April 8, 1969 T. T. HIGHLEY, JR 3,438,059

NON-CLOGGING PENPOINT FOR RECORDING SYSTEMS

Filed Oct. 18, 1967

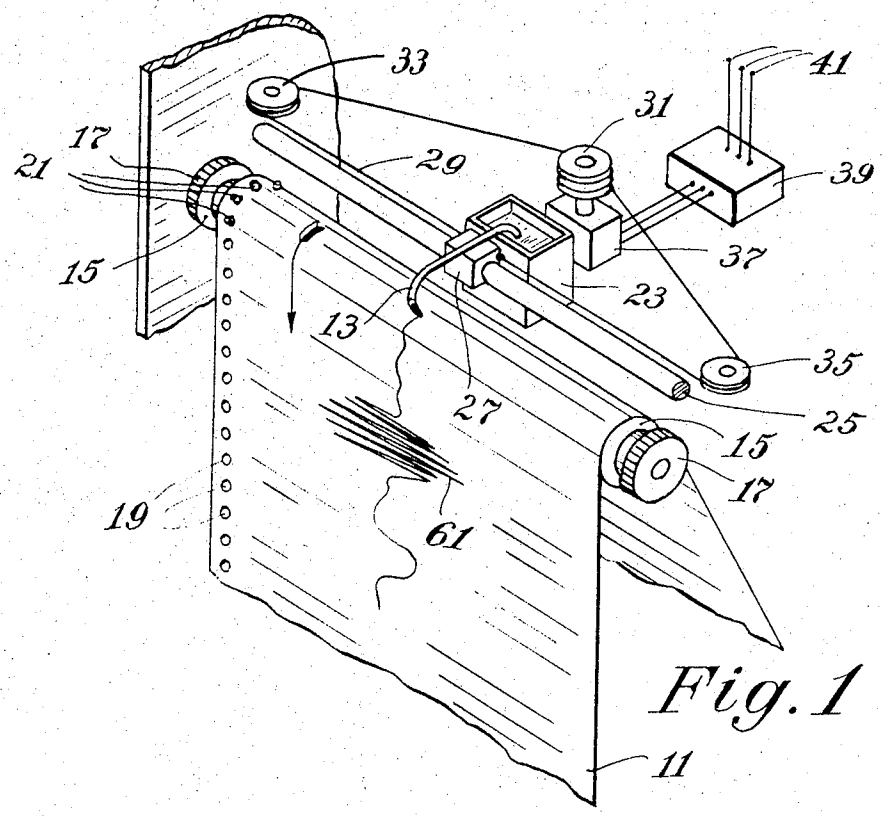

Fig. 1

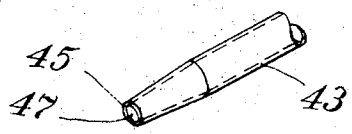

Fig. 2

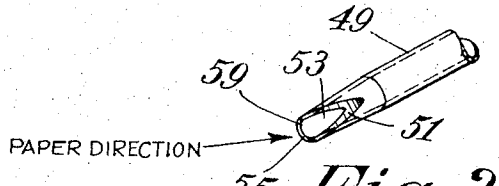

Fig. 3

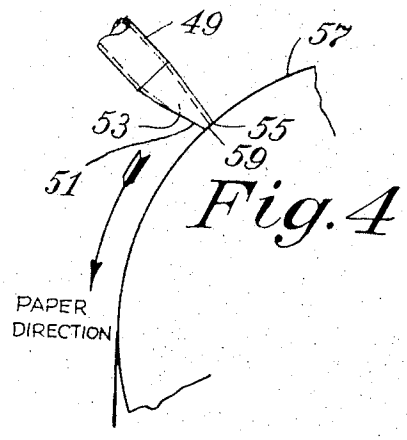

Fig. 4

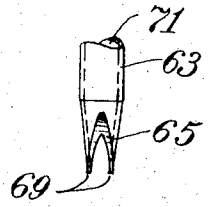

Fig. 5a

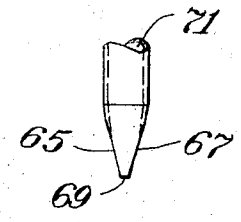

Fig. 5b

United States Patent Office 3,438,059 Patented Apr. 8, 1969

3,438,059

NON-CLOGGING PENPOINT FOR RECORDING SYSTEMS

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Filed Oct. 18, 1967, Ser. No. 676,144
Int. Cl. G01d 15/16, 15/18
U.S. Cl. 346—140 2 Claims

ABSTRACT OF THE DISCLOSURE

A non-clogging penpoint for an ink recording system is provided by reason of the end of a capillary tube having a large part of its area removed from the end through which ink is supplied. The single or double ended taper of the capillary tube provides a discharge path through its side for foreign material including paper fiber loosened during movement of the penpoint in one direction across the paper as soon as the direction of movement is reversed. Width control of the line is afforded by the selected orientation of the wedge-shaped end relative to the recording paper.

Background of the invention

This invention relates generally to capillary penpoints and more specifically to non-clogging penpoints for use in chart recorders.

Chart recorders have been in use for many years. Generally, a recorder of this class provides for relative movement between a pen and chart paper in response to an external condition being measured. As an example, it may be desired to make a record of temperature over a period of time where an electrical signal proportional to temperature is applied to the recorder.

Three types of recorders enjoy the greatest popularity. One type utilizes a roll or strip of chart paper which is moved past an ink pen fluctuating in response to the external condition signal in a direction transverse to that of the paper movement. A second type of recorder utilizes a round chart which is rotated at a constant speed past a pen which fluctuates according to the changes sensed in the external condition being measured. A third type provides for moving the pen along either of the two coordinate axes according to two independent external signals and finds its greatest utility in laboratory research work.

In these types of recorders, a capillary tube ink pen is generally utilized to mark the chart paper with the desired information. The pen is a vital part of any recorder since its malfunction causes a loss of record.

Such pens have frequently been found to clog with foreign material after a period of operation. This will cause a loss of information to the user of the recorder. Since many recorders are operated in areas not constantly supervised, a large amount of valuable information may be lost before the malfunction is discovered and the pen cleaned. Even when the clogging may be discovered immediately, the necessity for cleaning the pen is a time-consuming, bothersome and messy job. Therefore, it is a primary object of this invention to provide a non-clogging capillary tube penpoint.

It is also desired at times to provide a penpoint which may be adjusted for line width control or to provide for a different line width in one direction of pen movement than in other directions. Therefore, it is a further object of this invention to provide a penpoint that may be used for various line widths resulting in improved resolution of the record.

Summary of the invention

These and other objects are accomplished by a novel penpoint that provides a path for discharge of any loosened paper fibers when the pen changes direction relative to paper. Furthermore, a trailing scrapping edge found on conventional penpoints is eliminated to prevent the loosening of paper fibers. These two improvements prevent pen clogging due to paper fibers and other foreign material working far into the capillary tube and blocking the normal flow of ink.

By cutting away an edge of a conventional capillary tube penpoint, line width control is made possible. The resulting penpoint may be shaped to draw a line of smaller width in one direction than its normal line width which the pen will still draw in another direction. The present invention does not require an additional tip as required in some prior art arrangements.

While the invention is distinctly pointed out in the appended claims, the preferred embodiments of the invention together with further objects and advantages thereof may best be understood with reference to the following description and accompanying drawings.

Brief description of the drawings

FIG. 1 shows the essential elements of a chart recorder which may utilize the improved penpoint of this invention in a preferred embodiment;

FIG. 2 shows a typical prior art capillary tube penpoint;

FIG. 3 is an enlarged view of an embodiment of the present invention;

FIG. 4 shows one possible orientation of the penpoint of FIG. 3 relative to a chart paper;

FIG. *5a* shows another embodiment of the present invention; and

FIG. *5b* is a side view of FIG. *5a*.

Description of the preferred embodiments

To specifically describe the invention, the improved penpoint is shown as part of a strip chart recorder but it is understood that the penpoint will also operate to advantage in a variety of mechanisms. Referring to FIG. 1, a strip chart **11** upon which the information is to be recorded is driven past a capillary ink pen **13** by a typical roller **15** which is driven through its gears **17** from some suitable motor source (not shown). The chart **11** has holes **19** along one edge for positive engagement with the pins **21** which are attached to the roller **15**. The pen **13** is moved in a direction transverse to that of the advance of the paper **11** by sliding it and its ink supply reservoir **23** along a rod **25** by means of support block **27**. A continuous cable **29** is driven by a drive pulley **31**, guided by the pulleys **33** and **35** and attached to the block **27** for moving same relative to the rod **25**. A motor and position sensing mechanism **37** provides motor source to a drive pulley **31** and operates in response to a measuring circuit **39**. An E.M.F. proportional to the condition being measured is connected to the terminals **41** of the measuring circuit **39**. The application of a signal at the terminals **41** causes the pen **13** to travel along rod **25** according to the magnitude of the signal.

When ink is discharged from a pen onto ordinary chart paper and portions of the previous mark are retraced, fibers in the paper are caused to rise under the influence of the wetness. Referring to FIG. 2, a conventional capillary tube penpoint **43** is shown in enlargement. End surface **45** contacts the chart paper and moves relative thereto with ink being discharged from capillary bore **47**. The capillary bore **47** is reduced in diameter at the penpoint by tapering the tube **43**, resulting in a line drawn which is reduced in width. As the pen **43** moves

relative to a paper, ink is discharged from the forward portion of capillary bore **47** causing paper fibers to rise and to then be sheared by the trailing edge of capillary bore **47**. The loosened paper fibers are then entrapped within capillary bore **47** and cannot escape regardless of subsequent movements of the pen **43**. As more and more of these paper fibers are sheared, they push up into capillary bore **47**, restricting ink flow and making the pen inoperable. When this happens, signal information fed to the instrument is not recorded until an operator manually cleans capillary bore **47**.

An embodiment of the preferred penpoint of this invention is shown in FIG. 3, wherein capillary tube **49** has a portion of the tube wall removed from its end to form surface **51** and provide an opening in the side of the tube from capillary bore **53**. Enough of the wall is removed to leave an end surface **55** for contact with the chart paper that is a circular segment in cross-section and is about one-half the original circumference of the end of the tube. With this configuration, if any foreign material such as sheared paper fibers come within capillary bore **53**, they will be discharged through the side wall opening of this bore upon movement of the pen **49** in a direction other than that in which the foreign material was collected. It has been found that removal of approximately one-half the internal circumferential edge of the capillary bore **47** of the tube **43** to leave the internal edge **59** provides an adequate discharge path without sacrificing proper capillary action of the penpoint. It is to be understood that the removed portion of the side wall of the capillary tube may have a different configuration than the wedge-like shape illustrated and still have a non-clogging characteristic, the important requirement being that a discharge path be provided in the side wall of the capillary tube penpoint.

The improved penpoint of FIG. 3 is shown in FIG. 4 in its preferred embodiment relative to movement of the paper with which it is in contact to reduce the shearing action of the penpoint as much as possible. Paper **57** is shown to move against penpoint **49** in a manner to avoid the shearing action of the only internal edge **59** of capillary bore **53** which contacts the paper **57**. This preferred paper direction is also shown by an arrow in FIG. 3, where it is more clearly illustrated that the cutting edge of capillary bore **53**, which is responsible for shearing wettened paper fibers characteristic of the prior art penpoint of FIG. 2, has been cut away. Therefore, the source of accumulation of foreign material responsible for pen clogging is significantly reduced. When the pen **49** of FIG. 3 moves in a direction transverse to the direction of paper movement, as it will in the embodiment of FIG. 1 in response to an external signal, there may be some shearing action by the edge **59** of capillary bore **53**, but any fibers so sheared will be discharged through the side opening of pen **49**, being carried by a fresh flow of ink through the opening of capillary bore **53** whenever penpoint **49** is reversed in direction.

It should be understood that the orientation of the improved penpoint relative to paper as hereinabove described is a preferred embodiment of the invention when utilized in a chart recorder. Any orientation of the improved penpoint relative to its movement on a chart paper will still provide a self-cleansing action through the side opening of capillary bore **53** whenever the pen point **49** changes direction with respect to the paper in a significant way. In some applications it may be desired to control the line width drawn by pen **49** which can be done simply by rotating the pen around its own axis. Referring to the orientation of FIG. 3, the line drawn in the direction of paper movement will be the widest, while the line drawn in a direction transverse to that shown for paper movement will be the narrowest that the penpoint can produce.

In a period where high signal activity is being recorded, the penpoint **13** of FIG. 1 will oscillate rapidly.

When the speed of paper **11** is slow, as is frequently the case in order to get a large amount of information on a small amount of chart paper, such a period of high activity will cause a great deal of ink to be discharged onto the paper **11**, as shown by the heavy line density **61**. When the improved penpoint of this invention is utilized and oriented in the preferred direction as hereinabove described with reference to FIG. 4, the line drawn in a direction transverse to that of the paper motion in response to a signal will be much narrower than is possible with prior art pens. As a result, less ink will be discharged onto the paper in a period of high activity, which has the advantage of reducing the number of fibers which will be raised due to the ink wetness and will also result in a neater chart.

FIGS. *5a* and *5b* show another embodiment of the present invention which has the same self-cleaning characteristics as the above-described embodiment, presents still less cutting edge to shear loosened paper fibers, and further presents a narrower line when moved in one direction relative to a paper while still allowing the drawing of a full width line in a direction transverse thereto. The capillary tube **63** is tapered on opposite sides to form surfaces **65** and **67**, resulting in a small area **69** of the penpoint which contacts paper. The narrower width of the surface **69** will further improve the resolution where signal lines are very close together as shown in the area **61** of FIG. 1.

By so shaping the capillary tube **63**, most of the internal edge of the capillary bore **71** is removed, thus removing much of the edge responsible for shearing raised paper fibers. To minimize the shearing action of this penpoint, as much of the paper-contacting internal edge of the capillary bore **71** should be removed as is possible without sacrifice of proper capillary action by the bore.

Although the preferred embodiments of the present invention have been described as having a capillary bore of circular cross-section, a bore of another shape may be utilized so long as proper capillary action is maintained.

What is claimed is:

1. In a chart recorder having a mechanism for advancing paper past an ink pen and further having a mechanism for moving said pen in a direction approximately transverse to the direction of said paper advance in response to a condition being measured, said pen comprising an elongated tubular member having a capillary bore of circular cross-section at the discharge end thereof, said discharge end having only one surface defining a circular segment in cross-section contacting said paper for discharge of ink thereon, and said circular segment being oriented to be the leading edge of said pen relative to the movement of said paper.

2. A graph recorder having a mechanism for advancing paper past an ink pen, said pen comprising,

an elongated member having a capillary bore of circular cross-section and having one end thereof contacting said paper,

the paper contacting end of said elongated member being tapered to present less than one-half the circumference of said capillary bore for contact with said paper,

the circumferential section of said capillary bore being oriented to be the leading edge of said pen relative to the movement of said paper.

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