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(54) IMPROVEMENTS IN FACSIMILE RECORDING APPARATUS

(71) We, ALDEN RESEARCH FOUNDATION, a Massachusetts business trust organised under the laws of the State of Massachusetts, United States of America of Washington Street, Westboro, Massachusetts, 01581, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates in general to facsimile recording apparatus.

In the art of fascimile recording, a recording web, such as electrolytic paper, is fed between an elongate linear marking across the paper transversely of the direction in which the paper is fed. The scanning electrode moves in a path along a recording zone defined by its own path and the edge of the linear electrode which is parallel to the path of the scanning electrode. As the scanning electrode traverses the paper recording web electrical signals applied between the two electrodes mark graphic information on the web, line by line, similarly as television signals are traced on a cathode ray screen.

One form of scanning electrode is a conductive signal marking stylus carried on a belt which conveys the stylus or two or more styli across the web along the recording zone. Examples of such belt-supported styli are described in United States patent specifications 2,897,129 (M. Alden), 3,363,261 (K. Maiershofer) and 3,369,250 (T.H. Gifft). The scanning belt typically has feed performation or tooth elements interengaging with a driven pulley, roll or spool, which drives the belt in an orbital path and repeatedly conveys the stylus or styli along the scanning zone across the paper as electrical signals representing successive lines of a frame of graphic information are applied between the stylus and linear electrode during consecutive line scans by the stylus.

One requirement of such belt-supported stylus scanning is that the stylus or styli must start each line scan at the same position transversely of the web as each line of electrical signals is applied. If the transverse starting position of the stylus were to change from line to line in a frame some lines would be offset from others thereby distorting the graphic information in the frame or rendering it illegible. This problem of precisely repeating the stylus starting position at the beginning of consecutive line scans is particularly difficult when two or more styli are mounted on the belt as is usually desirable. For example, with two styli on the belt the spacing between the styli must be the same measured forwardly (or rearwardly) from each stylus in order to ensure that a constant speed drive pulley will present each stylus at the same starting position transversely of the recording web at each successive line scan. The correct spacing is not simply a matter of marking measured locations on a belt and positioning the styli at the measured locations. The stylus should be located within a frew thousandths of an inch of exact position, an accuracy not consistently achievable by eye. Moreover, the stylus must be precisely located with respect to the feed perforations, teeth or other feed elements on the belt.

A general object of the present invention is to provide an improved scanning means for fascimile recording apparatus wherein the stylus is located on the belt with improved accuracy.

Scanning means in accordance with the invention comprises a belt having a plurality of equally spaced feed elements between belt ends, and coupling perforations at each end in predetermined spatial relationship to the equal feed element spacing, a signal marking stylus having apertures registerable

with the belt coupling perforations, and means for extending through the stylus apertures and coupling perforations, when registered, thereby to fasten the stylus to the belt and also to joint the belt ends with the feed elements of the joined ends at the aforesaid equal feed element spacing and in predetermined spatial relationship to the stylus.

The coupling perforations in each of the two joined belt ends preferably have the same spatial relationship to the feed elements which may comprise further perforations or protruberances. The fastening means may comprise electrically conductive eyelets or the like.

In one form of scanning means made in accordance with the invention, there are a plurality of identical belt sections and a plurality of joined ends with a stylus at each joint between two ends. Preferably, the coupling perforations in corresponding ends of each belt section are equally spaced from the feed elements and the sum of the distance between coupling perforations and feed elements at one end of each belt section and the distance between coupling perforations and feed elements at the other end of each belt section is equal to the spacing between feed elements.

The invention may be understood more readily and various other features of the invention may become apparent from consideration of the following description.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:-

Figure 1 is a side elevation, partly broken away, of a belted stylus fascimile recording apparatus made in accordance with the invention;

Figure 2 is a section on line 2-2 of Figure 1 showing the stylus belt in elevation;

Figure 3 is a section on line 3-3 of Figure 2;

Figure 4 is a section on line 4-4 of Figure 3;

Figure 5 is a section on line 5-5 of Figure 2;

Figure 6 is a schematic diagram showing electrical circuits in the recorder;

Figure 7 is a plan view showing the geometric relation of plural belt sections;

Figure 8 is an enlarged section on line 8-8 of Figure 3;

Figure 9 is a view like Figure 4 showing an alternative form of belt and feed pulley therefor; and

Figure 10 is a view from line 10-10 of Figure 9.

The facsimile recorder shown in Figure 1 comprises a base 1 with sidewalls 2, of which one is shown, and a cover 3 hinged at 4 to the sidewalls. Within the cover is a bracket 6 which supports a cassette 7 of electrolytic recording paper 8. The paper is drawn from a roll within the cassette by a feed roll 9 and idler roll 11, passing under an elongate, linear marking electrode or blade 12, carried on the cassette as fully described in United States Patent Specification No. 3,875,577 (John M. Alden) which is incorporated herein by reference. As the paper is drawn relatively slowly under the linear electrode 12 it is scanned, line by line, transversely of the direction of paper feed, by styli 13 carried on a belt 14 of insulative material. The assembly, including the bracket 6 which mounts the cassette with its blade 12 and the scanning belt 14 with styli 13, defines an elongate scanning zone between the blade and the path of the styli.

As shown in Figure 2, the belt is orbitted in the direction of the arrow 14* on a path along the top and bottom of a guide rail 17 around a drive pulley 16 and an idler pulley 18. The drive pulley 16 is turned on a shaft 15 coupled through gears 20 to a motor M1. As shown in Figures 3 and 4 the drive pulley 16 is provided with teeth 19 engaging in feed perforations 21 in the belt, although the feed elements can be reversed, as shown in Figures 9 and 10, by providing feed teeth 19* on a modified belt 14* and tooth engaging recesses 21* on a modified drive roll 16*. The guide rail 17 is mounted on the bracket 6 by a bolt 22 and unit 23, but is electrically insulated from the bracket by insulative washers 24, 26 and 27, as shown in Figure 5.

Elelectronic circuits are shown diagrammatically in Figure 6 which control the synchronization of the scanning belt 14 with incoming facsimile signals (FACS. SIGS.) and which apply the graphic portion of the signals through the styli 13 to the electrolytic paper 8. The incoming facsimile signals transmitted to a receiver (RCVR) 31 consists of a synchronization (SYNC) pulse preceding the many lines of graphic signals making up one frame of graphic information. The sync pulse signals the start of the first line of the frame and it is essential for intelligible recording that the recorder scan, that is one stylus 13, begin its first line traverse of the recording paper at the same time as the sync pulse. For this purpose the sync pulse is separated from the graphic information and applied to a framing circuit 32 which controls the speed of the belt drive motor M1 and its phase relative to the sync pulse. The framing circuit 32 also receives a frame pulse generated by the belt styli 13. Whenever a stylus 13 reaches the phantom position of Figure 6 on the drive roll 16 at the end of a line scan (in which case there would be no stylus at the solid line position) the stylus makes contact with a button or like terminal 33. The drive roll 16 is

grounded and the stylus is electrically connected to the drive roll by conductive eyelets 34 described more fully hereinafter. Thus in the phantom position the stylus contact with the button 33 momentarily completes a sub-circuit in the framing circuit and applies a pulse thereto. As is known in the art, the framing circuit compares the relative timing of the sync pulse and framing pulse and adjusts the phase of the belt drive motor M1 until the two pulses are in phase. Preferably several sync pulses and framing pulses are compared prior to transmission of the graphic signals. The graphic signals are then modified and amplified in a marking amplifier 36 and applied line by line through the electrolytic recording paper 8 in a circuit including the linear electrode 12, the paper 8, the stylus 13, eyelets 34 and guide rail 17 to which the marking amplifier is connected. During graphic recording correct phasing of the belt and the incoming facsimile signals may be maintained by a crystal controlled oscillator in the framing circuit 32 which holds the belt drive motor at a standard speed.

Phasing of the belt drive motor M1 and subsequent crystal speed control will insure that the styli begin successive line scans in phase with the incoming graphic line signals only if the feed perforations are equally spaced throughout the length of the belt, each stylus is located in the same relation to the feed perforations, and the styli are equally spaced along the belt. As previously suggested the stylus spacing tolerance is less than one hundredth of an inch and approaches an accuracy of a few, e.g. 1 to 3, thousandths of an inch, an accuracy which can not be consistently obtained by hand and eye.

According to the present invention the above conditions for acceptable stylus phasing are achieved by providing a belt having feed perforations, teeth or equivalent feed elements preformed at equal intervals along one or more belt sections. With the example of Figures 7 and 8 belt coupling perforations 41 are formed in a predetermined spatial relationship to respective feed perforations 21 in two belt sections 14*a* and 14*b* to be joined end to end. The predetermined relation may be expressed concisely as the absolute value of the spacing (A) of the feed perforations (21) less the distance (B) lengthwise of the belt between the coupling perforations (41) and the feed perforations. Preferably the feed perforations 21 and coupling perforation 41 are die-formed together in identical belt sections like 14*a* and 14*b*. The sections are then joined in an endless loop by eyelets, grommets or the like 34 fastened through overlapping ends of the belt sections. The eyelets also pass through apertures 43 in the styli, which apertures register with the coupling apertures 41. Such preforming and fastening of the belt ends and stylus assures that feed perforations will be equally spaced from section to joined section, that the styli at each junction will have the same positional relation to the feed perforations, and most importantly, that the styli will be equally spaced with respect to each other both forwardly and rearwardly of the direction of 14** of belt travel. By the latter qualification it is intended to exclude the case of a three section belt wherein the first of three styli is spaced from the second equally as the second is spaced from the third, but the third is not equally spaced from the first stylus as in the present invention.

WHAT WE CLAIM IS:-

1. In or for facsimile recording apparatus for graphic recording of electric signals on a web fed through a recording zone; means for scanning the zone, said scanning means comprising:

a belt having a plurality of equally spaced feed elements between belt ends, and coupling perforations at each end in predetermined spatial relationship to the equal feed element spacing,

a signal marking stylus having apertures registerable with the belt coupling perforations, and

means for extending through the stylus apertures and coupling perforations when registered, thereby to fasten the stylus to the belt and also to join the belt ends with the feed elements of the joined ends at the aforesaid equal feed element spacing and in predetermined spatial relationship to the stylus.

2. Scanning means according to claim 1, wherein the coupling perforations in each of the two joined belt ends have the same spatial relation to the feed elements.

3. Scanning means according to claim 1 ro 2, wherein the feed elements are perforations.

4. Scanning means according to claim 1 ro 2, wherein the feed elements are protuberances.

5. Scanning means according to any one of claims 1 to 4, wherein the fastening means comprise eyelets.

6. Scanning means according to any one of claims 1 to 5, wherein the fastening means are electrically conductive.

7. Scanning means according to claim 1 and comprising a plurality of identical belt sections and a plurality of joined ends with a stylus at each joint between two ends.

8. Scanning means according to claim 7, wherein the coupling perforations in corresponding ends of each belt section are equally spaced from the feed elements.

9. Scanning means according to claim 8, wherein the sum of the distance between

coupling perforations and feed elements at one end of each belt section and the distance between coupling perforations and feed elements at the other end of each belt section is equal to the spacing between feed elements.

10. Facsimile recording apparatus employing scanning means according to any one of the preceding claims.

11. Facsimile recording apparatus or scanning means therefor substantially as described with reference, to, and as illustrated in the accompanying drawings.

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1570018 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

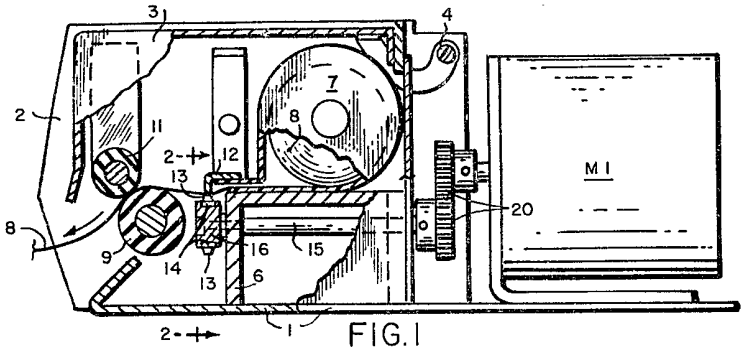

FIG.1

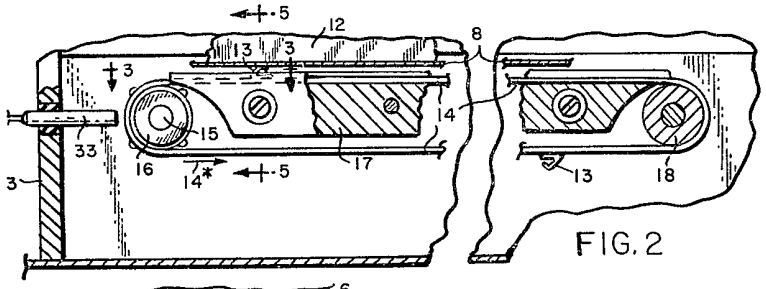

FIG.2

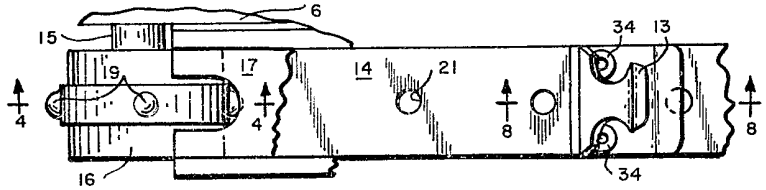

FIG.3

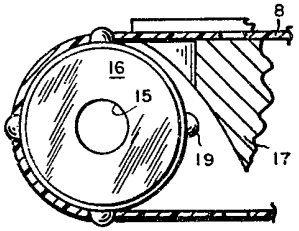

FIG.4

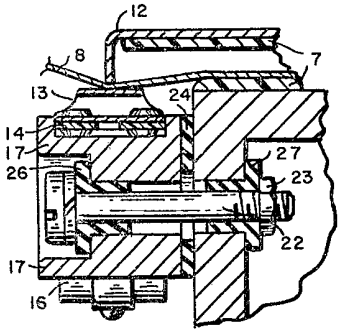

FIG.5

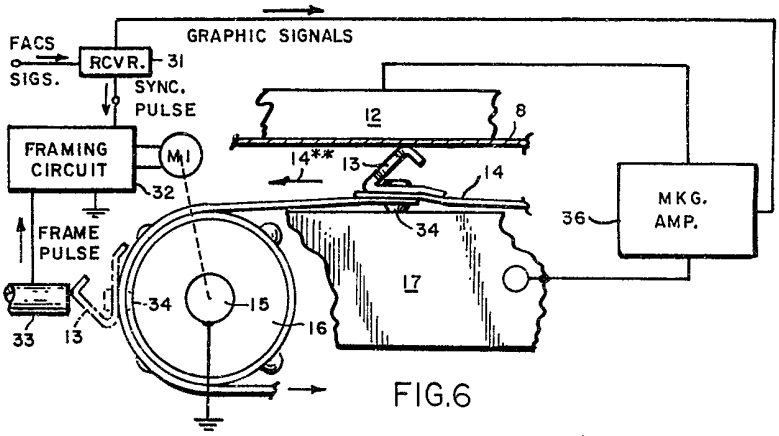

FIG.6

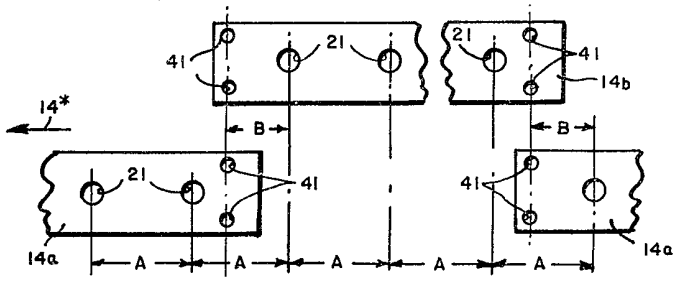

FIG.7

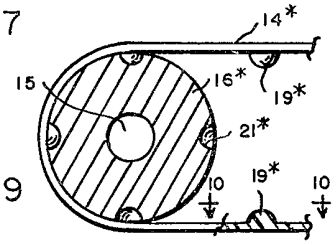

FIG.9

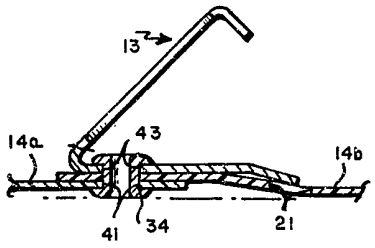

FIG.8

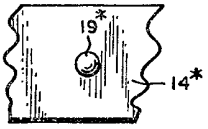

FIG.10