United States Patent [19]

Hoenig

[11] **3,739,824**

[45] **June 19, 1973**

[54] **PANTOGRAPH APPARATUS**

[76] Inventor: **George Hoenig**, 6521 Morton Drive, Boise, Idaho 83704

[22] Filed: **Nov. 3, 1971**

[21] Appl. No.: **195,308**

[52] **U.S. Cl.** **144/144**, 90/13.5, 142/7

[51] **Int. Cl.** **B27c 5/00**

[58] **Field of Search** ..... 90/13.5; 144/144 R, 144/144.5, 137; 408/DIG. 1; 142/6, 7

[56] **References Cited**

UNITED STATES PATENTS

3,543,636	12/1970	Tracy	144/144 R
3,255,791	6/1966	Garraffa	144/144 S X
3,143,901	8/1964	Bawtinheimer	90/13.5
1,294,500	2/1919	Lyons	142/7
1,221,552	4/1917	McCann	142/7

Primary Examiner—Andrew R. Juhasz
Assistant Examiner—W. D. Bray
Attorney—Keith Misegades, George R. Douglas, Jr., Sherman Leny

[57] **ABSTRACT**

Improved pantograph apparatus for providing pantographic movement of an instrument in three dimensional or in-depth aspects having the usual means for providing travel in all horizontal planes and having further an elevating mechanism with an adjustably oriented tilting plate on which are mounted a router and stylus element for performing the controlled operations according to the invention.

9 Claims, 5 Drawing Figures

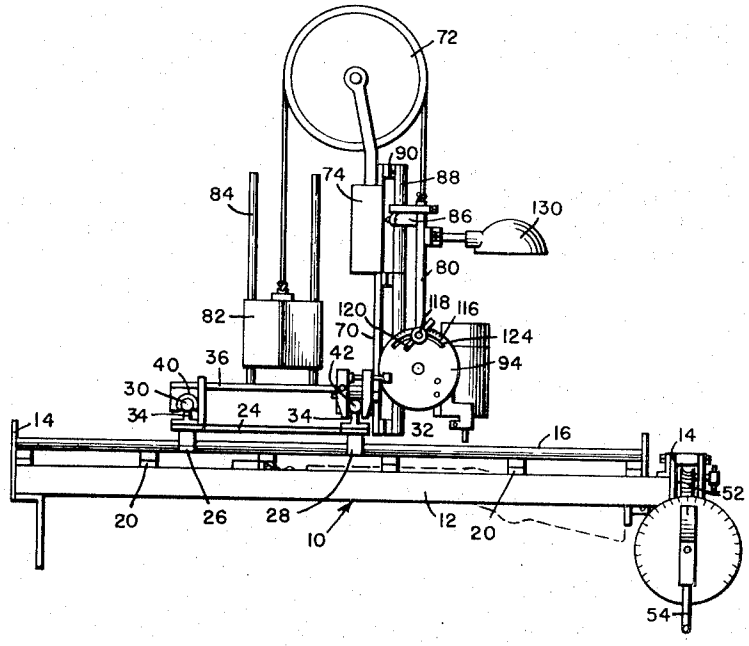


Fig. 1

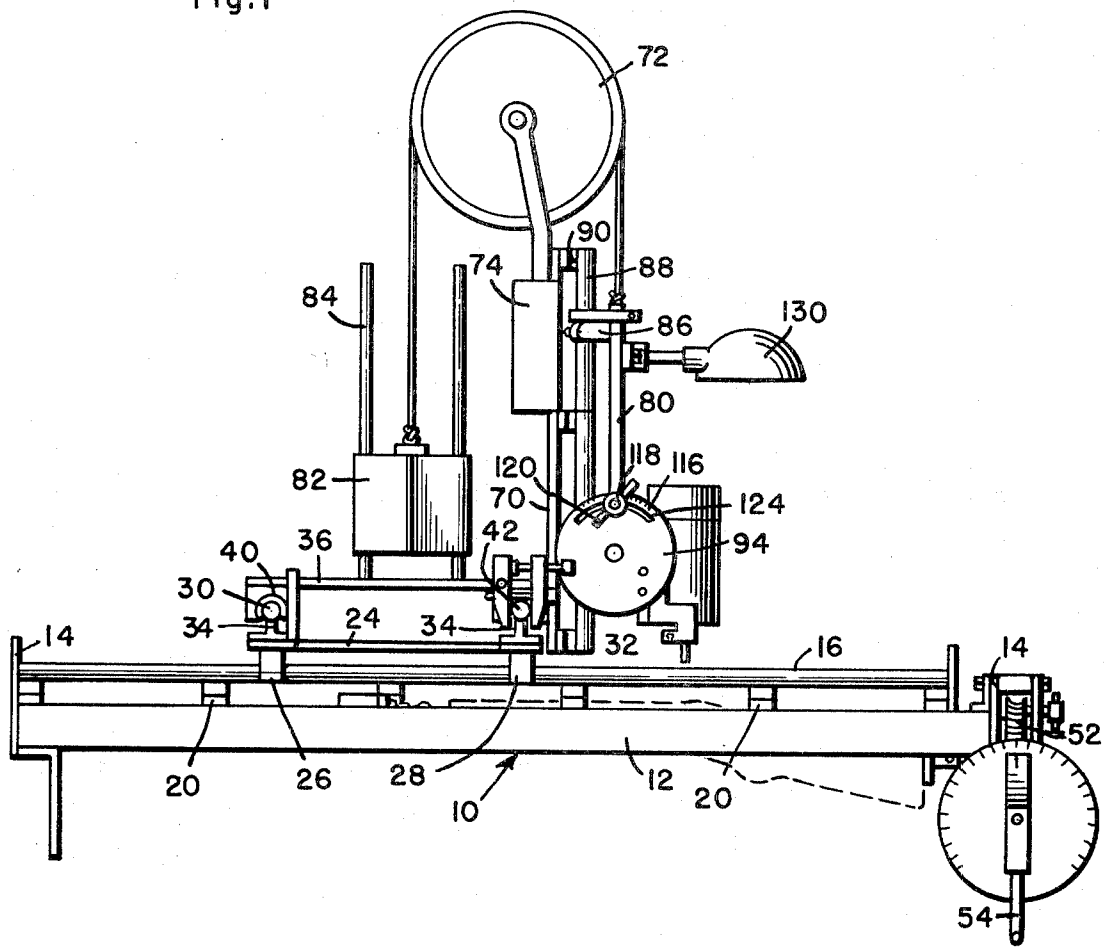


Fig. 4

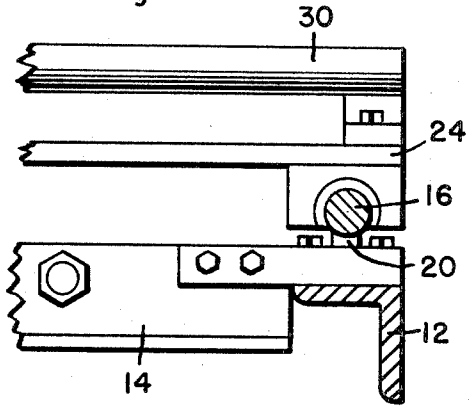


Fig. 5

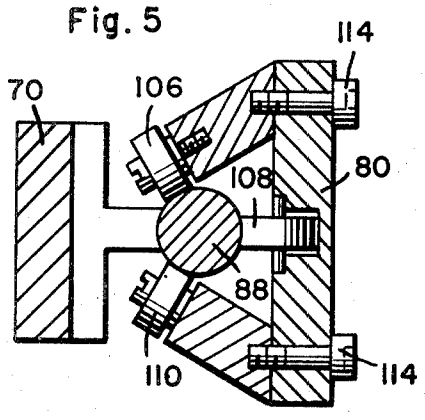


Fig. 2

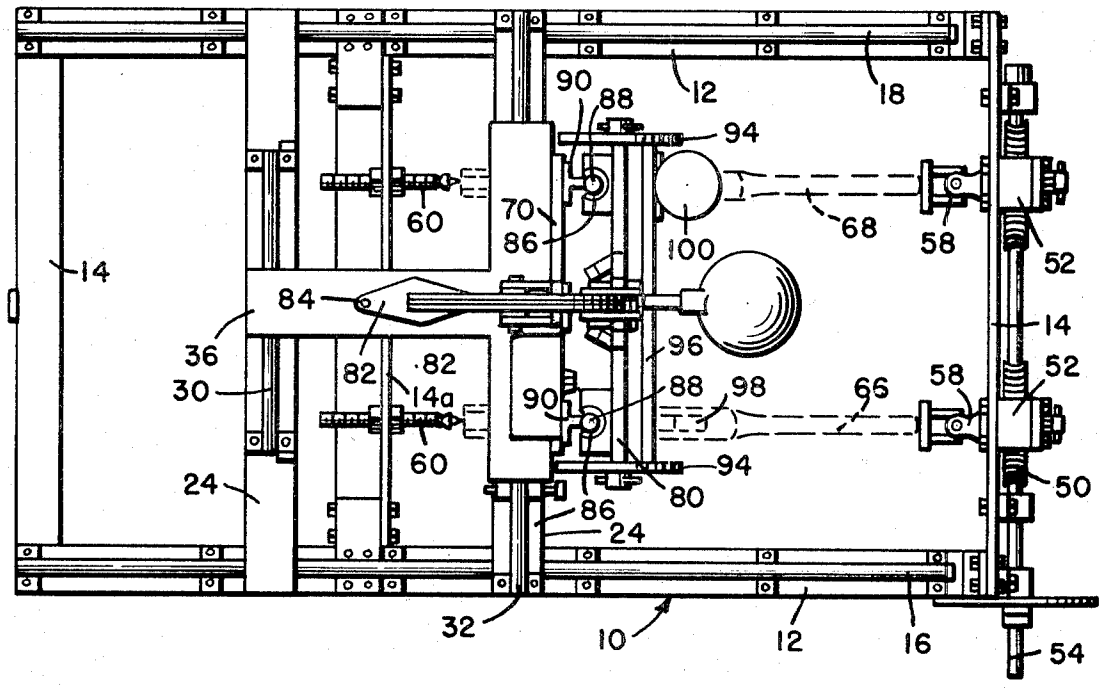
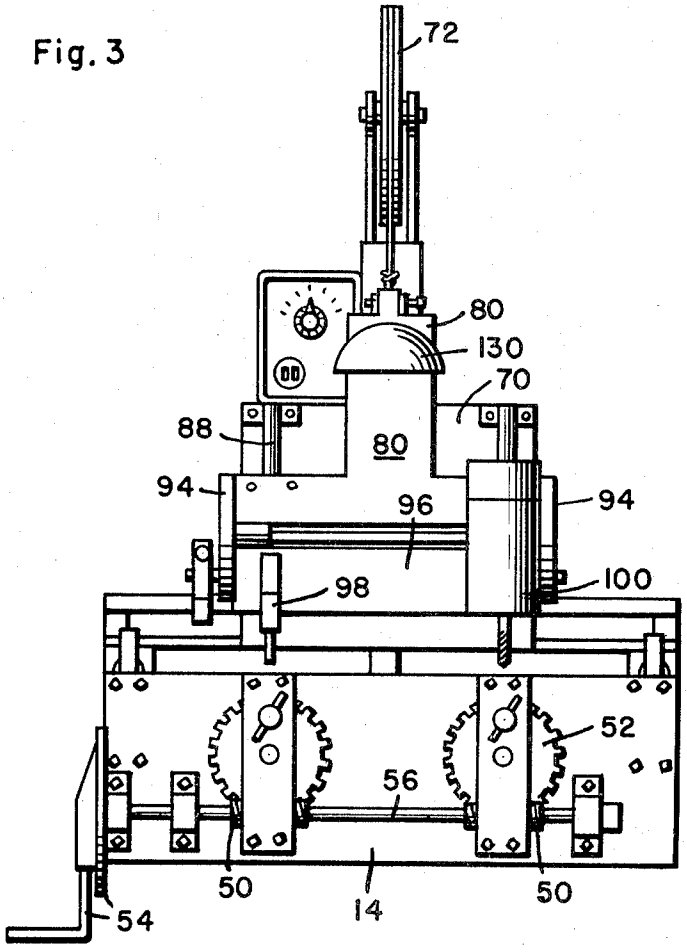

90
88
12
18
94
60
70
86
68
58
52
14
100
84
36
82
82
14a
30
90
88
98
66
58
52
60
96
14
24
94
80
50
86
24
32
10
12
16
54

Fig. 3


72
80
130
70
88
80
94
96
94
98
100
52
56
50
14
50
54

PANTOGRAPH APPARATUS

FIELD OF THE INVENTION

The present invention relates to an improved pantographic apparatus for performing in-depth operations controlled in precision and orientation over the known prior art and, more particularly, the invention relates to three-dimensional pantographic presentation of a stylus and router element. In this manner, and according to the invention as shown in its best mode as required according to 35 U.S.C. S112, there is provided a counter-balancing assembly and details of the movement of the third (or vertical) plane in which are shown the machine having the unique features of the invention. The stylus and router may provide for rotatable mounting of the master and work pieces.

BACKGROUND OF THE INVENTION

The prior art is replete with many forms and variations of pantographic apparatus, and all manner of omni-directionally movable surfaces or plates, such as those for mounting plates, mounting blocks, and pillow blocks, such as have been manufactured by Thomson Industries, Inc., Manhasset, N. Y. 11030. These typical devices provide for an arrangement of rails to give rigid continuous support and the like. Also, elementary forms of elevating mechanisms and tilting plates in various environments of tools have been known or suggested. However, as appears according to the present invention, there are no known complex arrangements having elevating mechanisms with counterweight control and being provided with tilting plate mountings on which are provided a router and stylus element.

BRIEF SUMMARY OF THE INVENTION

The objects, features over the prior art, and advantages of the present invention are:

1. A chatter-free operation, resulting in a more accurate reproduction of the master.

2. Rigidity of both master and the medium, resulting in more accurate reproduction.

3. Rigidity of the operational and functioning planes also contributing to accuracy.

4. Any movement of any plane can be locked at any point without affecting the movement of other planes.

5. All planes can and do move freely, individually or in any combination.

6. Accuracy is also controlled by having all pivot and vertex points critically located in close proximity of the stylus and cutting points, thus eliminating virtually all flex and unintended movement.

7. Use of linear bearings for all horizontal movements for ease of operation and accuracy.

8. Addition of a third dimensional working plane in the art of pantographs.

9. The horizontal planes, coupled with a third operating vertical plane which can be rotated on the vertical plane, places the stylus and cutting points in operating position at any location within the operating universe without restriction or affecting the accuracy of its functions.

10. The master and the work can be rotated 360° without affecting the operation of the machine or accuracy of the reproduction, resulting in increased versatility of the machine's operation.

11. The vertical plane can be elevated and rotated with points on that vertical plane movable horizontally by virtue of its being mounted on the combination of the two movable horizontal planes.

12. Increasing the size of the machine and, therefore, the size of its operating universe does not affect its accuracy.

While the embodiment of the invention is of general utility and application, the best mode thereof is easily adaptable to working in almost any popular medium or environment, while the parallelogram arrangement of the prior art is found to be limited in that the most dense media affect its accuracy by virtue of the lack of control over movement in the whole of the machine.

It is therefore a further advantage of the invention to provide improved pantographic apparatus to be used for duplication of gun stocks, and the like, from a master. However, its possible functions are not limited to that medium and may be used for the duplication of objects of metal, plastic and others.

The present invention is seen as encompassing an arrangement unlike the prior art, considering that most, if not all, pantographs now in existence operate and perform on the principle of a parallelogram. There are known defects in the parallelograph principle in that the larger the scale of the machine, the less the accuracy in its reproduction of a master or template. Further, the ease with which the parallelograph can be operated is adversely affected by increases in its size. Thus the advantages, objects and improvements of the present invention are realized in the contemplation thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages of the invention will become apparent upon full consideration of the following detailed description and accompanying drawings in which:

FIG. **1** is a front elevational view of the improved pantographic apparatus according to a preferred embodiment of the invention;

FIG. **2** is a plan view thereof;

FIG. **3** is a side elevational view taken from the right side of FIG. **1**;

FIG. **4** shows an enlarged detailed view partly in section and broken in part of self-aligning ball bushing mountings for the table on the rods for achieving horizontal movements; and

FIG. **5** is a cross-sectional view of the ball bearing roller bearing arrangement for a three bearing point contact for supporting the elevating table on the upright table in accordance with the invention.

DETAILED DESCRIPTION

Referring now to the drawings, there is shown a frame **10** of generally rectangular construction formed of longitudinal members **12,12** and end members **14,14.** Upon the frame there is a pair of horizontally disposed and parallel arranged cylindrical rods **16,18** which are mounted on projections **20** secured to the frame.

A flat table **24** is provided on its undersurface with four or more self-aligning ball or linear bearings bushings **26,28,** or the like type of bushings, for engaging in sliding relation with the respective cylindrical rods **16,18.** (See FIG. **4.**) This provides for longitudinal movement relative to the frame.

On the flat table **24** there is disposed a pair of horizontally arranged parallel cylindrical rods **30,32** mounted on metallic projections **34** secured to the rods and the flat table **24.**

A secondary table **36** which may be irregularly contoured, such as T-shaped or the like, has disposed on its undersurface four or more self-aligning ball bushings or linear bearings **40,42,** or the like type of bushings, for providing sliding engagement with the respective cylindrical rods **30,32.**

This combined arrangement provides for travel in all directions in the horizontal plane.

A ring gear **50,** a pinion **52** and crank means **54** are provided in duplicate fashion for mounting on a shaft **56** on the frame at the right-hand end member **14.** On the opposite side of the end member **14** is a universal joint coupling member **58,58.**

On an intermediate end member **14a,** there is a pair of rotatably mounted ball joint members **60,60.** The universal joint coupling members **58,58** and the ball joint members securely support a master piece **66** and a work piece **68,** respectively.

At one edge of the table **36** is securely connected an upright table **70.** A pulley mechanism **72** and its support member **74** extend from the upper portion of the upright table **70.**

A cable or rope **76** threaded through the pulley **72** is connected or secured to an elevating table **80** at one end, and the other end is connected to a counterweight **82** which is telescopically mounted in a slide member **84.**

The elevating table **80** has linear bearings **86** for providing sliding relation to cylindrical rods **88,** the rods being fixedly secured to the upright table **70** by projections **90.** The linear bearings allow the elevating table **80** relative movement in a vertical component and provide travel in respect thereto.

There is disposed outwardly of the lower portion of the elevating table **80** a set of shaft stubs in alignment with each other and on which are rotatably mounted hubs **94,94,** respectively. Between the hubs **94,94** is a tilting plate **96** secured to the hubs for rotating with the hubs. On the tilting plate **96** is secured a stylus **98** for following the master piece **66,** and a cutter or router **100** for cutting the work piece **68.**

The linear bearings for performing the vertical contact function may be especially constructed of a plurality, such as three or more, of ball bearing roller bearings **106,108,110** (FIG. **5**) arranged for a three point or more, as the case may be, contact with the rod and to support securely and firmly the movement of the elevating table with respect to the upright table. This is accomplished so that the bearings are equally and peripherally spaced about the rod **88.** Such mounting means may have adjustment elements **114,114** for lateral adjustment to enable compensation and adjustment for play and to provide essentially true vertical movement of the elevating table in the apparatus of the invention.

The hubs **94,94** may have an arcuate recess or aperture **116** near their circumference for receiving a threaded member **118** engaging with a lever actuable nut **120** for locking or securing the hub in place, and thus tighten the hub to the elevating table, resulting in fixing the tilting plate as desired.

The tilting plate **96** may be disposed along a non-diametric portion of the hub, as shown in the preferred embodiment. The hub may be provided with indicia **124** showing the degree and portion from a vertical orientation.

The crank **54** may similarly be provided with indicia **126** showing the degree and position in rotation of the master and work pieces.

In order to assist in operating the apparatus, an illuminating apparatus **130** is provided to direct light upon the master and work pieces.

Additional embodiments of the invention in this specification will occur to others, and therefore it is intended that the true spirit of the invention be limited only by the appended claims and not by the embodiment described hereinabove. Accordingly, reference should be made to the following claims in determining the true spirit of the invention.

What is claimed is:

1. An improved pantograph apparatus comprising:

a rectangular frame having a pair of horizontally disposed cylindrical rods mounted thereon, a table mounted by linear bearings upon said rods for longitudinal movement relative to the frame,

a pair of horizontally disposed secondary cylindrical rods mounted upon said table, a secondary table mounted by linear bearings upon said secondary rods for transverse movement relative to the frame and providing travel in directions throughout a horizontal plane,

at one end of the frame ring gear, pinion and crank means to allow rotation simultaneously of master and work pieces,

support means rotatably secured to the ring gear means and to the frame for securely supporting said master and work pieces,

an upright table having its lower portion secured to an edge of the secondary table, the upper portion of the upright table supporting a pulley mechanism over which is threaded a rope,

a pair of vertically disposed cylindrical rods mounted upon said upright table, an elevating table mounted by linear bearings upon said vertically disposed rods for elevational movement relative to the frame and providing travel in respect thereto, said elevating table having extendingly disposed shaft stubs in alignment with each other, a hub rotatably mounted on each of said shaft stubs,

a tilting plate secured to the hubs for rotating with the hubs about the axis of sais shaft stubs,

and means disposed upon the tilting plate for mounting a stylus to follow the master piece and for mounting a router to cut the work piece.

2. The invention according to claim **1,** wherein at least the linear bearings of the elevating table comprise at least three peripherally spaced ball bearing roller bearings each engaging the associated rod mounted on the upright table.

3. The invention according to claim **2,** wherein the ball bearing roller bearings are provided with mounting means for adjustment laterally thereof to enable compensation and adjustment for play and to provide essentially true vertical movement of the elevating table with respect to the entire apparatus.

4. The invention according to claim **1,** wherein the hubs are provided with locking means including an arcuate recess for receiving a threaded member engaging with lever means to tighten the hub to the elevating table.

5. The invention according to claims 1 and 4, wherein the tilting plate is non-radially mounted with respect to the axis of the shaft stubs.

6. The invention according to claim 1, wherein indicia of degree and position from a vertical orientation are provided upon the hubs.

7. The invention according to claim 1, wherein the rope fed over the pulley is secured at one end to said elevating table and at the other to a counterweight.

8. The invention according to claim 1, wherein the support means includes a universal joint in supporting the master and work pieces from the ring gear means, and wherein the support means includes a ball joint in supporting the master and work pieces from the frame.

9. The invention according to claim 1, wherein illumination means is mounted upon the elevating table directed upon the master and work pieces.

* * * * *