United States Patent

Gelb et al.

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[54] PEN CARRIAGE ASSEMBLY

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[52] **U.S. Cl.** .....**33/18 R**, 346/141

[51] **Int. Cl.**.....**B43l 13/00**

[58] **Field of Search**.....346/141; 33/18, 1 XY, 23, 32

[56] **References Cited**

UNITED STATES PATENTS

3,058,220	10/1962	Eary	33/32 C
3,353,273	11/1967	Sicking et al.	33/18 R

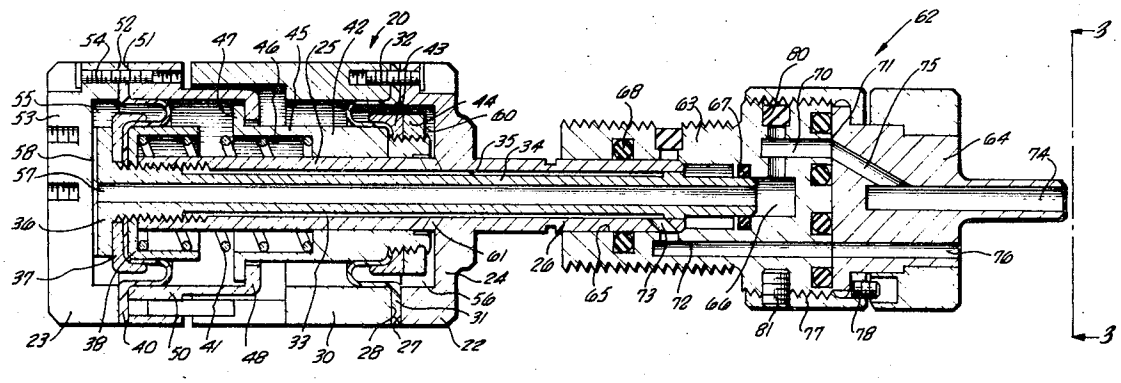
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[57] **ABSTRACT**

A pen carriage assembly for automatic drafting machines is described having a scribe holder reciprocably driven by a pneumatic drive assembly. The scribe holder is driven in two modes, a pressure mode and a gravity mode. In the pressure mode, the pneumatic drive assembly includes a first pressure chamber, the expansion of which forces the movable portion of the assembly downward to move the scribe into writing engagement with the drafting paper. In the gravity mode, the pneumatic drive assembly includes a second pressure chamber, the expansion of which enables the movable portion of the assembly to be released from its support means to drop downwardly due to gravity and also to move the scribe into writing engagement with the drafting paper.

11 Claims, 3 Drawing Figures



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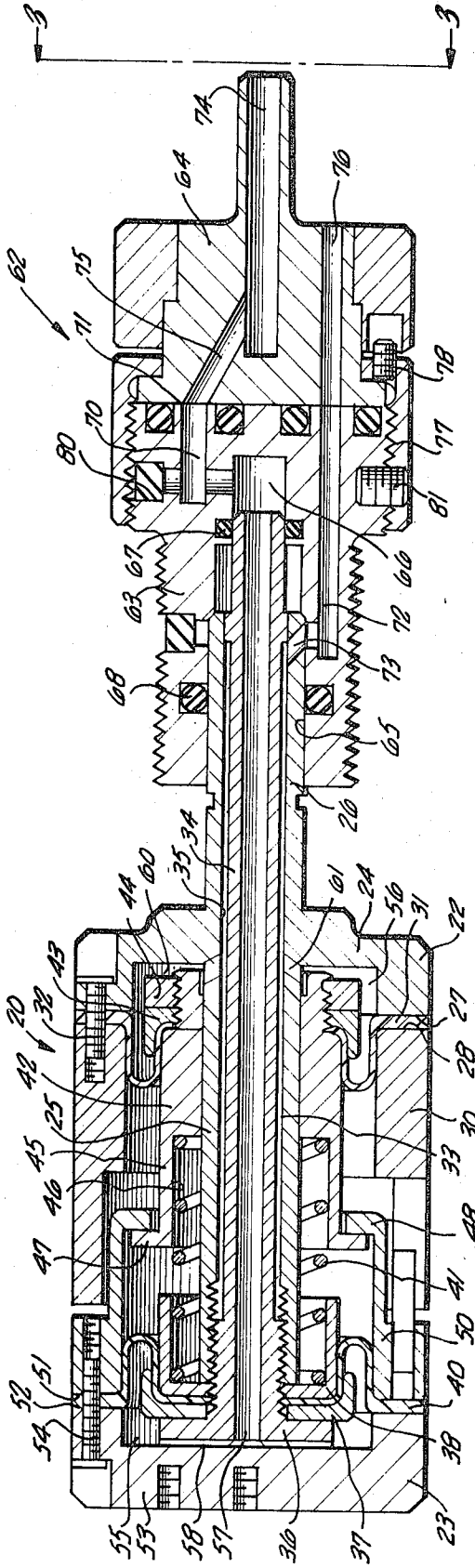


FIG. 2

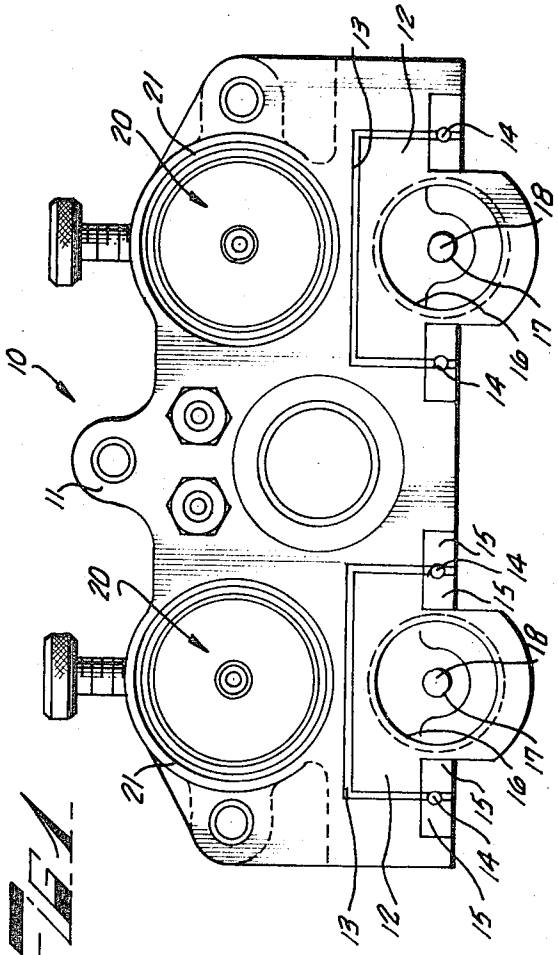


FIG. 1

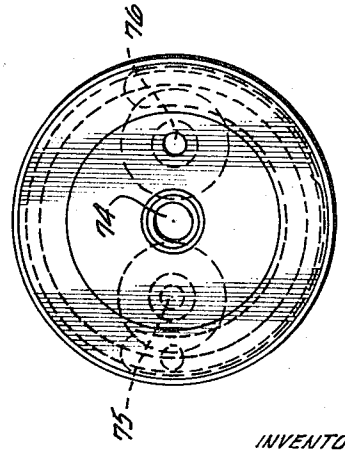


FIG. 3

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PEN CARRIAGE ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to pen carriages of automatic drafting machines, and more particularly to the motive means for reciprocating portions of the pen carriages carrying the scribes.

2. Description of the Prior Art

In general, graphic systems are used primarily for restructuring computed data via microfilm and pen-on-paper visuals. Included in such systems are microfilm printer-plotters, digital Delta incremental plotters, digital drafting systems, and flat-bed digital plotters. In these systems, commonly known as X–Y plotters, a pen carriage is driven by various means to enable the pen mounted thereon to automatically scribe on a sheet of drafting paper mounted on a table in response to a given set of commands by a control system. In one type of automatic drafting machine the carriage is slidably driven on a support bar in one axial direction, i.e., the X-axis while the drafting paper is wound onto two rotating bars which drive the paper perpendicularly in the Y-axis direction. In this manner, the relative movement of the carriage and the paper enables the scribe connected to the carriage to traverse the entire plotting surface of the paper.

In another common type of drafting machine, the carriage is slidably carried on a Y-axis arm which, in turn, is transversely slidable across the drafting table in the X-direction with the drafting paper remaining stationary. An example of such a machine is described in the U.S. Pat. application, Ser. No. 819,325 filed Apr. 25, 1969.

In any of the conventional drafting machines the scribe means mounted within the carriage is reciprocably driven perpendicularly along the Z-axis by drive means mounted on the carriage. The scribe means usually comprises a ballpoint pen, an ink pen or other scribes, and is usually maintained in two positions along the Z-axis, i.e., a lower or scribing position, wherein the scribe means contacts the surface of the paper for scribing thereon; or a raised or nonscribing position wherein the scribe means is out of contact with the drafting paper.

Although such carriages have been used extensively, the reciprocable drive means have several shortcomings which severely handicap the carriage's utilization. In the prior carriages, the scribing pens are reciprocably driven by a solenoid-spring drive means extending about the pen. In such a device the solenoid maintains the pen in the raised position. To lower the pen to the scribing position, the solenoid is deenergized to permit the spring to snap downwardly until the pen contacts the paper. The pen is then maintained in the scribing position by the spring. To raise the pen, the solenoid is again energized to drive the pen upwardly against the force of the spring.

One of the problems encountered with such a device is that the snap action of the spring in lowering the pen onto the paper causes the pen to strike the paper with such a force that the pen penetrates or digs into the paper. Naturally, this is undesirable, since such an action can severely damage the pen and also ruin the drafting paper. A manner of overcoming this shortcoming is by incorporating a spring having a smaller spring constant. However, such springs do not have enough force to maintain the pen in the scribing position. As a result, the pen tends to skip as it is scribing and the problem becomes more acute when the pen is a ballpoint pen, which requires more downward force for the writing mode than other type pens.

Another problem encountered is that different types of pens require different amounts of force applied thereto for the scribing mode. For example, an ink pen and other scribes require less force than a ballpoint pen. Because it is a requirement that pen carriages be capable of interchangeably receiving various types of scribes, it would be advantageous for the force applying means to be adjustable. However, a spring-loading device is not capable of performing this function by being able to adjust the force on the spring. The prior devices

attempt to solve this problem by designing a compromise compressive force in the spring for acting on all types of pens. This is not satisfactory, because, like all compromises, the ideal forces for the various types of pens is never attained.

SUMMARY OF THE INVENTION

The present invention obviates the above-mentioned shortcomings by providing motive means for a pen carriage that enables the scribe to be brought into engagement with the drafting paper without any damaging snap action. The pen carriage assembly includes a scribe holder reciprocably driven by a pneumatic drive assembly. The drive assembly includes a stationary portion and a movable portion with the movable portion being connected to a scribe holder to drive the scribe holder in two modes, a pressure mode and a gravity mode. In the pressure mode, the pneumatic drive assembly includes a first pressure chamber, the expansion of which forces the movable portion of the assembly downward to move the scribe into writing engagement with the drafting paper. In the gravity mode, the pneumatic drive assembly includes a second pressure chamber, the expansion of which enables the movable portion of the assembly to be released from its support means, to drop downwardly due to gravity and to also move the scribe into writing engagement with the drafting paper.

The drive assembly is also characterized by the fact that, through the use of diaphragms, there is no sliding engagement between the movable and stationary portions of the assembly to ensure against undue air leakage in the first pressure chamber.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a top elevational view of a pen carriage in accordance with the present invention;

FIG. 2 is a cross-sectional view of one of the drive means mounted within the carriage; and

FIG. 3 is an elevational view of the valve plate taken along lines 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIG. 1 shows a pen carriage assembly, generally indicated by arrow **10**, which is adapted to be slidably mounted onto a support arm (not shown) to be axially driven in a conventional manner. The pen carriage assembly **10** includes a body portion **11** having a pair of movable blocks **12** reciprocably mounted within a pair of recesses **13** formed therein. Each block **12** is movable on a plurality of roller bearings **14** located within a pair of raceways located on both sides thereof with each raceway being formed by a pair of longitudinally extending, complementary V-grooves formed in bearing linings **15** mounted on the walls of the block **12** and recess **13**. Each block **12** further includes a bore **16** formed on the top portion thereof to threadedly receive a cap member (not shown). The lower portion of each block **12** includes a smaller bore **17** which is adapted to threadedly receive and support the lower end of a scribe **18**. The end cap is adapted to slidably receive the upper portion of the scribe and functions as an axial support for the scribe **18**. In assembling the unit, the cap is removable to permit the scribe **18** to be easily insertable within the bore **17**.

Each block **12** is reciprocably driven by a pneumatic drive assembly, generally indicated by arrow **20**, located within cylindrical bores **21** formed within the main body **11**.

As shown in FIG. **2**, each pneumatic drive assembly **20** includes a fixed portion **22** and a movable portion **23**. The fixed portion **22** includes a flange **24** having a pair of outwardly ex-

tending stems 25 and 26 integrally formed therewith. The flange 24 also includes an annular face 27 which is adapted to register with an annular face 28 of a sleeve 30. The outer flanged portion of a diaphragm 31 is sandwiched between the annular faces 27 and 28 with the three members being connected by means of a plurality of screws 32 (of which one is shown).

A longitudinally bore 33 is formed within the stems 25 and 26 for receiving an air shaft 34. The air shaft 34 is enlarged at its extremities for engagement with the bore 33 with the chamber formed therebetween indicated at 35. The lower extremity of the air shaft 34 also includes an end plate 36 integrally formed thereon. The end plate 36 includes a flanged portion for supporting a cap 37. A retainer 38 is also threadedly engaged to the lower extremity of the air shaft 34 with an inner annular flange of a diaphragm 40 sandwiched between the cap 37 and the retainer 38. The retainer 38 further includes an inner cylindrical pocket for receiving the one end of a spring 41 which will be described in detail hereinafter.

The movable portion 23 of the drive assembly 20 includes a plunger 42 slidably mounted on the outer surface of the stem 25. The plunger 42 includes a threaded end for receiving a cap 43 utilized for retaining the inner annular end of the diaphragm 31 between the cap 43 and the plunger 42. The entire assembly is secured by means of a locknut 44 which is also threadedly engaged on the one end of the plunger 42. The other end of the plunger 42 forms an extension 45 having a cylindrical recess 46 formed therein for receiving the other end of the compression spring 41. The lower extremity of the extension 45 forms a laterally extending flange 47 adapted to contact and support an inwardly extending flange 48 of a piston housing 50. The other end of the piston housing 50 forms an annular face 51 adapted to register with an annular face 52 of a connecting plate 53 with the outer annular flange of the diaphragm 40. These three elements are united by means of a plurality of screws 54, of which one is shown.

The connecting plate 53 is adapted to extend from the lower end of the drive assembly 20 across the lower portion of the main housing 11 to be integrally connected to the lower portion of the penholder block 12. The stationary and movable portions 22 and 23 of the pneumatic drive assembly 20 cooperate to form a pair of pressure chambers 55 and 56 formed therebetween. The pressure chamber 55 is formed at the lower end of the assembly 20 and is bounded by the inner portion of the connecting plate 53, the lower surface of the diaphragm 40 and the wall portions of the end plate 36 and the cap 37. The pressure chamber 55 communicates with a longitudinal bore 57 of the air shaft 34 by means of a plurality of radially extending grooves 58 formed on the bottom surface of the end plate 36. The pressure chamber 56 is formed by the internal surface of the flange 24, the upper surface of the diaphragm 31 and the outer surfaces of the cap 43 and locknut 44. The locknut 44 also includes a plurality of radially extending grooves 60 formed therein for providing the chamber 56 with communication to the chamber 35 via a plurality of diagonal ports 61 extending through the stem 25. The air pressure directed to the chambers 55 and 56 is controlled by a rotary valve 62.

The valve 62 includes a valve body 63 and a rotary valve head 64. The valve body 63 includes a central bore 65 adapted to receive the stem 26 with the upper portion of the bore being reduced at 66 to receive the upper extremity of the air shaft 34. An annular seal 67 is provided for sealing the bore 65 from the bore 66, while an annular seal 68 is also provided for sealing purposes.

The valve body 63 further includes a passageway 70 extending from the bore 66 to the faceplate 71 of the valve body 63, while a passageway 72 also extends from the faceplate 71 to register with a port 73 formed through the wall of the stem 26.

The valve head 64 includes a central passageway 74 and a laterally offset passageway 75 extending to the face plate 71. A vent passage 76 also is provided within the valve head 64 and extends from the faceplate 71 through to the atmosphere. A sleeve 77 is fixedly connected to the valve head 64 by means of a setscrew 78 and extends over the outer surface of the valve body 63 to be threadedly engaged therewith. The sleeve is also keyed to one of a pair of indents 80 located on the periphery of the valve body 63 by means of a setscrew 81.

As shown in FIG. 3, the offset passageway 75 and the vent passage 76 are diagonally spaced 180° about the valve rotary axis, with the passageways 70 and 72 likewise positioned to register with these passageways.

In operation, the pneumatic drive assembly 20 operates in two modes, i.e., the pressure mode and the gravity mode. The pressure mode is utilized to accommodate ballpoint pens and other scribes that require a relatively higher pressure for scribing, while the gravity mode is utilized to accommodate ink pens and other like scribes that require relatively less force for scribing. In the pressure mode the valve head 64 is set in the position shown in FIG. 2. In this position air pressure enters the central passageway 74, through the passageway 70 downwardly into the cylindrical bore 57 of the air shaft 34 and finally to the pressure chamber 55. The air pressure entering the pressure chamber 57 forces the connecting plate 53 downwardly. The downward movement of the integrally connected housing 50, through the interconnection of the flanges 47 and 48 causes the plunger 42 to move downwardly in the same direction. The downward movement of the plunger 42 causes the spring 41 to compress, and the pressure chamber 56 to also expand, drawing air from the atmosphere through the passageways 57, 72 and 76. As a result, the connecting plate 53, being connected to the pen holder block 12, moves the block 12 downwardly until the scribe head engages the paper.

An important advantage of such a device is that the air pressure enables the connecting plate 53 and the penholder block 12 to move downwardly at a relatively even rate, thus enabling the pen to contact the paper without a great amount of force.

When it is desired to lift the pen, the air pressure is shut off and the compression spring forces the plunger 42 upwardly which, in turn, forces the connecting plate 53 and the penholder block 12 upwardly.

When it is desired to utilize the gravity mode, the valve head 64 is rotated 180°. In this position the pressure passageways 74 and 75 register with the passageway 72, while the vent passage registers with the passageway 70. Thus, the air pressure is forced downwardly through the chamber 35 and into the pressure chamber 56 to expand the pressure chamber 56 and move the plunger 42 downwardly against the compression of the spring 41. The flange 47 also moves downwardly and, since it supports the flange 48 of the housing 50, that portion, along with the connecting plate 53, drops downwardly due to gravity. During this movement, the pressure chamber 55 is permitted to expand through the vent passage 76. As can be seen, there is no pressure involved in maintaining the connecting plate in the scribing position. The only forces acting on the connecting plate is its own weight. When it is desired to raise the scribe, the air pressure is shut off and the force of the spring 41 forces the plunger 42 upwardly which, in turn, forces the connecting plate 53 and the pen holder block 12 upwardly.

A main advantage of the present invention is that the air pressure enables the penholder block 12 to be lowered evenly, without any sudden snap action, as in a spring.

Another important advantage of the present invention is that there is no relatively sliding engagement between the movable and stationary parts within the pressure chamber 55, with the sliding guide means being provided by the plunger 42 located without the pressure chamber 55. Since the main source of leakage occurs between sliding parts, this source is eliminated in the pressure chamber 55. As a result, a highly efficient pressure chamber with relatively little or no air leakage is achieved. This is very important in drafting machines because a loss in air pressure would result in the scribe not maintaining contact with the drafting paper.

It should be noted that various modifications can be made to the apparatus while still remaining within the purview of the following claims.

What is claimed is:

1. A pen carriage for an automatic drafting machine in which the carriage is driven over a sheet of paper mounted on a drafting table comprising:

a main carriage housing;

a block assembly reciprocably mounted on said main carriage housing, said block assembly adapted to hold a scribe for writing on the paper;

drive means for reciprocably driving said block assembly, said drive means including means forming a first pressure chamber, said means being drivingly connected to said block assembly, said means forming said first pressure chamber includes a fixed housing connected to said means connecting said first pressure chamber to a source of motor fluid, a movable housing connected to said block assembly, and flexible means for interconnecting said fixed housing to said movable housing; and

means connecting said first pressure chamber to a source of motive fluid for expanding said first pressure chamber to move said drive means and said block assembly thereby driving said scribe into engagement with said paper.

2. The invention in accordance with claim 1 further including means for guiding said movable housing along the reciprocable movement, said guide means being located without said first pressure chamber, thereby enabling said first pressure chamber to be free of any sliding friction between said movable housing and said fixed housing.

3. The invention in accordance with claim 1 wherein said flexible housing means includes a diaphragm being sealingly connected at one end to said fixed housing and at the other end to said movable housing.

4. The invention in accordance with claim 3 further including:

a compression spring having one end engaging said fixed housing;

means connecting said movable housing to the other end of said compression spring, said spring being adapted to force said movable housing upwardly upon release of fluid pressure within said first pressure chamber, thereby moving said scribe out of engagement with said drafting paper.

5. The invention in accordance with claim 4 further including means forming a second pressure chamber comprising:

a second fixed housing integrally connected to said first housing;

a second movable housing having one end engaged to the other end of said pressure spring;

a second flexible means for interconnecting said second fixed housing to the other end of said second movable housing; and

means for connecting said second pressure chamber to a source of motor fluid.

6. The invention in accordance with claim 5 whereby said second movable housing is coupled to said means connecting said first movable housing to the other end of said compression spring in such a manner that upon fluid pressure entering said second pressure chamber the second movable housing is driven downwardly against the compression of the source of said compression spring and said second movable housing permits said means connecting said first movable housing with said compression spring to fall downwardly by the force of gravity thereby permitting said first movable housing to also fall, due to gravity.

7. The invention in accordance with claim 6 wherein said means connecting said first and second pressure chambers to the source of fluid includes a valve having a first passageway adapted to communicate alternatively with one of said passageways connected to said source of fluid and a vent passageway adapted to communicate alternatively with the other of said passageways.

8. The invention in accordance with claim 7 wherein said valve means includes a rotary valve head having said first and second passageways being positioned 180° with respect to said moving axis.

9. The invention in accordance with claim 1 wherein said source of motor fluid is pressurized gas.

10. The invention in accordance with claim 9 wherein said pressurized gas is air.

11. The invention in accordance with claim 8 wherein said coupling means includes a first flange located on the lower end of said second movable housing and a second flange located on said means connecting said first movable housing to said other end of said compression spring, said second flange being mounted on said first flange and adapted to be drivingly moved upwardly upon upward movement of said second movable housing.

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