motors thus will be synchronized within sufficiently narrow limits for the successful operation of the invention. If, on the other hand, said motors derive their power from separate frequency sources, they must be approximately synchronized and any error in synchronization may be permitted to accumulate for one or a series of revolutions but must periodically be reduced to zero, which can be done by timing impulses in a well known manner. In other words, while it is not essential to the successful operation of the present invention that the elements 10 and 11 be exactly synchronized, it is essential that they be driven approximately synchronously, either by synchronous motors employing current of suitable high frequency or in some other appropriate manner in itself forming no part of the present invention and therefore not specifically shown or claimed.

The rotatable element 10 of the sending mechanism A carries a plurality of contacts 14 which are spaced angularly about the axis of rotation of said element and also longitudinally along said element. On the other hand, the rotatable ele-

ment 11 of the receiving mechanism B carries a plurality of characters 15 which are spaced angularly about the axis of rotation of said element corresponding to the angular spacing of the contacts 14, but which are disposed in a common plane normal to the axis of rotation of said member.

A plurality of contacts 16, one individual to each of the contacts 14, are provided for cooperation with said contacts 14. These contacts 16 normally are disposed out of the paths of rotation of the contacts 14, but are movable into the paths of rotation of said contacts 14 so as to be engaged by said contacts 14 responsive to rotation of the element 10. Moreover, said contacts 16 are disposed in a common plane including the axis of rotation of the element 10 and thereby have fixed positions so far as concerns rotation of the element 10 and the contacts 14, so that no two of said contacts 16 can simultaneously engage related contacts 14, because of the aforesaid angular spacing of the contacts 14.

The characters 15 are, according to one practical embodiment of the invention, in the form of electrodes and cooperate with an electrode 17 which is mounted outwardly of and adjacent to the rotatable element 11 in a fixed position, so that the characters 15 successively move past the same in suitable spaced relationship thereto as the element 11 rotates. Thus, by the selection of a contact 16 bearing any particular designation or character, and by the actuation of said contact so that the related contact 14 will engage therewith, element 11 may be so oriented that upon engagement of the related contact 14 therewith, the corresponding character 15 will be in a position aligned with the electrode 17 when engagement between the contacts 14, 16 occurs. In this connection any suitable means responsive to engagement of any given pair of the contacts 14, 16 with each other may be provided to effect recording of the related character 15 at the instant of its alignment with the fixed electrode 17. One such means is illustrated conventionally in Fig. 1, from which figure it will be observed that all of the contacts 16 are connected with the electrode 17 by a common line wire 18; that all of the contacts 14 are connected with all of the characters 15 by a common line wire 19; that a suitable recording medium 20 affected by flow of electric current is interposed between the element 11 and the fixed electrode 17, and that interposed in the line wire 18 is a means 21 for producing an electric current between the electrode 17 and the particular character 15 which may be aligned therewith when the circuit is closed by engagement of a related pair of the contacts 14 and 16. Thus, upon closing of the circuit as a result of movement of any selected contact 16 into the path of movement of its related contact 14 and subsequent movement of the contact 14 into engagement with the selected contact 16, a recording of the character 15 related to the selected contact 16 will be effected on the recording medium 20 by the electric current between the electrode 17 and the said related character 15.

The recording medium 20 may be in the form of a strip of paper or other suitable material sensitized or otherwise treated so as to be affected by the electric current, and any suitable means may be provided for advancing the same as the characters 15 are successively recorded so that the successively recorded characters will be

properly spaced and will follow one another in a line on the recording medium.

While some or all of the characters 15 may comprise only a single electrode for cooperation with the fixed electrode 17, it is preferred that said characters, except in the cases of such of the same as are relatively small, as commas, periods and the like, shall be comprised by pluralities of electrodes designated as 22, and that the electric currents between the fixed electrode 17 and the different electrodes 22 shall be distinct from each other, thereby to assure recording of the complete outlines of said characters 15. These features of the invention, as well as a suitable current producing means especially suited for use in the present system is illustrated in Figs. 2 to 4 of the drawings.

Referring in detail to Figs. 2 to 5 which illustrate a refined embodiment of the invention as compared with the conventional Figure 1 illustration, it will be observed that the rotatable element 11 is provided with a series of contacts 23 which are angularly spaced apart corresponding to the angular spacing of the characters 15; that a fixed contact 24 is provided for cooperation with said contacts 23; that the line wire 18 connects all of the contacts 16 with all of the contacts 23; that a wire 25 leads from the fixed contact 24 to the current producing means designated generally as 21, and that the line wire 19 connects all of the contacts 14 with said current producing means 21. It will further be observed that the rotary element 11 carries a plurality of conductor rings 26; that there are separate connections 27 between said rings and the electrodes 22 of each of the characters 15, and that each conductor ring 26 has cooperating therewith an individual fixed contact 28.

Of course, some of the characters 15 may be comprised by a greater or lesser number of electrodes 22 than other of said characters. Accordingly, there are as many of the conductor rings 26 as the maximum number of electrodes in any given character 15 so that each electrode of each character may have a connection 27 with a distinct ring. Thus, all of the rings 26 may be utilized to provide separate connections for the electrodes 22 of certain of the characters 15 and only some of said rings may be utilized to provide separate connections for the electrodes of other of said characters, depending, of course, upon the number of electrodes comprising the different characters.

There is an electric current producing means 21 individual to each of the conductor rings 26 to assure a separate current between the electrode 17 and each of the electrodes 22 comprising any given character being recorded. Since, however, said current producing means are, or may be duplicates of one another, only one of the same has been illustrated for the sake of simplifying the description and to avoid complicating the illustration.

As illustrated in Fig. 2 a preferred current producing means includes essentially a thermionic vacuum tube 29 including filament 30, a grid 31, and a plate 32. A source of E. M. F. 33 normally serves to bias tube 29 negatively thru impedance 34 to essentially "cut-off" or zero plate current condition. However, upon engagement of any given contact 14 with its related contact 16, said bias will be removed at the instant contacts 23 and 24 engage, thereby permitting a source of plate E. M. F. 35 to force an electric current through the vacuum tube plate circuit which as

indicated includes contact 23, ring 26, character element 22, recording medium 20, cooperating contact 17, and the plate 32 and filament 30 of the tube itself. Thus since as aforesaid, there is a current producing means 21 individual to each of the rings 26 and therefore to each of the electrodes 22 of each of the characters 15, it is apparent that during the time interval in which contacts 14, 16 and 23, 24 remain closed, there will occur a separate current between the fixed electrode 17 and all of the electrodes 22 of any character being recorded, with the result that a distinct outline of the complete character will be recorded. It will also be apparent that each character may alternatively consist of a single continuous electrodic outline, with only one vacuum tube circuit associated therewith to effect recording. However the plural electrodic characters serve to insure a more nearly uniform recording current density throughout the character outline.

The contacts 14, 16 have sufficient relative width to remain engaged with each other throughout the angle represented by the maximum "hunting" range of the synchronous motors 12 and 13. The contacts 23 are, on the other hand, of knife-edge type to assure that a current between the fixed electrode 17 and any given character 15 will occur only when said character 15 is exactly aligned with said fixed electrode 17. Thus, straight line recording of the characters 15, as distinguished from staggered recording thereof, is assured.

Since contacts 23 and 24 determine the interval during which recording current flows through recording medium 20, and because of the finite width of these contacts it will be apparent that the characters being recorded will move through a small peripheral distance during the recording operation. In order to obtain printed characters of uniform line width, therefore, it is desirable to form the characters as shown in Fig. 5 in such a manner that the width of vertical lines 36 is equal to the width of horizontal lines 37 plus the peripheral (vertical in this instance) distance 38 covered during the recording operation. Similarly, the peripheral distance 38 and width of horizontal lines may be altered in any desired manner to produce characters of other desired shading or form.

In the foregoing description the vacuum tube 29 is assumed to be of the high vacuum type. However, it is to be understood that grid controlled gaseous discharge tubes may be used equally as well with proper choice of circuit components and constants, as may also multi-grid tubes.

According to the specific embodiment of the invention illustrated in Figs. 2 to 5, the contacts 16 are disposed above the rotatable element 10 and are in the form of laterally deflectable fingers depending from pivoted lever arms 39 which are constantly urged upwardly by spring means 40. Accordingly, said fingers normally are held out of the paths of rotation of their related contacts 14, but are depressible to positions where they will be engaged by said contacts 14 and, when released, will return to their normal positions. In this connection means are provided whereby depression of any given contact 16 into the path of rotation of its related contact 14 will result in engagement of said contact 14 with said contact 16 only once even though the contact 16 may be held depressed, thereby to assure that the related character 15 will be recorded only once despite

the high speed rotation of the element 10 and despite the possibility, and probability, that the contact 14 may travel past the contact 16 a number of times while the latter contact is held depressed. In the present instance the means referred to comprises, in association with each of the contacts 16, two channels 41 and 42 (Fig. 4) in the element 10 respectively aligned with and disaligned from the contact 16 when the latter is in its normal, retracted position. The last mentioned channel 42 of each pair is annular, and the companion channel 41 is substantially annular, but instead of continuing entirely around the element 10, is interrupted and is joined, at its trailing end, as regards the direction of rotation of the element 10, with the channel 42 by a diagonal channel 43 in which, at the side thereof toward the channel 41, is located the contact 14. Accordingly, when the contact 16 is depressed, its lower end enters the channel 41 and remains therein until, by rotation of the element 10, it is deflected into the channel 42 by the diagonal connecting channel 43. As this deflection or switching occurs the contact 14 wipes against the contact 16 and provides for closing of the related circuit by engagement of the related contact 23 with the fixed contact 24 at the instant when the related character 15 is exactly aligned with the fixed electrode 17. Obviously, once the contact 16 is deflected laterally into the channel 42, it will remain therein as long as it is held depressed and cannot again enter the channel 41 until it has been released and again depressed, which means, of course, that despite the high rotary speed of the element 10, the related circuit will be closed once, and only once, upon depression of any given contact 16, no matter how long said contact may be held depressed. In short, the means described insures against repeated records of any character 15 being made on the recording medium 20 as the result of any single actuation of the related contact 16.

The arms 39 carrying the contacts 16 may be arranged in the manner of the keyboard arms of a typewriter, and may be equipped with finger buttons or keys 44 having thereon characters corresponding to the related characters 15. Alternatively, any suitable means other than the means described may be provided for controlling engagement and disengagement of the contacts 14, 16. For example, engagement and disengagement of said contacts may be under the control of a perforated tape in a manner well known in so-called tape transmission telegraph systems.

As aforesaid, any suitable means may be employed to effect advance of the recording medium 20 as recordation of successive of the characters 15 takes place. As illustrated in Fig. 3 this means may comprise a wheel or roll 45 rotatably urged by a spring or other suitable means in a direction to advance said medium 20; an escapement lever 46 cooperating with teeth 47 on said wheel or roll, and suitable electro-magnetic means 48 cooperating with spring means 49 to actuate said lever 46 to permit said wheel or roll 45 to advance the recording medium 20 one step each time a recording of any one of the characters 15 takes place. This electro-magnetic means may derive its actuating energy from a thermionic tube, the grid of which is affected by the recording impulse, as shown in Fig. 2. There may also be provided any suitable means for actuating said sheet or strip advancing means for the purpose of obtaining spaces between characters 15 and between words or the like formed by groups of

said characters, said means including, for example, a pair of contacts 14, 16 cooperating with a blank space in lieu of a character 15 on the element 11.

The forms of the invention illustrated in Figs. 1 to 5 utilize unidirectional electric current under thermionic vacuum tube control to effect recording of the characters on the recording medium 20. However it will be readily understood that other forms of current producing means might be employed. For example, the high frequency alternating current from a Tesla coil or radio frequency oscillator might be employed as the current producing means 21. A simplified circuit capable of accomplishing this result is shown in Fig. 6 wherein T represents a high frequency transformer coupling the output from oscillating tubes 50 into recording circuit containing electrode 17, electrodic characters 15, and recording medium 20.

Further it is apparent that instead of utilizing synchronous distributors at sending and receiving stations, for selection of characters, other suitable nonsynchronous means might be employed such as the use of different frequencies, one for each character to be recorded. In Fig. 7 is shown a practical receiving station mechanism responsive to selection of characters by frequency differentiation, in which all mechanical motion whatsoever has been eliminated with the sole exception of that required to advance the recording medium. In Fig. 7, 18 and 19 designate a transmission circuit over which is received a recording signal consisting of a short wave train of frequency n . Normally this signal will be short circuited through impedance 34 and source of E. M. F. 33, except in that instance where the impedance 34, being now a tuned circuit, is resonant at the frequency n , in which latter instance the signal will be impressed upon the grid 31 of the vacuum tube 29, which normally is biased to cut-off by E. M. F. 33. The signal will thereupon decrease the effective resistance of tube 29, permitting E. M. F. 33 to force an electric recording current through electrode 17, recording medium 20, recordable character 15, and plate 32 of said vacuum tube 29. The recordable characters in this instance consist of elemental conducting areas 22 outlining and partially filling the form of the character to be recorded, all elemental areas of any one character being connected together as at 51 and to the plate 32 of the vacuum tube 29. Interspersed with and surrounding the elemental areas or electrodes 22 of any one character, are placed other elemental electrodic areas held in a character matrix 52 and connected in groups to outline all required characters, each group being connected to a different vacuum tube or other current producing means. In Fig. 8 are shown one character 15 with elemental areas connected as at 51 and the manner in which other required characters, only one of which is shown for the sake of clarity, are in effect superimposed in matrix 52 although comprising different electrodic elements.

Alternatively, as shown in Fig. 9, character matrix 52 might be constructed of relatively large electrodic elements 53, none of which are connected together, each being supplied by a separate current producing means, and selectively grouped by any desired type of signal to produce desired characters 15. Areas shaded indicate manner of such grouping. For example, each current producing means may be an electronic

tube 29, designed to energize its related character element upon the receipt over line 18 of a relatively short wave train of an audio frequency signal. Upon the simultaneous receipt at the receiving station of a combination of such signals, each frequency component may be separated by a suitable filter network in a well known manner, and caused to energize the related character elements to produce any desired character.

While the drawings illustrate wire connections between the sending and receiving mechanisms A and B, it is manifest that such connections may readily be replaced by suitable wireless transmitting and receiving devices associated with the sending and receiving mechanisms A and B, respectively, and that it accordingly is within the purview of the invention to employ such devices if desired. Moreover, while only certain specific embodiments of the invention have been illustrated and described to convey the general concept of the invention, it is to be understood that the same is readily capable of various other embodiments within its spirit and scope as defined in the appended claims.

I claim:

1. In a telegraph system, a receiving station mechanism including means defining recordable characters in the form of letters, numerals and symbols, a sensitized electrically conductive recording medium, means for advancing said recording medium relative to said characters, means with which said character defining means cooperate to supply to said recording medium by direct contact conduction a recording current to effect complete, instantaneous electrochemical recording of said characters on said recording medium, said means and said characters having an unvarying relationship to each other with respect to motion, and means controlling said recording current and the selection of characters to be recorded.

2. In a telegraph system, a receiving station mechanism including means defining recordable characters in the form of letters, numerals and symbols, a sensitized electrically conductive recording medium, means for advancing said recording medium relative to said characters, means fixed with respect to said characters and with which said character defining means cooperate to supply to said recording medium by direct contact conduction a recording current to effect complete, instantaneous electrochemical recording of said characters on said recording medium, and means controlling said recording current and the selection of characters to be recorded.

3. In a telegraph system, a receiving station mechanism including means defining recordable characters in the form of letters, numerals and symbols, a sensitized electrically conductive recording medium, means for advancing said recording medium relative to said characters, electrodic means continuously uniformly movable relative to said characters and with which said character defining means cooperate to supply to said recording medium by direct contact conduction a recording current to effect complete, instantaneous electrochemical recording of said characters on said recording medium, said electrodic means and said characters being continuously uniformly movable one relative to the other, and means controlling said recording current and the selection of characters to be recorded.

4. A telegraph system as set forth in claim 3

in which the electrodic means and the character defining means have rotary motion one relative to the other.

5. In a telegraph system, a receiving station mechanism comprising electrochemical character recording means including recordable electrodic characters in the form of letters, numerals, and symbols, each comprising a plurality of electrodes; a recording medium; means for advancing said recording medium relative to said characters; cooperative means, including an electrode, fixed in relation to the electrodes of said characters and with which the electrodes of said characters cooperate to effect complete instantaneous recording of the electrodes of any given character by the electrochemical action of a recording current conducted to said recording medium by direct contact of the electrodes of said characters and said cooperating electrode therewith; a separate recording current producing means for each electrode of each of said characters, said character electrodes having an interfitting relationship to each other so that certain of the same are common to different characters, and means controlling said recording current and the selection of character electrodes to be recorded.

6. In a telegraph system, a receiving station mechanism including recordable electrodic characters in the form of letters, numerals and symbols; a sensitized, electrically conductive recording medium relative to said characters; means for advancing said recording medium; cooperative means including an electrode fixed in relation to said electrodic characters and with which said electrodic characters cooperate to effect complete instantaneous recording of the same by the electrochemical action of a recording

current conducted to said recording medium by direct contact of said electrodic characters and cooperative electrode therewith; and means controlling said recording current and selection of characters to be recorded; said electrodic characters each comprising a plurality of electrodes connected together and further connected to a separate recording current producing means individual to each character, the electrodes comprising each character being separate and distinct from the electrodes comprising each other character and certain of the electrodes comprising certain of said characters being disposed within the outlines of certain other of said characters.

7. In a telegraph system, a receiving station mechanism comprising recordable characters in the form of letters, numerals and symbols; a recording medium; means for advancing said recording medium relative to said characters; means for recording said characters on said medium; said last mentioned means including means whereby said characters and said medium have motion relative to each other during recording of said characters, and means to assure that recorded characters possess uniform line width regardless of relative motion between said recordable characters and said medium during interval in which recordation of characters occurs, said last mentioned means comprising recordable characters of such line width that the sum of the displacement relative to said recording medium of any given point on a character being recorded during the recording interval, and the line width of said character at said given point measured in the direction of said relative displacement, is a constant.

IVAN W. CONRAD.