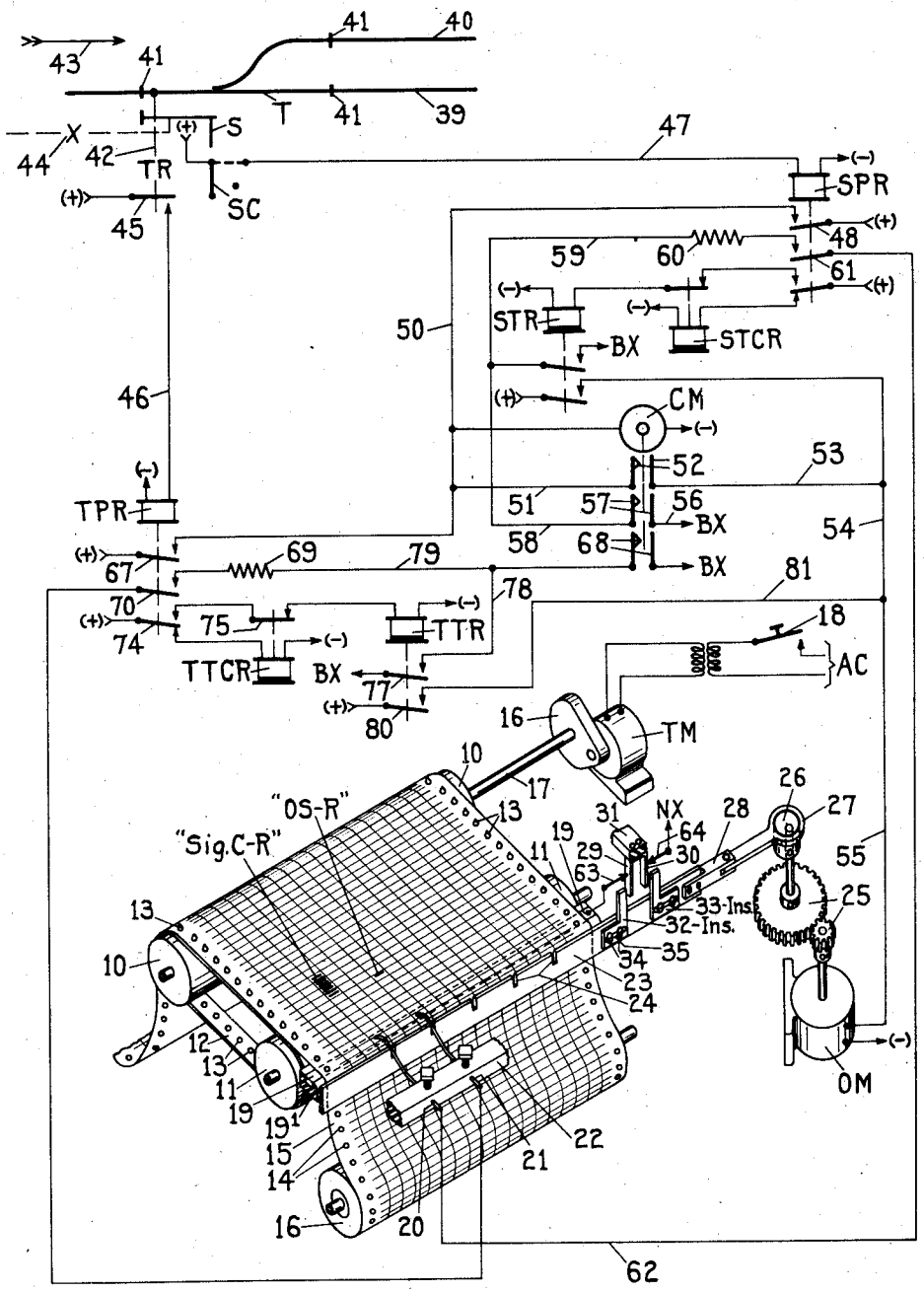
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ELECTRIC TRAIN RECORDER FOR RAILWAY DISPATCHING SYSTEMS

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ELECTRIC TRAIN RECORDER FOR RAILWAY DISPATCHING SYSTEMS

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This invention relates in general to automatic train recorders for use in railway dispatching, and has more particular reference to an electrically operated recorder having improved characteristics.

In recorders of the type to which this invention relates, a record sheet is moved at a slow but uniform rate over a platen, while resting above the platen and on the upper surface of the sheet is a stylus or marker for each of the functions to be recorded. The recorder is generally located at a central office and is connected by electrical circuits with outlying locations whereby such functions as "signal clear," track occupancy, or "OSing" can be recorded.

The record paper employed is known as "teledeltos" paper and is comprised by a carbon base which is, of course, electrically conductive, covered by a thin coating of opaque material having insulating characteristics and against which the styli rest. When electrical energy of the proper energy level, depending upon the rate of movement of the styli with respect to the paper, is applied across any stylus and the platen, the insulating surface is punctured or disrupted, and a legible record is produced.

If the energy level applied to a stylus is not properly related to the speed of movement of the stylus with respect to the record paper, and is too low, the marking may not occur or be weak, illegible and undependable, while if the energy level be too high, destructive burning may occur and as a result the marking is rough and ragged and illegible.

It is proposed in order to obtain the proper speed of the styli with respect to the record paper and still not move the paper so fast as to produce a record which is over lengthy or voluminous, to move the styli during the time they are energized, as well as moving the paper. More specifically, it is proposed to oscillate the styli in a direction at right angles to the movement of the paper in oscillations of a relatively small amplitude.

Also, to care for making a record of considerable duration, since the record paper travels away from the styli at a very slow rate, it is proposed to code the energy applied to the styli, whereby to avoid any possibility of destructive burning and a consequently illegible record.

One of the objects of the present invention is to provide a recorder of the type set forth above which records with great certainty and in a most legible manner, records of relatively short duration, as in the order of a few seconds, and records of relatively long duration, as in the order of many minutes or even hours.

Another object of this invention is to provide a recorder which will function to make a compact and conveniently usable record.

Another object of the present invention is to provide a recorder which is economical in its operation and its maintenance.

Another object of the present invention is to provide a recorder which is simple, rugged, dependable, and long lived.

Further objects, purposes, and characteristic features of this invention will appear as the description progresses, reference being made to the accompanying drawing, showing solely by way of example and in no manner whatsoever in a limiting sense, one form which the recorder can assume.

In the drawing the single figure of drawing shows in a wholly diagrammatic manner, one form which the invention can assume.

Referring now to the drawing there is here shown in very simplified form and with only such details as are necessary for an understanding of this invention, a recorder and its control circuits.

The recorder includes suitably supported operating rollers 10 and 11 spaced from each other and at each end carrying a belt 12 having studs 13 thereon which are received in perforations 14 along the edges of the record paper 15 which is in the form of a roll 16 and so can be moved at a uniform rate of speed by the rollers.

One roller 10 is driven by a timing motor TM through gears in a casing 16 and a shaft 17. The timing motor is of the constant speed type and, while shown as an alternating current synchronous motor, operated through a circuit controlled by a switch 18, it may also be a constant speed direct current type, such, for example, as disclosed in the Field patent, No. 2,263,331, granted November 18, 1941.

The record paper passes over an electrically conducting platen 19 suitably insulated as at 19¹ from the remainder of the structure. Bearing on the upper face of the record paper and directly above platen 19 is a series of markers or styli, only two of which, 20 and 21, are shown. These styli are removably carried in a fixed carrying bar 22 of insulating material and near the free ends are received in notches in an oscillable member or comb 23 also of insulating material, and extend forwardly therefrom to have their marking ends resting against the record paper. The comb can be of any desired length and receive

any desired number of styli in other receiving notches as 24.

The stylus carrying comb is arranged to be oscillated at a small amplitude by an oscillating motor OM which is of the constant speed type and while shown as a direct current motor, it can, if desired, be an alternating current motor of the synchronous type, for example. The oscillating motor OM through gearing 25 rotates an eccentric cam 26 to thereby oscillate the comb by means of a loop 27 and a link connection 28.

A clipper switch having spaced electrically interconnected contact fingers 29 and 30 is connected to a fixed insulated portion 31 of the structure and is arranged to have its contact fingers moved inwardly by operating members 32 and 33 on the comb as the comb oscillates. The operating members 32 and 33, carried by the comb, are adjustably fastened thereto as by screws 34 in slots 35, all for a purpose to be more fully explained below.

As described in general in the introductory portion of this specification, the styli are at times automatically energized through control circuits connecting the recorder, usually at a central office with a field station or stations spaced therefrom, and when energized at the proper energy level, produce legible recording marks on the record paper.

Referring now to apparatus at the field station which may be a considerable distance from the central office, there is here shown a section of single track 39 connecting with a passing siding 40. Insulating joints 41 defining a usual isolated track section T, including a short portion of track where the siding joins the main track. Track section T includes a track circuit with a usual track relay TR indicated diagrammatically by dotted line 42.

At the entrance to track section T, movement being considered eastwardly as indicated by arrow 43 is a wayside signal S. This signal is shown in its normal stop position and can be controlled in any usual manner by controls indicated diagrammatically at 44 to assume its clear position whereby to allow an eastbound train to enter and pass over the track section. The signal control to clear position can be either manual or by usual approach control means and it is to be understood that the signal moves automatically to its stop position upon occupancy of the section, and so remains until next cleared.

The circuit arrangement connecting the field station with the recorder at the central office is arranged to control the recorder so as to make a record of various conditions in the field, so long as these conditions persist. The signal S may be put to clear and remain at clear for a considerable time. On the other hand, the track section may be occupied not only for a considerable time but when it is relatively short, and a short train or only a locomotive passes over it at speed, the occupancy may include a time of only one or two seconds. The circuit arrangement is such that the recorder will reliably and legibly record these indications whether they be of very short or very long duration.

Included in the circuit controls are a track repeater relay TPR which is normally deenergized but which picks up and remains up so long as the track section is occupied, due to the making up of contact finger 45 and back point of track relay TR.

In a similar manner the signal S includes a signal contact SC which when the signal is at clear completes an energizing circuit for a signal repeater relay SPR which is normally deenergized but which picks up and stays up so long as the signal remains at clear. Wires 46 and 47 connect the field station with these repeater relays, which, together with the remainder of the circuits to be described, are located at the central office.

In the interest of simplifying the disclosure of this invention, the circuit connection between the outlying way-station and the central office has been shown as by means of unit line wires as wires 46 and 47. It is to be understood, however, that this invention contemplates such connection by means of any usual or desired "CTC," or centralized traffic control system, as, for example, in the patent to W. D. Hailes, No. 2,184,696, granted December 26, 1939.

Associated with signal repeater relay SPR is a signal timing relay STR and a signal timing control relay STCR which relays are relatively quick to pick up, but are slow to release each having a release time of about 1½ seconds in one exemplification of the invention.

Associated with track repeater relay TPR are timing relays similar to those just described and identified as TTR and TTCR which relays are quick to pick up and slow to release in the order of 1½ seconds each, in the same manner as described above in connection with the signal controlled relays.

Included in the circuit control for coding the energy to be applied to the various styli is a code motor CM which can be of any usual or desired type so long as it carries out the desired function. This motor, for example, can operate a cam for the coding contact fingers employed with a dwell on the cam so as to provide alternate periods of current "on" and current "off" of any relationship desired.

The operation of the recorder can be best understood from a consideration of an actual train movement. Assume that a train is approaching the track section T and that some time prior to its arrival at the section signal S is cleared and remains cleared until the track section is occupied, and hence the signal is clear for a period of time of several moments at least. Upon the signal reaching its clear position the repeater relay SPR picks up to thereby energize code motor CM, which is normally at rest, through contact finger 48 and front point, wire 50, etc. as is obvious from the drawing. Contact finger 48 also closes a circuit for energizing the oscillating motor OM with coded current which circuit includes wires 50 and 51, coding contact 52, and wires 53, 54 and 55.

Also the picking up of the signal repeater relay SPR closes a circuit for placing coded energy on the "signal at clear" recording stylus 20 through a circuit including wire 56, coding contacts 57, wires 58 and 59, energy limiting resistance 60, contact finger 61 and front point of signal repeater relay SPR, wire 62, stylus 20, platen 19, clipper contact point 63, clipper contact fingers 29 and 30, and clipper contact point 64.

As described just above the clearing of signal S in the field results in energizing the coding motor and applying coded energy to the oscillating motor and to the corresponding stylus of the recorder whereby the stylus produces a series of horizontal, spaced lines as indicated at "Sig C–R" or "signal-at-clear record."

The energy in one application of the invention is coded so as to be alternately "on" for approxi-

mately three seconds and "off" for approximately 17 seconds, and the styli are moved to make a complete oscillation of over and back in a time of about one second. Thus, with the first "on" period of current applied to the stylus a short horizontal mark is made and during the following period of current "off" the record paper is travelled a sufficient distance even though moved very slowly to cause the stylus to make a spaced horizontal mark during the next period of current "on."

The clipper contact fingers and points as described above are adjusted to remove energy from all energized styli for a portion at either end of the oscillating stroke. It is clear that with the cam control as explained above the speed of movement of a stylus over the paper in its oscillating motion decreases to become zero at each end of the stroke. In order to avoid blurring or destructive burning of the record paper at this slow end speed the energy is removed from a portion of the stroke at each end by these clipper contacts and fingers. It is clear that by adjusting the control members **32** and **33** the portion of the stroke throughout which energy is removed can be readily controlled to thus produce the desired marking in a wholly reliable and legible manner.

By coding the current applied to the styli whereby to space the horizontal markings any destructive burning or blurring is prevented as might otherwise occur due to the styli having a substantial bearing area on the record paper (as described more fully below), retracing perhaps several times the same portion of the record paper during successive "on" periods of current.

The recorder is controlled in the same manner as set forth above in connection with the clearing of the signal, to record track occupancy, for example.

More specifically, upon occupancy of track section T, track relay TR makes up its back point to pick up its repeater relay TPR and thereby control the recorder in a manner wholly similar to that described above. In brief, contact finger **67** and front point of relay TPR energizes coding motor CM and oscillating motor OM, the latter with coded energy through coding contacts **52**. Also, through coding contacts **68**, resistance **69**, and contact finger **70** and front point of track repeater relay TPR, coded energy is placed on stylus **21** to thereby record the track occupancy and produce a record as indicated on the record paper as "OS—R" or an "OS-ing" record. In this particular case it is assumed that the condition of occupancy continues but for a matter of a few seconds whereby the record is comprised of a single line transverse to the direction of movement of the record paper.

When we consider that while the recording of one function is being made, another function may come into being and its indication may come into the central station to be recorded, it can be seen that during the "off" period of current as controlled by the code motor a new indication of short duration might occur and be completely included in this "off" period of the indication already being recorded. As a result the stylus corresponding to the newly received indication would not become energized and the indication would not be recorded.

To avoid any such occurrence a means is provided whenever an indication is first transmitted to the central office to energize the corresponding stylus for a short period of time as, for example, 3 seconds, regardless of the then position of the code motor. This means comprises the two timing relays STR and STCR for the signal-at-clear indication and the two relays TTR and TTCR for the OS indication.

Let us assume that the recording of the signal-at-clear indication is in progress at the time an OS indication comes into the central office. Further let us assume that the "off" period of current for the signal-at-clear indication has just begun, and that it continues for a period of, for example, 17 seconds, which period is sufficient to include the complete duration of the OS indication which, we may assume, is of the order of about 3 seconds.

On the picking up of contact finger **74** of relay TPR timing relay TTR picks up and the control timing relay TTCR after approximately 1½ seconds opens its contact finger **75** to deenergize relay TTR which releases approximately 1½ seconds thereafter. Thus, relay TTR after picking up, remains up for approximately 3 seconds. With relay TTR in attracted position energy is placed through contact finger **77** and front point, wires **78** and **79**, resistance **69**, contact fingers **70** and front point, etc. on stylus **21** which is the stylus which produces the OS record. At the same time through contact finger **80** and front point of relay TTR and wires **81** and **55**, etc., the oscillating motor OM is energized whereby the energized OS stylus is oscillated and a record as shown on the drawing is produced.

In a similar manner the timing relays STR and STCR associated with repeater relay SPR function to always make a record when the corresponding indication comes into the central office regardless of the then position of the code motor, all as explained just above.

By means as described above, it can be seen that a recorder is provided which produces a dependable, legible record; and one that is much more visible and more readily read than if it were merely a point or a single line parallel to the direction of movement of the record paper. Furthermore, by oscillating the styli the speed of movement of the styli with respect to the paper can be increased so as to more suitably adapt the paper for use in a recorder where the record paper is preferably moved very slowly. Furthermore, by coding the energy and by the employment of clipper contacts to cut off energy at each end of each oscillation, all danger of destructive burning with a consequent blurring and the production of an illegible record, is completely obviated.

While the speeds of the styli with respect to the record paper can be varied throughout wide limits as well as the speed of movement of the paper itself and also the energy level applied to the styli, it has been found that one practical set of relative values which has proven to give very satisfactory records on "teledeltos" paper, grade L, are approximately as follows.

A steel stylus is employed having a diameter of .026" bearing against the record paper with a pressure of from 20 to 25 gms. Each stylus is energized with 60 cycle alternating current at 260 volts and is included in series with a resistance of about 15000 ohms. The coding of the energy applied to the styli and the oscillating motor is such as to place current "on" for 3 seconds and "off" for 17 seconds out of every 20 seconds. Furthermore, the oscillating stroke has a total length of about .078" and the clipper contacts

are set to remove current at each end of the stroke so that energy is applied at the central portion of each stroke for a length of travel of about .035". The rate of oscillation for a complete over-and-back movement is about 1 second. The record paper is moved by the timing motor at a uniform rate of speed of 2" per hour.

The energy for the styli can be direct current or high frequency alternating current, as well as 60 cycle alternating current, as in the example above.

While the invention has been described above as including oscillation of the styli in combination with coding the energy applied to the styli, and also cutting energy off by means of the clipper contacts at the ends of the oscillations, it should be understood that various of these features may be employed either alone or in various combinations. The styli, made of fairly large wire as set forth above, are not sharply pointed when they bear on the paper but have a wedge shaped end of considerable transverse width and of very appreciable area. If paper should be obtainable which would tolerate the repeated oscillations of styli which are sharply pointed and the travel of the record paper should be fast enough in relation to the oscillations to prevent tearing or mutilation of the paper by the repeated movement of the styli over closely adjacent portions, then it is clear that coding might be dispensed with.

Furthermore, if the paper should be of a character that would tolerate wide ranges in styli speeds for short periods of time without materially affecting the character of mark produced, then the clipper contacts and their function might be dispensed with.

With the styli now employed, which have a bearing face of considerable area and which seem best suited for operation on record paper now readily available due to the low rate of movement of the record sheet the very same part of the paper may be traversed several times by a stylus and if there were no coding it would be traversed many more times. By coding the energy applied to the styli and having the periods of current "off" of a sufficient duration, the paper can travel in this "off" period far enough so that the mark produced by the stylus during the next period of current "on" is at least slightly spaced from the next previously produced mark.

The above specific example is merely one set of relative values which gives a very satisfactory record and obviously other combinations of values can be employed where circumstances make it desirable or expedient.

The above rather specific description of one form of this invention has been given solely by way of example, and is not intended in any manner whatsoever in a limiting way. Various modifications and adaptations as may, from time to time, appear desirable can be made without departing from the spirit and scope of this invention except insofar as it may be limited by the appended claims.

Having described our invention, we now claim:

1. In an electric recorder; in combination; a fixed frame; means for moving an electro-sensitive record sheet linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of such record sheet; a conductive platen directly beneath the stylus but insulated therefrom and in electrically operative relation to the back of such record sheet; a stylus energizing circuit including in series the stylus, record sheet and platen; means for controlling said circuit in accordance with events to be recorded; and means for uniformly oscillating the marking end of the stylus through repeated identical distances of movement which are small relative to the width of such record sheet effective only when potential is applied to said circuit and oscillating said stylus in a direction transverse to the direction of movement of such record sheet in order to increase the speed of relative movement between the stylus and record sheet and to make a relatively wide mark thereon.

2. In an electric recorder; in combination; a fixed frame; means for moving an electro-sensitive record sheet linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive flexible stylus having one end fixed to the frame; a marking point at the other end of the stylus and positioned in electrically operative relation to the face of such record sheet; a conductive platen directly beneath the stylus but insulated therefrom and in electrically operative relation to the back of such record sheet; a stylus energizing circuit including in series the stylus, record sheet and platen; means for controlling said circuit in accordance with events to be recorded; and means effective only when a potential is applied to said circuit for uniformly oscillating the marking point of the stylus by flexing the stylus repeatedly to like extents and in a direction transverse to the direction of movement of the record sheet.

3. In an electric recorder; in combination; a fixed frame; means for moving an electro-sensitive record sheet linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of such record sheet; a conductive platen directly beneath the stylus and in electrically operative relation to the back of such record sheet; a stylus energizing circuit including in series the stylus, such record sheet and platen; means for controlling said circuit; and means for oscillating the marking end of the stylus in a direction transverse to the direction of movement of such record sheet; clipper contacts included in the stylus energizing circuit and effective to open the circuit of the stylus during a portion of the oscillating movement of the stylus at each end of its oscillations.

4. In an electric recorder; in combination; a fixed frame; means for moving a record sheet linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of an inserted record sheet; a conductive platen directly beneath the stylus and in electrically operative relation to the back of such record sheet; a stylus energizing circuit including in series the stylus, sheet and platen; means for controlling said circuit; and means for oscillating the marking end of the stylus in a direction transverse to the direction of movement of the sheet only while the stylus energizing circuit is controlled so as to energize the stylus; clipper contacts included in the stylus energizing circuit and effective to open the circuit of the stylus during a portion of the oscillating movement of the stylus at each end of its oscillations.

5. In an electric recorder; in combination; a fixed frame; means for moving a record sheet linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of an inserted record sheet; a conductive platen directly beneath the stylus and in electrically operative relation to the back of such record sheet; a stylus energizing circuit including in series the stylus, sheet and platen; means for controlling said circuit; means for oscillating the marking end of the stylus in a direction transverse to the direction of movement of such record sheet; clipper contacts included in the stylus energizing circuit and effective to open the circuit of the stylus during a portion of the oscillating movement of the stylus at each end of its oscillations; and adjusting means for the clipper contacts for varying the extent of the portions of the oscillations during which the circuit is maintained open by these contacts.

6. In an electric recorder; in combination; a fixed frame, means for moving a record sheet, responsive to electrical energy applied thereto to leave a mark on its face, linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of such record sheet; a conductive platen directly beneath the stylus but insulated therefrom and in electrically operative relation to the back of such record sheet, a stylus energizing circuit including in series the stylus, sheet and platen; means for controlling said circuit in accordance with information to be recorded, means for oscillating the marking end of the stylus at a uniform rate and in a direction transverse to the direction of movement of such record sheet, and current interrupting means in the stylus energizing circuit effective to alternately open and close the circuit at times such as to have the circuit open when the transverse speed of movement of the stylus is below a predetermined value.

7. In an electric recorder; in combination; a fixed frame; means for moving a record sheet, responsive to electrical energy applied thereto to leave a mark on its face, linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of such record sheet; a conductive platen directly beneath the stylus and in electrically operative relation to the back of such record sheet; a stylus energizing circuit including in series the stylus, sheet and platen; means for controlling said circuit in accordance with information to be recorded; means for oscillating the marking end of the stylus in a direction transverse to the direction of movement of such record sheet; clipper contacts included in the stylus energizing circuit and effective to open the circuit of the stylus during a portion of the oscillating movement of the stylus at each end of its oscillations; and current interrupting means in the stylus energizing circuit effective to alternately open and close the circuit.

8. In an electric recorder; in combination; a fixed frame; means for moving a record sheet, responsive to electrical energy applied thereto to leave a mark on its face, linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of such record sheet; a conductive platen directly beneath the stylus and in electrically operative relation to the back of such record; a stylus energizing circuit including in series the stylus, sheet and platen; means for controlling said circuit in accordance with information to be recorded; means for oscillating the marking end of the stylus in a direction transverse to the direction of movement of such record sheet; clipper contacts included in the stylus energizing circuit and effective to open the circuit of the stylus during a portion of the oscillating movement of the stylus at each end of its oscillations; adjusting means for the clipper contacts for varying the extent of the portions of the oscillations during which the circuit is maintained open by these contacts; and current interrupting means in the stylus energizing circuit effective to alternately open and close the circuit.

9. In an electric recorder; in combination; a fixed frame; means for moving a record sheet, responsive to electrical energy applied thereto to leave a mark on its face, linearly at a substantially uniform rate of speed relatively to the frame; an electrically conductive stylus fixed to the frame; a marking end on the stylus and positioned in electrically operative relation to the face of such record sheet; a conductive platen directly beneath the stylus and in electrically operative relation to the back of such record sheet; a stylus energizing circuit including in series the stylus, sheet and platen; means for controlling said circuit in accordance with information to be recorded; means for oscillating the marking end of the stylus in a direction transverse to the direction of movement of such record sheet; clipper contacts included in the stylus energizing circuit and effective to open the circuit during a portion of the oscillating movement of the stylus at each end of its oscillations; adjusting means for the clipper contacts for varying the extent of the portions of the oscillations during which the circuit is maintained open by these contacts; and current interrupting means in the stylus energizing circuit effective to alternately open and close the circuit with the open periods relatively long as compared with the closed periods.

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