

Feb. 4, 1964

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3,120,214

INK RESERVOIR FOR RECORDING APPARATUS

Filed March 8, 1962

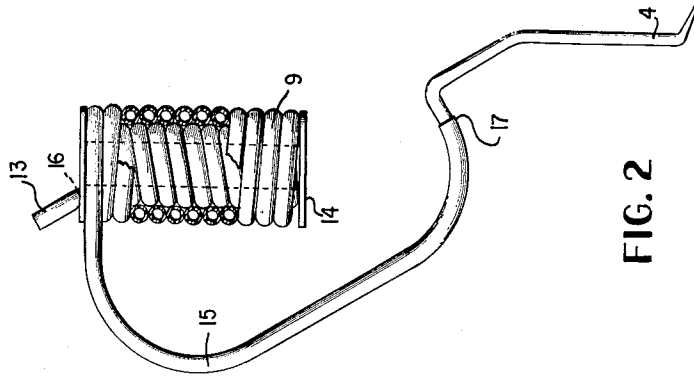


FIG. 2

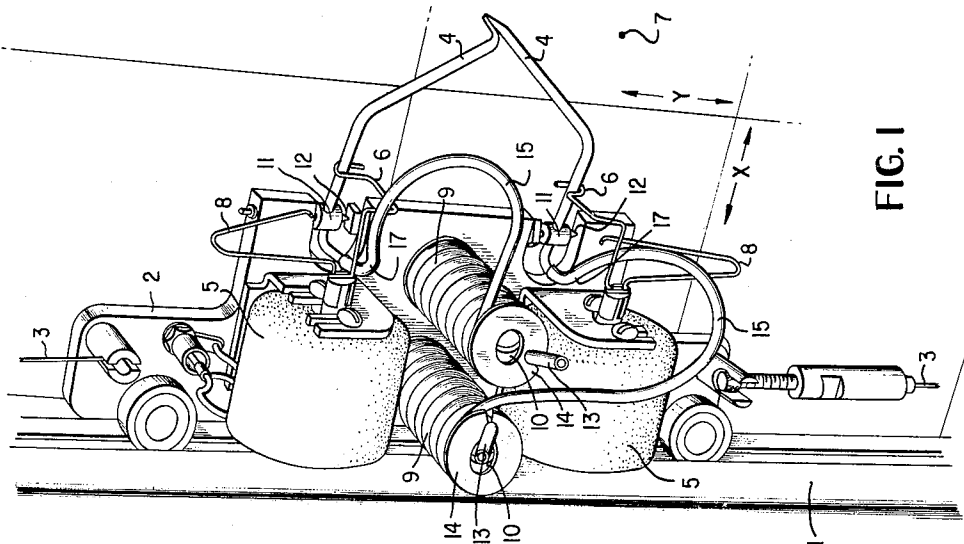


FIG. 1

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INK RESERVOIR AND RECORDING APPARATUS
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 Filed Mar. 8, 1962, Ser. No. 178,450
 5 Claims. (Cl. 120—42.06)

This invention relates to marking systems for recording instruments and, more particularly, to an ink reservoir for "X—Y" recorders where the ink reservoir is mounted on a moving pen carriage.

In recording instruments of the "X—Y" type where the record sheet remains stationary and the marking pen assembly moves, the inking system is subjected to a combination of acceleration forces along two axes. These forces, when motion is rapid, create several undesirable effects on existing inking systems resulting in ink dripping from the pen tips, ink sloshing out of vent and filler holes in ink reservoirs, loss of feed to pen due to air bubbles resulting from ink sloshing, loss of feed to pen due to acceleration forces drawing ink out of pen tips, obliteration of records from dripping or spilling, and other interrelated effects.

Most existing ink reservoir designs present a large area of ink exposed to the atmosphere, with consequent evaporation and thickening of the remaining ink which may prevent continuous flow of ink to the pen tip. Existing reservoirs are subject to variations in the pressure head as the reservoir level changes, often resulting in syphon action.

It is, therefore, an object of this invention to provide an inking system which, when subjected to acceleration forces, does not drip ink from the pen tip.

It is another object of this invention to prevent spilling and loss of ink supply.

A further object of this invention is to prevent air bubbles from forming in the supply line to the pen and consequent interruption of the ink flow.

Still another object of this invention is to minimize exposure of ink to the atmosphere to avoid thickening by evaporation.

A still further object of this invention is to provide a constant ink flow as the ink supply is used.

These and other objects and advantages will become more apparent from the following description when taken with the accompanying drawings, wherein like reference characters denote like parts in the several views.

FIG. 1 is an isometric view showing a typical two pen carriage mounted on a vertical arm with ink reservoirs in accordance with this invention.

FIG. 2 is an isometric view somewhat enlarged of an ink reservoir in accordance with this invention.

Referring now to FIG. 1, a portion of a plotting arm 1 is shown with a pen carriage assembly 2 mounted thereon. The arm 1 is driven in the "X" direction by means of a cable drive (not shown) which in turn is connected to a servo drive system (not shown). The pen carriage 2 is driven in the "Y" direction by means of a cable drive 3 which is attached to a pen carriage drive drum (not shown) which in turn is connected to a servo drive system (not shown), but each in accordance with well known arrangements. The combined use of these drive systems allows movement of the pen carriage 2 in any variable of X—Y desired.

To actuate a pen 4 from a non-writing to a writing condition, its associated solenoid coil 5 is energized which causes an actuator 6 to urge a pen 4 into contact with the writing surface 7. When solenoid coil 5 is de-energized, return spring portion 8 of actuator 6 lifts pen 4 clear of writing surface 7.

Ink reservoirs 9 are mounted on split posts 10 which

exert sufficient pressure on the inside bore of reservoir bobbin 14 to hold it firmly but removably in place so that reservoir 9 may be readily slipped off the post 10 when desired. Each pen 4 is mounted by means of a pivot piece 11 in a spring loaded jewel bearing 12 which permits ready removal of the pen when required.

In FIG. 1, the ink supply for a pen 4 is held in an associated reservoir 9 which consists of a length of flexible tubing 15, preferably of clear or translucent plastic, wound in a helical fashion over a suitable bobbin 14 and there secured. The length of tubing 15 which is wound on the bobbin 14 determines the writing capacity of each pen 4. In the reservoir shown, two helically wound layers of plastic tubing have been placed on a bobbin 14. If greater capacity is required, a longer length of tube may be used by winding more layers or using a longer bobbin.

One end of tubing 15 is led off the bobbin and slipped over the outside of pen 4 and the other end of the tubing 15 protrudes from the end of the bobbin and serves as a vent 13. Any ink surface exposed to the atmosphere is therefore never greater than the inside cross section of the tube. This essentially eliminates the loss of ink by evaporation, and the thickening or contamination of the ink. By using a thin tube as the reservoir, sloshing of the ink is eliminated, and no air bubbles can be introduced into the ink feed system. Ink leakage will not occur at vent 13 or pen 4 because of the capillary action in a thin tube which may be of $\frac{1}{16}$ inch outer diameter or less. The bore of the pen 4 is smaller than the bore of the tubing 15, to provide greater capillary attraction at pen 4 than at the open end of the tube at 13, the diameter at the writing surface being preferably further reduced to assure continuous feed.

The ink is delivered to a pen 4 at a constant head until the ink leaves the last coil of the reservoir 9, since it must follow a helical path, and the head is determined by the highest point of the helix on the bobbin 14 until the ink leaves the last helical position. The use of a tube-type reservoir 9 is effective to stop dripping of ink at the pen 4 tip because of the predominance of the forces of capillary attraction in the tube 15 over other forces, occasioned by acceleration in any direction, or variations of head or liquid level, such as are normally experienced in open well arrangements. This arrangement effectively produces a constant feed because of the capillary action and nearly constant head in this tube-type reservoir.

Reservoir 9 may therefore be variously positioned relative to the pen tip without undue attention to gravity feed limitations, since it will operate either above or below the pen level in contrast to a standard single gravity type reservoir, in which the head must be set higher than the pen so as to insure sufficient head as the ink level lowers in the reservoir. A syphon action frequently occurs in such a standard arrangement, and results in a dripping of the pen which generally lasts until the reservoir is about three-fourths empty, when the dripping at the pen tip diminishes or stops. This problem is overcome as herein disclosed. A capillary surface at the vent end of the ink supply and a smaller one at the pen end of the tube results in a differential of capillary forces between the two ends because of the different exposed cross sections. At the pen end as the ink begins to emerge from the pen opening this force undergoes a reversal of direction before a substantial drop of ink can form at the pen even though the reservoir may be elevated. Thus, no substantial droplet of ink forms at the pen even under lateral accelerations which may tend to force ink along the tube at times.

Referring now to FIG. 2, a tube-type reservoir 9 is shown as comprising a tube 15 which is placed first in a hole or slot 16 in the end of bobbin 14; is then wound in a helical manner to the other end of bobbin 14, where

the lay of the helix is reversed and a second layer of tubing 15 is wound to the end of bobbin 14 where the winding started, and there secured by means such as solvent or cement. This bobbin 14 may be mounted on post 19 either end up, so as to control to some measure the head at the outlet end of the helix, thereby lessening the need for leveling the recorder. Because of the capillary force balance above-mentioned the recorder thus need not be placed in upright position. It is also to be understood that posts 10 may be arranged vertically or horizontally, or alternative posts may be provided for differing positions of such a recorder apparatus. Tubing 15 thus has vent end 13 initially placed in hole 16 on bobbin 14, and the other end 17 serves as the feed to a pen 4.

The tubing comprising the reservoir may be made differently to suit differing atmospheric conditions such as humidity and temperature. When a heavier ink is required a somewhat larger diameter of tubing is employed, preferably varying from .015 to .040 inch internal diameter and being substantially less than one-sixteenth inch in diameter to assure that no air bubbles may develop therein and to secure the right magnitude of capillary forces.

It is to be understood that the drawings are for purposes of illustration and are not to be construed as limiting the scope of the invention, since other embodiments and equivalents are intended to be included within the scope of the appended claims.

What is claimed is:

1. A recorder inking device comprising a multi-layer spooled tubular container open at one end, a tubular pen fitted within the other end of said container and having a constricted open end forming the writing point, an ink supply partially filling said container and pen, the container diameter being substantially greater than that of the pen and less than one-sixteenth inch whereby capillary attraction within the pen exceeds that at the opposite end of the ink supply in said container, and means mounting the entire container for translatory motion with said pen.

2. An ink reservoir for an automatic recording device having a tubular pen comprising a plastic tube for receiving a supply of recording ink, said tube having a cylindrical diameter of capillary dimensions, means holding said tube uniformly coiled on a supporting structure

for translatory motion with said pen, one end of said tube being open and the other end receiving said pen therein, and mounting means maintaining the fluid in the coiled portion of said reservoir dynamically balanced against said motion and the remaining portion thereof aligned with said pen, thereby to prevent acceleration-feeding of ink during said translatory motion.

3. In a recording device, the combination of a uniform tubular container of capillary diameter open at one end and fixedly coiled in concentric helices upon supporting means from said end to a free end thereof, a tubular pen member secured partially within said free end of said container, and a supply of ink filling said pen and extending from said free end toward said open end of the tubular container, said pen having a tapering cross section such that said ink experiences stronger capillary action at the writing point than elsewhere therein, and stronger capillary action throughout said pen than in said container, and common means mounting said pen and container for motion restrictively perpendicular to the axis of said pen and the axis of said helices.

4. The combination of claim 3 including a cylindrical spool for friction mounting upon a post movable with said pen, said spool having secured thereon a variable ink supply according to differing lengths of said container wound thereon.

5. A reservoir for dynamically stabilizing an ink supply mounted for movement with a moving pen, comprising a wholly tubular transparent member wound in a layered helix and having first and second open ends, means securing said pen within said first end of the member adjacent said helix, means securing said second end of the member to an adjacent coil of the helix thereby to prevent unwinding thereof, and spool means supporting said helix generally perpendicular to the motion of said pen for simultaneous motion therewith.

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