

May 9, 1967

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3,318,593

MICROPOSITIONING MECHANISM

Filed Dec. 15, 1964

2 Sheets-Sheet 1

Fig. 1

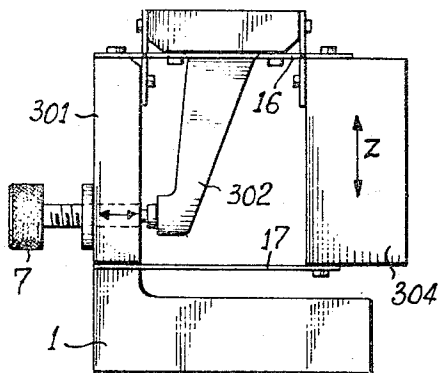


Fig. 3

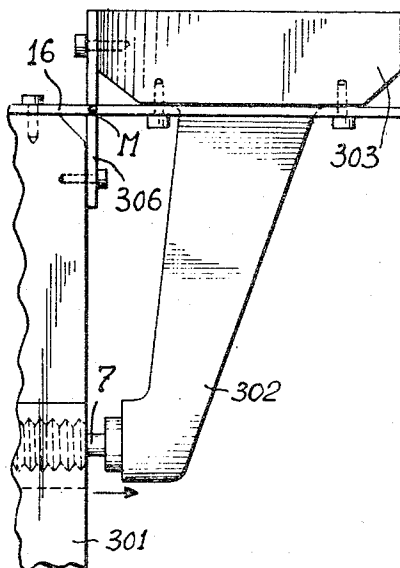
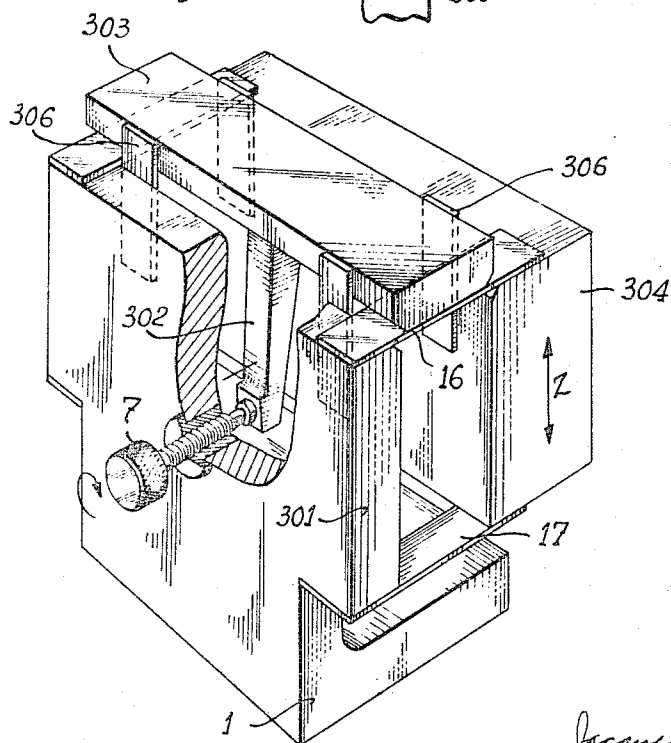


Fig. 2



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2 Sheets-Sheet 2

Fig. 4

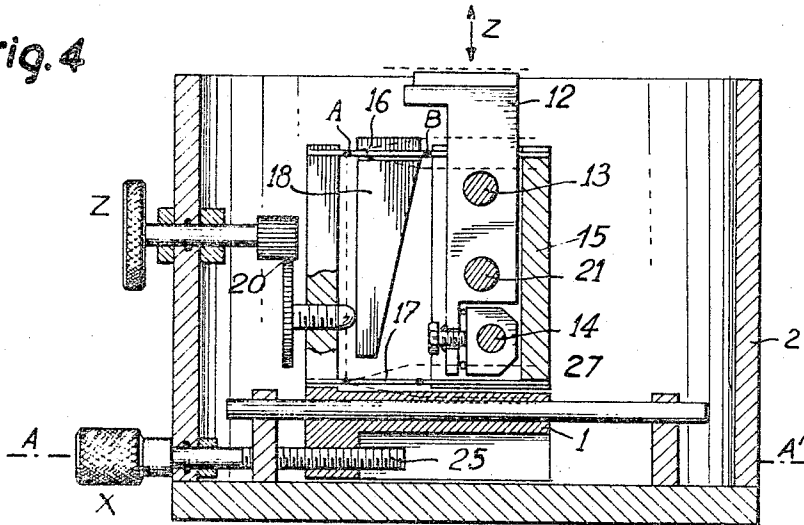


Fig. 5

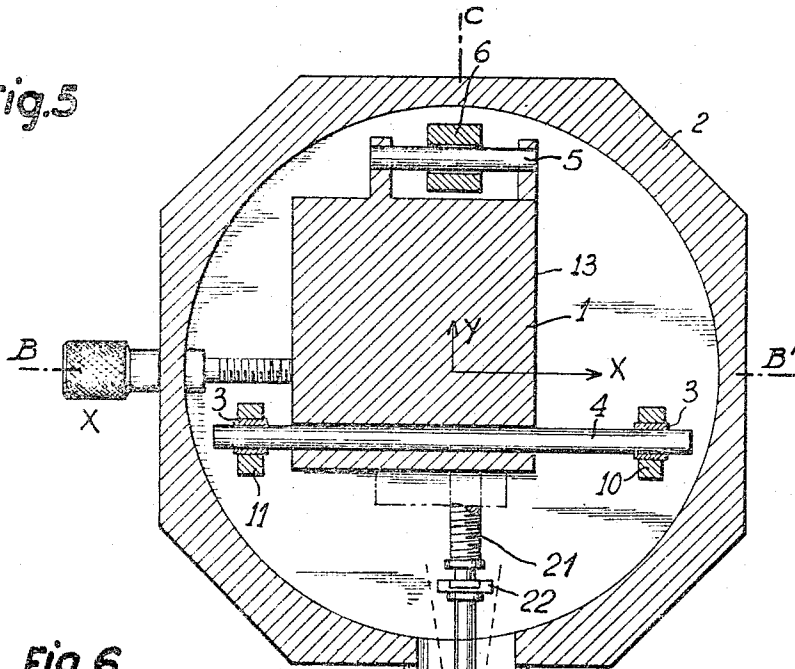
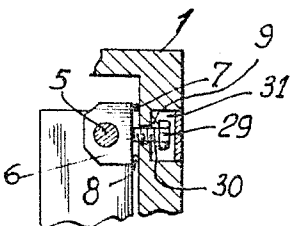


Fig. 6



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1

3,318,593

MICROPOSITIONING MECHANISM

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6 Claims. (Cl. 269—60)

The present invention relates to mechanism for providing small displacements of an object in a given direction.

According to the invention there is provided a mechanism for providing limited displacements of a stage member in a given direction, comprising a rigid support, first and second coplanar and parallel elastic strips, extending in respective planes normal to said direction and having their ends rigidly connected to said support and to said member respectively, the respective intermediate portions of said first strips being rigidly connected to a rigid body, rigidly connected by further parallel elastic strips, directed along said given direction, to said support and member and means for pivoting said body about the line of intersection of the planes respectively tangent to said first strips and said further strips.

The invention is particularly applicable to the displacement of a stage, such as a microscope stage.

For a better understanding of the invention and to show how the same may be carried into effect, reference will be made to the drawing, accompanying the following description and in which:

FIG. 1 shows in section one embodiment of an arrangement according to the invention, given by way of example;

FIG. 2 shows the same embodiment in perspective;

FIG. 3 shows a detail of FIG. 1;

FIGS. 4 and 5 show in cross-section one example of application of the invention; and

FIG. 6 shows a detail of FIG. 5.

FIGS. 1 and 2 show a fixed frame 1 generally shaped as a corner iron and including a vertical, plane and solid plate 301 having two lateral projections, as shown in FIG. 2, which carry on their upper ends horizontal elastic strips 16 and 17. The strips may be mounted, for instance, by means of screws.

Strips 16 are inset or screwed at their intermediate portions in a solid and substantially horizontal bar 303, which is in turn fixed to the vertical wall of plate 301, by vertical elastic strips 306, fixed at their ends to parts 301 and 303, respectively.

At their free ends, opposite to plate 301, strips 16 and 17 are fixed to a solid vertical plate 304, which is also fixed to bar 303 by further vertical strip 306.

An arm 302, solid with or fixed to bar 303, may be moved by means of a screw, screwed in plate 301 and terminated with a knurled knob 7, to adjust the position of bar 303.

The operation of the arrangement will be understood with reference to FIG. 3 which shows, at an enlarged scale, how plate 301 is fixed to bar 303.

As the screw actuated by knob 7 presses against arm 302 in the direction of the arrow, arm 302 tilts to the right. Strips 16, 17 and 306 are elastically distorted and, because their respective free lengths are small as compared to their total length, since they are fixed to parts 303 and 301, it can be shown that their distortion is such that the intersection line M of planes respectively tangential to strips 306 at their fixation points on plate 301 and to strips 16 at their fixation points on bar 303 remains stationary.

Thus the system of strips 16 and 17 may be considered as forming the sides of an articulated parallelogram whose sides 301 and 304 retain a fixed direction.

2

Side 304 thus moves in a direction parallel to itself. Since the displacements are of small extent, everything happens as though it were to slide along itself.

The invention may advantageously be applied for producing vertical displacements of a specimen carrying stage, designed for the examination of a small object by means of a vertical axis electron optics system. Such vertical movements, which are made when adjusting the instrument, are always of small amplitude.

In order to explore the various areas of an object, it is necessary to be able to move the object holder in two horizontal directions O_x and O_y . In addition, in spite of the fact that the arrangement is kept under high vacuum, all controls have to be extremely sensitive and accurate, and the object must be capable of being positioned to within 1μ .

FIGS. 4 and 5 show, respectively in section through planes BB' and AA', one embodiment of such an object holder or stage.

The stage system as a whole is located in a frame 2 which, once the evacuation has taken place, is in a fixed position. The stage has to be moved in three directions O_x , O_y and O_z forming a trirectangular trihedron with respect to this frame, the displacement along O_z taking place as just described.

In order to make displacements along O_x possible, the base of support 1 is provided with two rods 4 and 5 extending in the direction O_x . Rod 4 is slidably mounted in bearings 3 and rod 5 is slidably mounted in a bearing sleeve 6.

Bearings 3 are fixed to the bottom of frame 2. Sleeve 6 is, as shown in FIG. 6 in section along line C-C' of FIG. 5, mounted on the bottom of frame 2 with a certain degree of freedom. To this end, sleeve 6 is fixed to the bottom of frame 2 by means of a screw 30 whose head 29 bears against a cup 9 located in a cavity formed in the bottom of frame 2. Between frame 2 and sleeve 6 are placed two balls 7 and 8 so that the connection acts somewhat as a knee joint.

This three point mounting makes it possible to avoid any detrimental strain.

Since the assembly operates in vacuum, bars 3 and 5 are made of stainless steel and slide in plastic bearing rings.

The displacement in the direction O_x as obtained by means of a screw 25 driven by a knurled knob X.

The displacement along direction O_y is achieved in a similar manner. To this end the arrangement comprises a solid member 15, which plays the same part as member 304 of FIGS. 1 to 4 and is supported in the same manner. Member 15 carries rod 13 by means of two bearings (not shown) and similar to bearings 3. Rod 13 supports a stage 12. Stage 12 is also fixed to member 15 by means of a further rod 14 mounted in a further sleeve 27, entirely similar to and mounted as sleeve 6. Stage 12 is displaced along direction O_y by sliding on rods 13 and 14 by means of a screw 21, driven by a knurled knob Y connected thereto by means of flexible connections 22 and 23.

The displacement along direction O_z takes place as already described. It is performed by means of a gear 20 controlling a screw 19 acting on an arm 18, similar to the arm 302 of FIGS. 1 to 4. Gear 20 is actuated by means of a driving knurled knob Z.

Of course the invention is not limited to the embodiments described and shown which were given solely by way of example.

What is claimed is:

1. A mechanism for providing limited displacements of a member in a given direction, comprising: a rigid support; first coplanar and parallel elastic strips; second coplanar and parallel elastic strips extending in a plane

3

parallel to said first strips; said strips extending in respective planes normal to said direction and having ends rigidly connected to said support and to said member respectively and having respective intermediate portions; a rigid bar rigidly connected to said intermediate portions of said first strips; first and second further parallel elastic strips directed along said given direction and rigidly connecting said bar to said support and said member respectively; and means for pivoting said bar about the line of intersection of the planes respectively tangent to said first strips and said first further strips.

2. A mechanism for providing limited displacements of a member in a given direction, comprising: a rigid support; a pair of first coplanar and parallel elastic strips; a pair of second coplanar and parallel elastic strips extending in a plane parallel to said first strips; said strips extending normally to said direction and having ends rigidly connected to said support and to said member respectively and having respective intermediate portions; a rigid bar rigidly connected to said intermediate portions of said first strips; first and second further parallel elastic strips directed normally to the plane of said first strips and rigidly connecting said bar to said support and said member respectively; and means for pivoting said bar about the line of intersection of the planes respectively tangent to said first strips and said first further strips.

3. An object carrier stage arrangement including a mechanism for providing limited displacements of said stage in a first direction and the respective displacements thereof in a second and a third mutually perpendicular directions perpendicular to said first direction, comprising in combination: a rigid support; a stage carrier member; first coplanar and parallel elastic strips; second coplanar and parallel elastic strips extending in a plane parallel to said first strips; said strips extending in respective planes normal to said first direction and having ends rigidly connected to said support and to said stage carrier member respectively and having respective intermediate portions; a rigid bar rigidly connected to said intermediate portions of said first strips; first and second further parallel elastic strips directed along said first direction and rigidly connecting said bar to said support and said stage carrier member respectively; means for pivoting said bar about the line of intersection of the planes respectively tangent to said first strips and said first further strips; a fixed frame; bearing means solid with said frame and supporting said support slidably in said second direction; further bearing means solid with said stage carrier member and supporting said stage slidably in said third direction; and means for displacing said support and said stage in said second and third directions respectively.

4. An object carrier stage arrangement including a mechanism for providing limited displacements of said stage in a given vertical direction, and the respective displacements thereof in a second and a third mutually perpendicular horizontal directions comprising in combination: a rigid support; a rigid stage carrier member; first coplanar and parallel elastic strips, second coplanar and parallel elastic strips extending in a plane parallel to said first strips; said strips extending in respective planes normal to said vertical direction and having ends rigidly

4

connected to said support and to said member respectively and having respective intermediate portions; a rigid bar rigidly connected to said intermediate portions of said first strips; first and second further parallel elastic strips directed along said vertical direction and rigidly connecting said bar to said support and said stage carrier member respectively; means for pivoting said bar about the line of intersection of the planes respectively tangent to said first strips and said first further strips; a fixed frame; a table carrying said rigid support; a first and a second rigid rod carried by said table, extending in said second horizontal direction; two first bearings and a first sleeve, carried by said frame, said first and second rods being slidably mounted respectively in said first bearings and in said first sleeve; a stage having a third and a fourth rod extending in said third direction; two second bearings and a second sleeve carried by said stage carrier member; said third and said fourth rods being slidably mounted in said second bearings and in said second sleeve.

5. An object carrier stage arrangement including a mechanism for providing limited displacements of said stage in a given vertical direction, and the respective displacements thereof in a second and a third mutually perpendicular horizontal directions comprising in combination: a rigid support; a rigid stage carrier member; first coplanar and parallel elastic strips, second coplanar and parallel elastic strips extending in a plane parallel to said first strips; said strips extending in respective planes normal to said first direction and having ends rigidly connected to said support and to said member respectively and having respective intermediate portions; a rigid bar rigidly connected to said intermediate portions of said first strips; first and second further parallel elastic strips directed along said first given direction and rigidly connecting said bar to said support and said stage member respectively; means for pivoting said bar about the line of intersection of the planes respectively tangent to said first strips and said first further strips; a fixed frame; a table carrying said rigid support, a first and a second rigid rod carried by said table, extending in said second horizontal direction; two first bearings carried by said frame and a first sleeve, non-rigidly mounted on said frame, said first and second rods being slidably mounted respectively in said first bearings and in said first sleeve; a stage carrying a third and a fourth rod extending in said third direction; two second bearings solid with said stage carrier member and a second sleeve non-rigidly mounted on said member; said third and said fourth rods, being slidably mounted in said second bearings and in said second sleeve.

6. A system as claimed in claim 5, comprising screws connecting said sleeves respectively to said frame and member and balls interposed between said sleeves and said frame and member respectively.

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