Nov. 13, 1956 D. M. ZABRISKIE 2,770,517

FACSIMILE SCANNING MECHANISM

Filed March 18, 1954

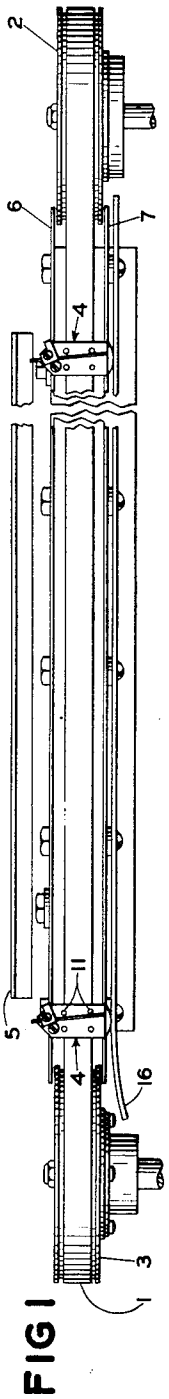

FIG 1

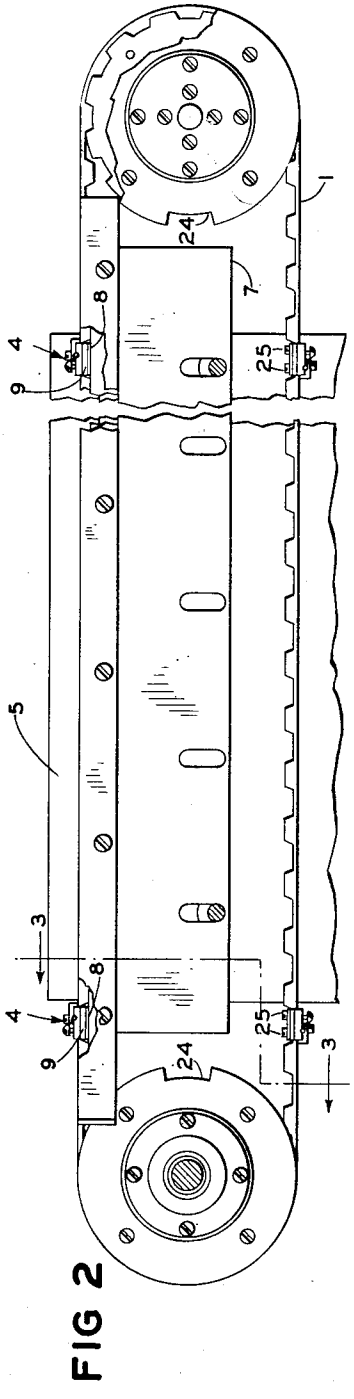

FIG 2

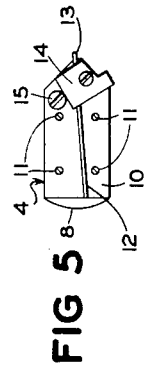

FIG 5

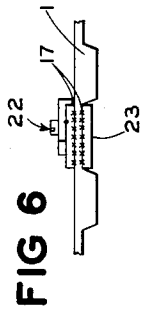

FIG 6

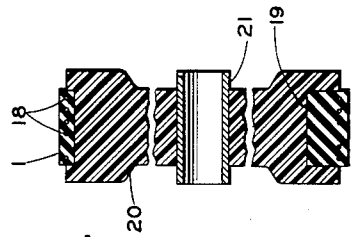

FIG 4

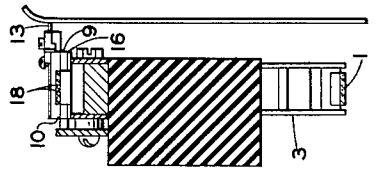

FIG 3

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FACSIMILE SCANNING MECHANISM

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8 Claims. (Cl. 346—74)

This invention relates to an improvement in the construction of facsimile recorders, and more particularly to a novel structure for providing traverse of the recording medium by a stylus which is carried on a belt made of elastic material.

Previously constructed belt type facsimile recorders, such as that of my application Ser. No. 279,261, filed March 29, 1952, have employed a belt made of flat spring steel and rotated between two pulleys for supporting and carrying a plurality of writing styluses across the surface of an electrographic recording paper. The belt in such machines is constructed of a flat spring steel strip bent into a closed curve and welded together at the ends. It is necessary to punch holes at regular intervals throughout the length of the belt for engagement with corresponding cogs formed on the surfaces of the driving and idler pulleys over which the belt is looped. Such cogs and holes are necessary because of the need for precise registration of the styluses carried by the belt, each one of which successively must assume the same writing position upon successive revolutions of the driving pulley, within a few thousandths of an inch, in order to produce a facsimile recording having satisfactory definition. It is therefore obvious that great care must be employed to make a belt of precisely correct length which is an integral multiple of the circumference of the driving wheel, to locate and punch the driving holes in the belt at the exact spacing of the driving cogs, and to apply the styluses to the belt in their correct relative positions.

One of the major disadvantages of such spring steel belts which is encountered in their use is that they are subject to failure by breakage as a result of metal fatigue after a limited number of operations. Since the cost of the belts is relatively high due to the care required in their construction as previously described, replacement of broken belts constitutes an important item of service expense on such machines. In addition to the expense involved, the fact is that a machine becomes inoperative as soon as a belt is broken and, in the case where the machine is in use by a business or commercial enterprise employing no technical personnel, must be repaired by a service man after he has been summoned for the purpose. Loss of time and impaired reliability of the equipment are thus entailed.

By means of the present invention, these difficulties are avoided through the provision of a flexible rubber-like belt which nevertheless has great dimensional stability in the longitudinal direction, and by means of which the styluses are held in accurately spaced positions. Cogs are provided on the interior surface of the belt to engage mating recesses in the surface of the pulleys over which the belt travels, in order that it may not creep, and thereby change its relative position upon successive revolutions of the pulleys. Due to the non-conducting properties of the rubber belt, a simplification and improvement in the structure of the driving pulleys is achieved, in a manner later to be explained.

By the use of a belt constructed of a rubber-like material, such as rubber, or neoprene, which is a well known proprietary brand of so-called "synthetic rubber," or of other similar artificial rubber materials, the flexibility of such compound is retained as a property of the belt, while fatigue failure is eliminated, since these materials are not subject to fatigue from repeated flexing.

In order to ensure dimensional stability of the belt in the longitudinal direction sufficient to provide the desired resolution, and to prevent the gradual stretching of the belt with age, which is a characteristic of such belts, it is constructed with pull cords in the neutral axis composed of fine steel wires instead of the usual organic fiber cords. These wires are of relatively small diameter, and are therefore able to bend over the curvature of the circumference of the pulleys with no appreciable fatigue effect on their structure being imposed. They are sufficiently numerous, however, to provide adequate longitudinal rigidity to the belt, and by reason of their small diameter, they do not impair the transverse flexibility of the belt.

It is therefore an object of the present invention to provide a system of belt type stylus scanning for a facsimile machine, wherein the durability of the belt is greatly increased.

A further object of this invention is to provide a means for retaining accurate stylus registration in a belt type scanner for facsimile machines while employing a belt constructed principally of long-life rubber-like materials.

Still another object of the present invention is to effect a simplification in the construction of facsimile scanner-belt pulleys.

Further objects and advantages of the present invention will become apparent from a consideration of the accompanying description, taken in conjunction with the drawings, wherein:

Fig. 1 is a plan view of a stylus traversing belt and pulley system constructed in accordance with the present invention;

Fig. 2 is an elevation view of the mechanism of Fig. 1;

Fig. 3 is a sectional view of Fig. 1;

Fig. 4 is a sectional view of a different embodiment of Fig. 3;

Fig. 5 is an enlarged plan of a portion of Fig. 1; and

Fig. 6 depicts an alternative mode of attachment of a stylus assembly to a flexible belt.

Referring now to Fig. 1, it is seen that a belt **1** is stretched between a driving pulley **2** and an idler pulley **3** such that the stylus holders **4** are drawn across the electrographic recording paper **5** in approximately linear fashion when the driving pulley **2** is rotated by a motor and gear reducing mechanism which is not shown on the drawing. Notches **24** in the pulleys accommodate the stylus holders in their passage around the pulleys. In order to ensure that the travel of the stylus holders is accurately linear, it is desirable that a guiding means be introduced against which the stylus holder may slide while in motion across the recording sheet. It has been found that a system of stylus guidance well suited for the instant application consists of a long trough-shaped magnetic assembly having a U-shaped cross-section, mounted below the stylus guide for attracting it into sliding contact therewith. Such an arrangement is shown in my copending application Ser. No. 357,731, filed May 27, 1953, the parts whereof are here represented by the magnetic guide rails **6** and **7**. The sliding action of the stylus holders along the magnetic guide rails further requires that a suitably wear-resistant material be used in the construction of the stylus holder, and it has been found that the wear plates **8** which are secured to the inner member **9** of the stylus holders **4** by the screws **25** can be made of tempered spring steel. The wear plates **8** are therefore replaceable as required for the instant invention since the belt outlasts the wear plate, a condition formerly not encountered.

The stylus holders 4, as seen in Figs. 2 and 5, comprise a recessed upper plate of steel 10 having a guideway 12 cut in its top surface to receive a stylus wire of tungsten metal 13, a screw-fastened tab 14 overlying the guideway. Four holddown screws 11 engage an inner plate 9 to clamp the belt between the plates, and an adjusting screw 15 operates to spring the wear plate 8 downward for stylus height adjustment. Screw 15 is preferably soldered in place after being adjusted to produce the correct stylus height when the belt assembly is in use. It will be observed that the entire assembly with the exception of the stylus itself is constructed of magnetic material so that it is readily attracted by the aforementioned magnetic rails 6 and 7 into guiding contact therewith.

Since a belt constructed of non-conducting material is employed in the instant embodiment of this invention, it is necessary that electrical contact be established to each stylus during the time that it engages the recording medium. In addition to this, the lateral flexibility of the belt makes it necessary that support sufficient to provide constant writing pressure to the stylus be supplied. Both of these requirements are fulfilled by the metal contact bar 16 in Fig. 1, which is secured in a fixed position such that the wear plate 8 of the stylus holder 4 bears against it during travel of the said stylus holder across the record medium. The necessity for such an arrangement as that here given lies in the use of a belt constructed of non-conducting material, and in the use of a relatively wide record sheet. In the case of a narrow record sheet, such as a ticket, it is possible to use other advantageous arrangements, for example, a belt constructed of a flexible conductive material such as conductive rubber, in which case the bar 16 is not required for guiding purposes, and electrical connection to the styluses can be made by other appropriate means, such as by brushes contacting a conductive belt pulley.

In another embodiment of the stylus holder previously described, the construction shown in Fig. 6 is employed. In this arrangement the stylus holder 22, instead of being bolted to the belt 1, is secured to it by means of cement 17. This is advantageous in providing a construction which is lighter and less bulky so that its centrifugal force on a rapidly moving belt is less, and in rendering it impossible for the stylus holder to creep or slip on the belt. A suitable wear plate 23 is cemented to the inner side of the belt beneath each such stylus holder for the purposes and in the location previously described. In employing this method of assembly, in order to obtain a cemented joint of high tensile strength, it is desirable to use a heat vulcanizable type of cement, and to plate or otherwise coat with brass the metal parts to which the cement is intended to adhere.

Fig. 3 shows a cross-section of the belt 1 in which may be seen the metallic pull cords 18 located approximately at the neutral axis of the belt and embedded in and bonded to the elastomeric material comprising the body of the belt, and the pulley 3 over which the belt turns. The features of the construction of this pulley which apply also to the pulley 2, and which render it especially advantageous and one of the important advantages made possible by this invention are seen more clearly in the cross-sectional view of a different embodiment thereof shown in Fig. 4. Because of the large size and outwardly convex contour of the recesses 19 in the pulley 20, unit stress in the material is relatively low and the shape is moldable. Moreover, the yielding nature of the material of the belt 1 renders it non-cutting and non-abrasive to the pulley. As a consequence of this, it is possible and economically desirable to mold the pulleys of a suitable plastic material in permanent molds on automatic machinery. By thus obviating the use of conical metal cogs on the said pulleys, it is made unnecessary to use the metal pulley body otherwise required to support them, and the insulation of the metal pulley from its hub is avoided as would otherwise be required by the fact that the stylus assembly is necessarily operated at a different electrical potential from that of the frame. A suitable metal bearing bushing 21 is cast in place at the time the pulley is molded.

An advantage of the particular construction of stylus carrying belt here described is the longitudinal stability of its parts, since by the use of a steel wire core in the neutral axis of the belt, longitudinal creep or anomalous displacement of the stylus holders, which is evidenced by loss of detail in the facsimile reproduction, is avoided to the extent that results are obtained which are in all respects equivalent in quality to those obtained with a steel belt.

A further and principal advantage obtained by the use of this invention is the extension of the life of the stylus carrying belt by a factor of at least 30 under conditions of intensive use requiring frequent starting and stopping. Such a gain would constitute an important advantage even if accompanied by some degradation of the fascimile reproduction, and it is therefore obvious that preservation of full detail under this condition, as previously described constitutes an independent and additional advantage of the invention.

Although the invention has been described in terms of a specific embodiment thereof, it is to be understood that various modifications and elaborations thereof can be effected without departing from the spirit of the inventive concept involved. It is therefore intended that the invention shall be limited only by the terms specifically set forth in the appended claims.

What is claimed is:

1. In a facsimile recorder of the kind employing electric writing on a sheet of electrosensitive paper, in combination, a belt of flexible organic material, metallic tension strands embedded longitudinally in the interior thereof, cogs formed on the inner surface thereof, a pair of belt carrying pulleys constructed of readily moldable material and having recesses in the faces thereof, metallic hubs in the said pulleys, a plurality of stylus carrying stylus holders affixed to the said belt, styluses in the said holders, means for guiding the said stylus holders in a linear track, a conductive bar fixed adjacent the path of travel of said stylus holders in sliding contact therewith, and a sheet of electrographic paper advanceably retained in the path of travel of said styluses.

2. In a facsimile recorder of the kind employing electric writing on a sheet of electrosensitive paper, in combination, a belt of flexible elastomeric material, metallic tension strands embedded longitudinally in the interior thereof, cogs formed on the inner surface thereof, a pair of belt carrying pulleys constructed of insulating material and having recesses in the faces thereof, metallic hubs in the said pulleys, a plurality of stylus carrying stylus holders affixed to the said belt, styluses in the said holders, means for guiding the said stylus holders in a linear track in the plane of the pulleys, an electrically conductive bar fixed adjacent the path of travel of said stylus holders in sliding contact therewith, and a sheet of electrographic paper advanceable in its own plane, retained in the path of travel of said styluses.

3. In a facsimile recorder of the kind employing electric writing on a sheet of electrosensitive paper, in combination, an endless belt of flexible rubber, steel tension strands embedded longitudinally in the interior thereof, cogs formed on the inner surface of said belt, a pair of belt carrying pulleys on fixed centers constructed of plastic insulating material and having cog receiving and stylus holder receiving recesses in the faces thereof, metallic hubs in the said pulleys, a plurality of vertically adjustable stylus carrying stylus holders affixed to the said belt, styluses in the said holders, means for guiding the said stylus holders in a linear track in the plane of the pulleys, a conductive bar having a flat face, fixed adjacent the path of travel of said stylus holders for guiding and sliding contact thereon, and a sheet of electrographic

paper advanceable in its own plane, resiliently retained in the path of travel of said styluses.

4. In a facsimile recorder of the kind employing electric writing on a continuous sheet of electrosensitive paper, in combination, a belt of flexible and elastic polymeric material, longitudinal inextensible strands embedded in the interior thereof, cogs formed on the inner surface thereof, a plurality of pulleys having cog receiving recesses in the faces thereof, rotatable about fixed axes, engaging and driving the said belt in a predetermined path having a portion linear in at least one projection thereof, means for driving at least one of the said pulleys, a plurality of stylus carrying stylus holders affixed to the said belt, styluses in the said holders, electrically conductive means to energize the said styluses, and a sheet of electrographic paper advanceably retained in the path of travel of the writing ends of the said styluses.

5. In a facsimile recorder of the kind employing electric writing on a continuous sheet of electrosensitive paper, in combination, a belt of flexible and elastic polymeric material, longitudinal inextensible strands embedded in the interior thereof, cogs formed on the inner surface thereof, a plurality of molded plastic pulleys having cog receiving recesses in the faces thereof, rotatable about fixed axes, engaging and driving the said belt in a predetermined path having a portion linear in at least one projection thereof, means for driving at least one of the said pulleys, a plurality of stylus carrying stylus holders affixed to the said belt, styluses in the said holders, an electrically conductive trolley fixed adjacent to the path of stylus travel for sliding contact therewith to energize the said styluses, and a sheet of electrographic paper advanceably retained in the path of travel of said styluses.

6. Facsimile scanning means comprising a flexible belt of elastic material, a filamentary reinforcement of inelastic strands therein, a plurality of driving teeth molded in spaced sequence on the interior surface thereof, at least one stylus holder means immovably affixed thereto,

writing stylus means affixed to the said stylus holder means, a plurality of belt carrying pulleys including a belt driving pulley, having belt driving tooth receiving recesses in the perimeter thereof, the said belt carrying pulleys being rotatable on axes fixed during operation and defining a path of stylus travel having a linear portion therein, electrically conductive stylus energizing means, and a sheet of electrographic paper advanceably retained in the path of travel of said styluses.

7. Facsimile scanning means comprising a flexible belt of neoprene, multiple filamentary reinforcement of steel strands therein, a plurality of driving teeth molded in spaced sequence on the interior surface thereof, at least one stylus holder means immovably affixed thereto, writing stylus means affixed to the said stylus holder means, a plurality of belt carrying pulleys including a belt driving pulley of moldable organic material having belt driving, tooth receiving recesses in the perimeter thereof, the said belt carrying pulleys being rotatable on fixed axes and defining a path of stylus travel having a linear portion therein, a sheet of electrographic paper retained for advancement in contact with the said styluses, electrically conductive stylus energizing means, comprising a fixed member having a straight portion for sliding contact on the said stylus holder means whereby the styluses are pressed into paper contact and a straight edged guideway disposed parallel to the path of stylus travel for stylus holder height control by magnetic attraction thereof into sliding guided contact.

8. The invention of claim 7 wherein the said at least one stylus holder means is adhesively affixed to the said belt.

References Cited in the file of this patent

UNITED STATES PATENTS

2,129,483	Van Deventer	Sept. 6, 1938
2,133,181	Allen	Oct. 11, 1938
2,355,369	Finch	Aug. 8, 1944
2,643,173	Cooley	June 23, 1953