United States Patent

Ikeda

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[54] **APPARATUS FOR FEEDING PEN-DRIVING CURRENT**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**346/139 R**, 346/139 B, 339/5 RL

[51] **Int. Cl.**.....**G01d 15/24**

[58] **Field of Search** .....346/139, 141, 29; 339/5 RL, 339/8 RL, 9 R; 191/12.2 R, 12.4

[56] **References Cited**

UNITED STATES PATENTS

2,751,565	6/1956	Johnson	339/5 RL
3,351,949	11/1967	Brown	346/141 X

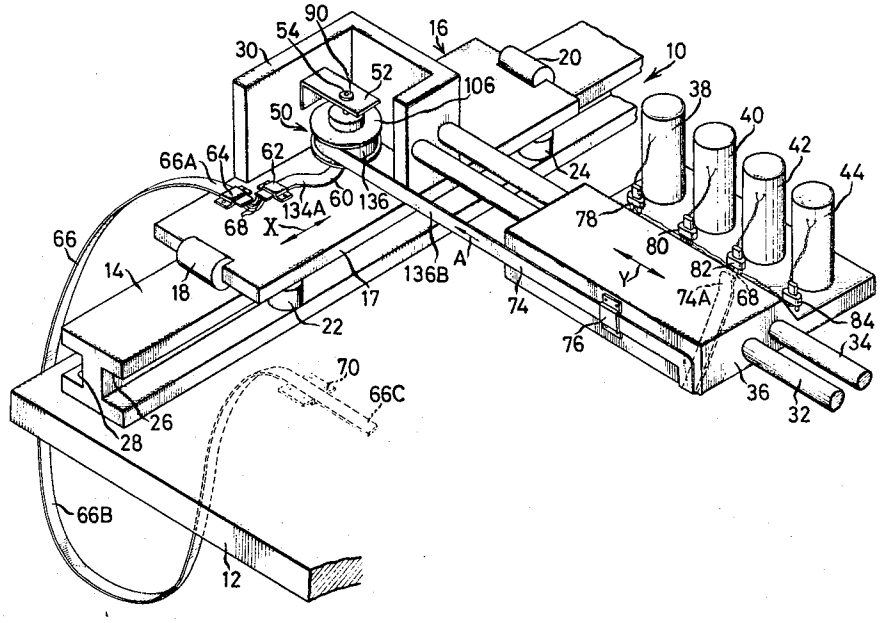
Primary Examiner—Joseph W. Hartary

Attorney—McDougall, Hersh & Scott

[57] **ABSTRACT**

An apparatus for feeding pen-driving current through a feeding wire to movable pen means including a wire winding drum rotatably journaled to a fixed member, the feeding wire being wound around the drum, and resilient means urging the drum to turn in the winding direction of the wire.

1 Claim, 5 Drawing Figures



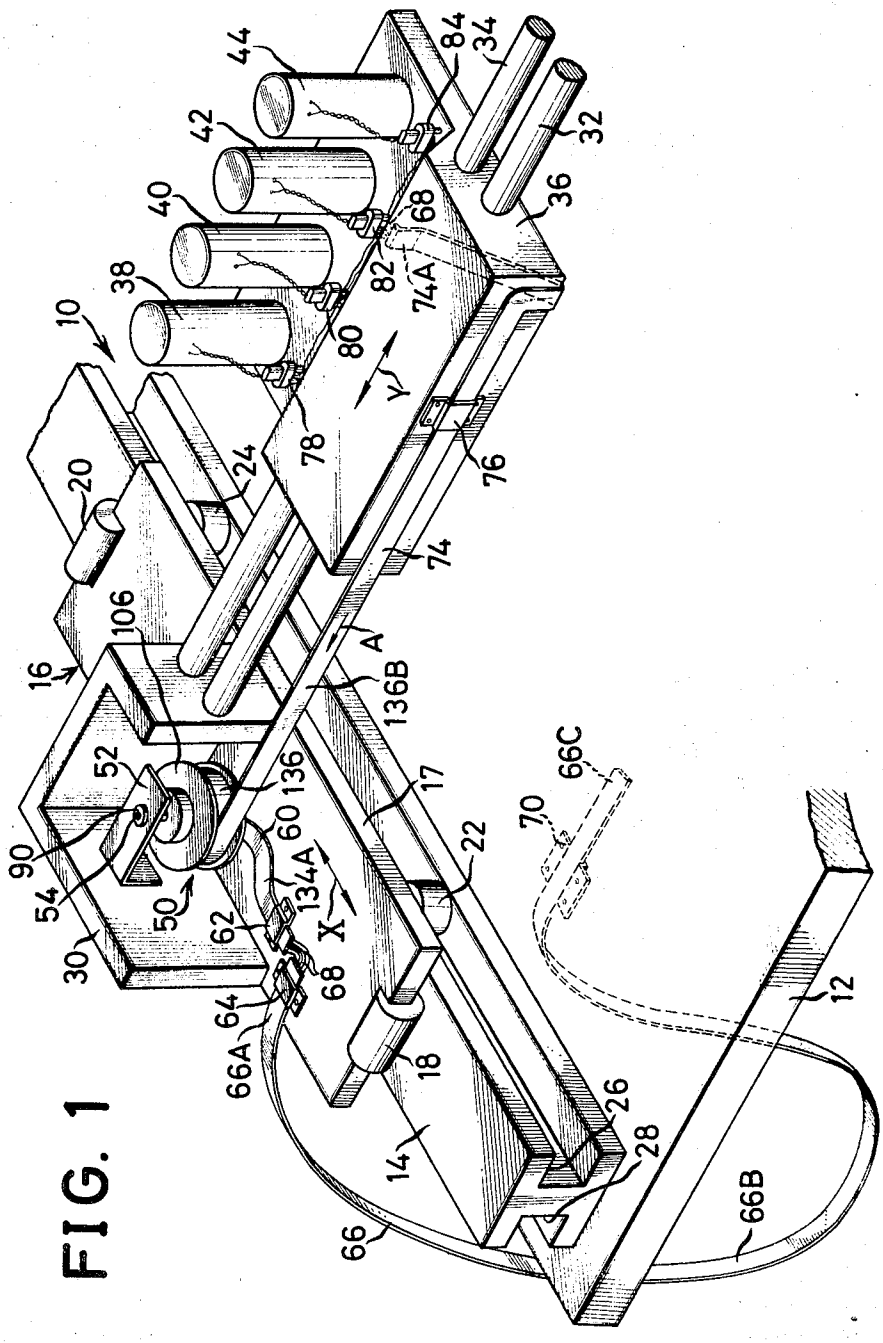


FIG. 1

by McDougall, Hersh & Scott Att'ys

FIG. 2

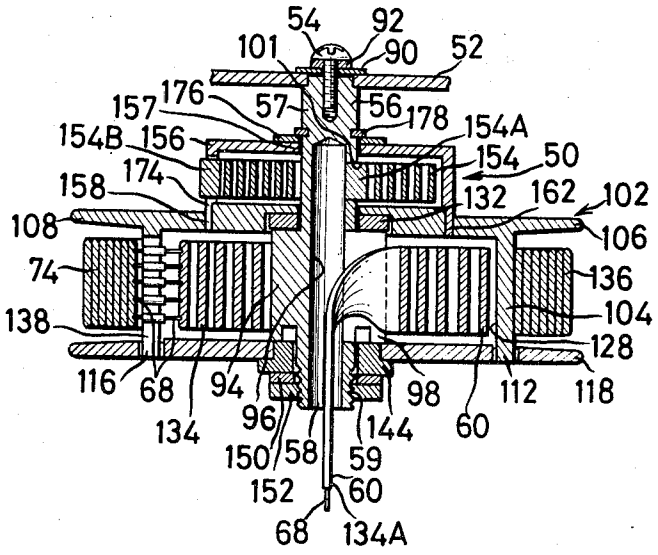

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134A

FIG. 5

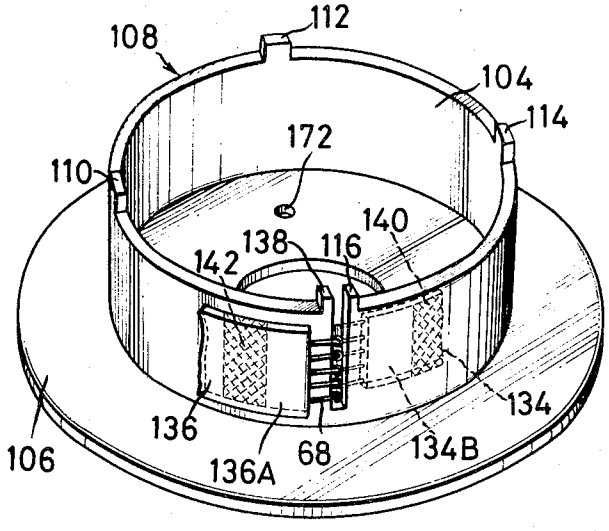

112
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FIG. 3

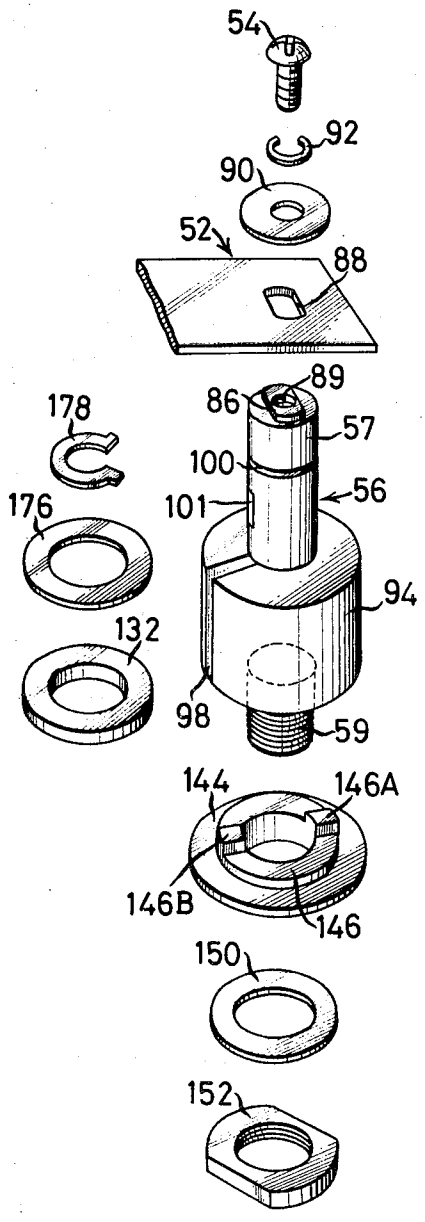
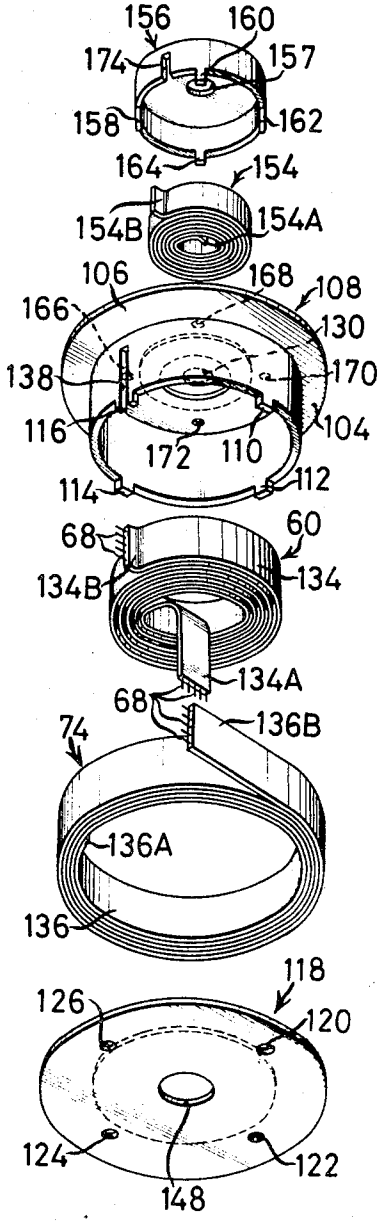

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FIG. 4


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154B
154A
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134B
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134A
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136B
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136A
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APPARATUS FOR FEEDING PEN-DRIVING CURRENT

FIELD OF THE INVENTION

This invention relates to an apparatus for feeding pen-driving current generally and, more especially, to an apparatus that feeds pen-driving current travelling continuously or intermittently through a feeding wire to pen means as seen in an X-Y recorder or similar apparatus.

The X–Y recorder or similar apparatus has pen means on a Y axis direction travel stand or pen stand. The pen-driving current or signal that moves the pen up and down against a construction surface has conventionally been supplied to the pen means from the signal source or control switch by means of the following methods. In one of these methods, current feeding is done directly by the feeding wire in suspension. In this method, however, the suspended feeding wire and its attachments get in the way when replacing the construction surface and checking-up in the course of construction. In another instance of the said methods, the guide portion (it travels jointly with X axis direction travel stand and consists, for example, of guide rails or rods) of the pen stand is provided with a slender feeding wire or a feeding plate extending along the travel direction of the pen stand and the feeding element on the pen stand while contacting with feeding wire or feeding plate is arranged to travel jointly with the said pen stand. This method, however, renders poor contact due to presence of dust and friction at the contacting portion between the feeding wire or feeding plate and the feeding element. In another instance of the said methods, current feeding is done using traction wire for moving the pen stand to the Y axis direction as the feeding wire. In this method, however, it contacts with the signal source is achieved by sliding contact at the end portion of the signal source of the said wire. And, as such, in this method, too, contact is poor due to presence of dust and friction and, therefore, maintenance and check-ups are constantly needed.

SUMMARY AND OBJECT OF THE INVENTION

Accordingly, an object of this invention is to provide an apparatus for feeding pen-driving current which assures constant feed of the driving current or signal from signal source or control switch to pen means.

Another object of this invention is to provide an apparatus for feeding pen-driving current in which the presence of feeding wire causes little or no inconvenience when replacing the construction surface or checking-up in the course of construction.

According to the present invention, an apparatus for feeding pen driving current provides a feeding wire winding drum rotatably journaled at a fixing member that relatively travels against the pen means. This drum is wound from several to 10 odd times, for example about four times, by feeding wire, such as, flat- or sectionally round-shaped coated wire or cable. The drum is resiliently urged in the winding direction of the feeding wire by resilient means, such as, a spiral spring and other springs.

The above and the other objects, features and advantages of this invention will become apparent from the following detailed description of the illustrated embodiment in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a partial perspective view of one embodiment of an X—Y recorder in which an apparatus for feeding the pen-driving current in accordance with this invention is set;

FIG. 2 represents a longitudinal cross-sectional view of the apparatus for feeding the pen-driving current shown in FIG. 1;

FIG. 3 is a perspective view of the overhauled inner portion of the apparatus for feeding the pen-driving current shown in FIGS. 1 and 2;

FIG. 4 shows a longitudinal cross-sectional view of the overhauled outer portion of the apparatus for feeding the pen-driving current shown in FIGS. 1 and 2; and

FIG. 5 illustrates a perspective view, in the apparatus for feeding the pen-driving current shown in FIGS. 1–4, of the upper element of cable winding drum, upside down, devoid of majority of cable, showing how a pair of flat cables are connected to each other.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

In FIG. 1, an X—Y recorder 10 has at its left and right of side guide rails 14 of H type cross section supported on the fixed stand 12 (In FIG. 1, one only of the rail pairs 14 is shown). On these rails 14, trucks 16 travel in the X axis direction in the direction of arrow X as seen in FIG. 1 (In FIG. 1, only one of the trucks 16 is shown).

Fitting of these is done in the following way. Firstly, a pair of guide wheels 18 and 20 rotatably journaled in the front and rear ends of the trucks 16 are rotatably put on the guide rails 14. Next a pair of guide wheels 22 and 24 rotatably journaled near the front and rear ends of the inside of the back of the trucks 16 are put in guide grooves 26 of the inside of guide rails 14 so as to rotate in one side of the rails 14. Then a pair of guide wheels (none of these is shown in the drawing) rotatably journaled near the front and rear ends of the outside of the back of the trucks 16 are put in the guide grooves 28 of the outside of the guide rails 14 so as to rotate in the other side of the rails 14.

On each of these trucks 16 is fixed an L-shaped plate 30 respectively. Between these plates are bridged a pair of guide rods 32 and 34 respectively. These guide rods 32 and 34 are fitted with a Y axis direction travel stand or pen stand 36 to enable moving to the direction of Y axis, i.e. the direction of an arrow Y in FIG. 1. On the pen stand 36 are plural numbered, for example 4, electromagnetic pen means 38, 40, 42 and 44 respectively.

Further, in FIG. 1, driving means for driving trucks 16 to travel in the direction of the X axis and stand 36 to travel to the direction of Y axis respectively is not shown. Various conventional driving means may be employed for this purpose.

In the X axis direction travel truck 16 is fitted with apparatus 50 for feeding the pen-driving current in a state of suspension. This fitting is done by fixing the fixed axis 56 of the feeding apparatus 50 on the L-shaped suspension plate 52 screwed to fitting plate 30 by means of screw 54. The inner end 134A of the winding portion 134 of flat cable 60 extending downward from an opening 58 at the end of fixed axis 56 is fixed on the base plate 17 of truck 16. On this base plate 17, one end 66A of another flat cable 66 is affixed by

means of fixture 64. Cores in a plural number, for example 5 lines, exposed at the end of cable 66 are connected by soldering with a plural number, for example five lines, of cores 68 exposed at the end 134A of the flat cable 60 respectively.

The other end 66C of flat cable 66 is affixed on the back of fixed stand 12 by fixture 70 to give a sag similar to sag 66B whose length is equal to about one half of the travel limit in the direction of X axis of the truck 16. As the fixing is done at about the center portion of the front and rear direction (similar to the direction of X axis) of the fixed stand 12, if the sag 66B is equal to about a half of the travel limit of X axis direction of the truck 16, the truck 16 can travel up to the maximum travel limit. It is possible to remove the sag 66B by adding another feeding apparatus 50 as may be detailed later. As, however, the sag 66B doesn't hinder the travel of truck 16 to any extent, the removal of sag is not necessary. In FIG. 1, for the sake of showing it clearly, the position of fixture 70 is shown a bit forward from the actual position. At the other end 66C of flat cable 66 the cores 68 are respectively connected with the prescribed signal source or control switch (neither of them are shown in the drawing). The outer end 136B of winding portion 136 of flat cable 74 extending outward from the circumference of hub portion 104 of cable winding drum 102 of the feeding apparatus 50 is fixed on a side of the pen stand 36 by fixture 76. One end 74A of said cable 74 extends from the lower side of the pen stand 36 upwards through an opening (not shown in the drawing) passing through upward and downward of the pen stand 36. Plural numbered cores 68, for example five lines, exposed at end 74A are connected with input terminals of electromagnetic pen means 38, 40, 42 and 44 respectively via terminal boxes 78, 80, 82 and 84. Four out of five cores are plus terminals corresponding to four electromagnetic pen means while the remaining one core represents minus terminal commonly applied to four electromagnetic pens.

Particulars of the feeding apparatus 50 are shown in FIGS. 2 and 4. On the upper end of upper small radius portion 57 of the fixed axis of feeding apparatus 50 a slender projection portion 86 is formed. This projecting portion 86 is put in an opening 88 being almost similar to said portion 86 and formed in the suspension plate 52 whereby the fixed axis 56 is held against rotation relative to suspension plate 52. The projecting portion 86 has a tapped hole 89. Into this hole, screw 54 is screwed through suspension plate 52, washer 90 and spring washer 92 whereby fixed axis 56 is fixed on the suspension plate 52.

Around the center of the fixed axis 56 is formed a large radius portion 94. The fixed axis 56 has a center hole 96 which has an opening 58 at the lower end of lower small radius portion 59 of this axis with its upper end being blocked up. On a large radius portion 94 is formed a slit 98 extending in a longitudinal direction of the fixed axis 56. The slit 98 extends from the center hole 96 to the outer circumference of large radius portion 94.

On the outer circumference of upper small radius portion 57 of the fixed axis 56 are formed a ring-shaped groove 100 and slit 101 extending in the axial direction.

The cable winding drum 102 is provided with an upper element 108 consisting of a cylindrical hub portion 104 and a disk-shaped flange portion 106 making a unit with the hub portion at its upper end. On the lower end of the hub portion 104 of this element 108 are formed projected portions 110, 112, 114 and 116 respectively arranged at a distance of about 90 degrees. These projecting portions are forcibly put in to openings 120, 122, 124 and 126 respectively that correspond with a disk-shaped lower element 118 of drum 102 thereby are fitted in a manner that the lower element 118 produces a lower flange portion of drum 102 at the lower end of hub portion 104.

Into the center hole 130 formed at the flange portion 106 of upper element 108 the upper small radius portion 57 of fixed axis 56 penetrates rotatably. Between the lower surface of flange portion 106 and the upper surface of large radius portion 94 of axis 56 is washer 132 that penetrates into small radius portion 57.

To the inner space 128 of drum 102 that is formed by hub portion 104, a pair of flange portions 106 and 118 and large radius portion 94 of axis 56, the loosely wound and ring-shaped winding portion 134 of flat cable 60 is put in before the flange portion 118 is fitted on the hub portion 104. The inner end 134A of said winding portion extends downward of the fixed axis 56 from the lower-end opening 58 through slit 98 and center hole 96.

On the circumference of hub portion 104 is a winding portion 136 of flat cable 74 which is a bit tightly wound and ring-shaped. 5 cores 68 exposing to the outer end 134B of winding portion 134 and 5 cores 68 exposing to the inner end 136A of winding portion 136 are connected respectively.

The connection is done in this way: Firstly, a part of outer end 134B combines with the inner circumference of hub portion 104 by means of adhesives layer 140 at around slit 138 formed in the hub portion 104 likely extending to the direction of axis center through the projected portion 76. Next, a part of the inner end 136A combines with the outer circumference of hub portion 104 by means of adhesives layer 142 at around slit 138. Next, the cores 68 exposing respectively to said ends 134B and 136A get contacted with other via slit 138. Then, these contact portions are connected with respective cores 68 after being soldered.

In this state, as already described, the lower element 118 is rotatably attached to the small radius portion 59 of fixed axis 56 and is connected with the upper element 108. Then, a bushing 144 is attached to the lower small radius portion 59 of axis 56 and the small radius portion 146 having portions 146A and 146B is put in the center hole 148 of lower element 118. Next, a washer 150 is put in the small radius portion 59 of axis 56 and, further, a screw portion formed on the circumference of this small radius portion is screwed jointly with nut 152.

The upper small radius portion 57 of fixed axis 56 is penetrated by a spiral spring 154. The inner end 154A of said spiral spring is put in said slit 101 of axis 56 whereby its end is affixed on the axis 56. On the surface of upper flange portion 106 of drum 102, a cup-like spring box 156, into the center hole 157 of which the upper small radius portion 57 of axis 56 is relatively rotatably penetrated, is fitted in a state of holding a

spiral spring 154 in said box. This fitting is done in this way, i.e. the projecting portions 158, 160, 162 and 164 that are positioned at nearly the same interval at the lower end of the box are forcibly put into the respective openings 166, 168, 170 and 172 formed on the flange portion 106. The outer end 154B of spiral spring 154 is put in the slit 174 formed to extend to the axial direction along the circumference of spring box 156 whereby the outer end 154B is affixed on the spring box 156. As the spring 154 is urged resiliently in the winding direction in itself under its fitting condition, the spring box 156 jointly with drum 102 that makes a unit is urged resiliently to pull and wind in the direction marked by arrow A in FIG. 1 the outer end 136B of winding portion 136 of wire 74.

On the surface of spring box 156 is a washer 176 attached to the small radius portion 57 of axis 56. On the upper side of the washer is a U-shaped stop ring 178. By strongly screwing down nut 152, therefore, it is possible to eliminate an axial direction play of spring box 156 and cable winding drum 102.

Therefore, when put in use, as practiced in the prior art, the X axis direction travel truck 16 can travel in the X axis direction against guide rail 14 and the pen stand 36 to the Y axis direction against guide rods 32 and 34 respectively by driving means, whereby the pen stand 36 can travel to any optional position in either direction of X axis or Y axis against a construction (not shown) on the fixed stand 12. Then, a prescribed signal is respectively given to electromagnetic pen means 38, 40, 42 and 44 from the prescribed signal source or control switch through the respective cores of flat cables 66, 60 and 74 whereby a prescribed drawing on said construction is done by dropping selectively the respective pens of pen means 38, 40, 42 and 44 for necessary construction.

When the X axis direction travel truck 16 travels, the extent of sag 66B of flat cable 66 increases or decreases in accordance with the travel position of truck 16.

However, the sag 66B disappears substantially as the travel distance reaches a maximum. Hence it will cause no hinderance to the travel of truck 16.

On the other hand, when the Y axis direction travel stand or pen stand 36 travels, for example when it travels from right to left in FIG. 1, the flat cable 74 will tend to sag. But the spring box 156 and the cable winding drum 102 that make a unit are resiliently urged, because of spiral spring 154, in a manner that the outer end 136B of winding portion 136 of flat cable 74 is wound on the winding portion 136. Thereby, when said sag of cable 74 is about to get caused, the drum 102 rotates in the direction of winding cable 74. Thereby, said sag is absorbed by winding of outer end 136B to the winding portion 136. Thereby, no sag will be caused on the flat cable 74. Contrary to the above assumption, when the pen stand 36 travels from left to right in FIG. 1, the spiral spring 154 gets rewound overcoming the elastic strain force or spring force of said spring and the spring box 156 and cable winding drum 102 respectively rotate. As the winding portion 136 of cable 74 and its outer end 136B are rewound, said travel of pen stand 74 is carried out smoothly. As said rewinding amount of winding portion 136 corresponds to the distance of travel of pen stand 74, cable 74 will cause no sag between the feeding apparatus 50 and fixture 76.

When the winding portion 136 of cable 74 is wound or rewound by drum 102, the drum 102 rotates. This rotation is transmitted to the outer end 134B of winding portion 134 of flat cable 60 and, for this reason, the outer end also rotates. As the winding portion 134 is loosely wound, said rotation, for example several rotations, will not be transmitted up to the inner end 134A of winding portion 134 as the rotation is absorbed between the outer end 134B and inner end 134A. Thereby, the inner end 134A of winding portion 134 will never be twisted. The inner end, always in a predetermined state, extends downward from an opening 148 at the lower end of drum 102.

When the pen stand 36 travels from the nearest position of the feeding apparatus 50 to the fartherest, the frequency of drum rotation can be changed from a few to ten odd times, for example abut four times. By the use of spiral spring 154 having an appropriate spring constant, the torque given to drum 102 via spring 154 can be regulated on a fixed standard, for example about 100 - about 150 g/cm. In this case, the outer diameter of hub portion 104 of drum 102 ranges between about 30 – 90 mm, for example about 60 mm.

Further, flat cables 60, 66 and 74 can be those made by solid or stranded wire placed in side by side relationship with several wires being nearly parallel with each other and coated by synthetic resin. By the use of this kind of cable it is possible to supply pen-driving signals, from several circuits.

When silicon oil is put on the respective surface of flat cables 60, 66 and 74, friction on these surfaces will be minimized and smooth functioning of said feeding apparatus 50 may be ensured.

Although the illustrative embodiment of this invention has been described in detail above with reference to the accompanying drawings, it is to be understood that this invention is not limited to this precise embodiment, and that various changes and modifications may be effected therein by one skilld in art without departing from the scope or spirit of the invention.

What is claimed is:

1. An apparatus for feeding pen-driving current comprising a feeding member and pen means traveling relative thereto, a cable-winding drum rotatably attached to said member, current feeding wire, resilient means normally urging said drum in one direction of rotation for winding said current-feeding wire about the outer circumference of the drum, said drum being rotatably journaled on a fixed axis to said feeding member and wherein said resilient means comprises a spiral spring associating its inner end with said axis and, concurrently, its outer end with said drum, said feeding wire comprising a winding portion and outer and inner end portions, means electrically connecting the outer end of said winding portion to said pen means and means electrically connecting the inner end of said winding portion to a signal source or control operating to unwind or rewind current feeding wire in relation to the travel direction and distance of said pen means relative to said feeding means, said resilient means operating to avoid any sag in said winding portion between said drum and said pen means, and wherein said feeding wire is provided with a second winding portion wound loosely between the outer circumference of said fixed axis and the inner circumference of said drum, the outer end of said second winding portion being electri-

cally connected with the inner end of said first winding portion, and the inner end of said second winding portion stretching outside through a center hole defined by said fixed axis whereby said feeding wire can avoid twisting when said drum rotates, said inner end of said second winding portion extending to said signal source or control.

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