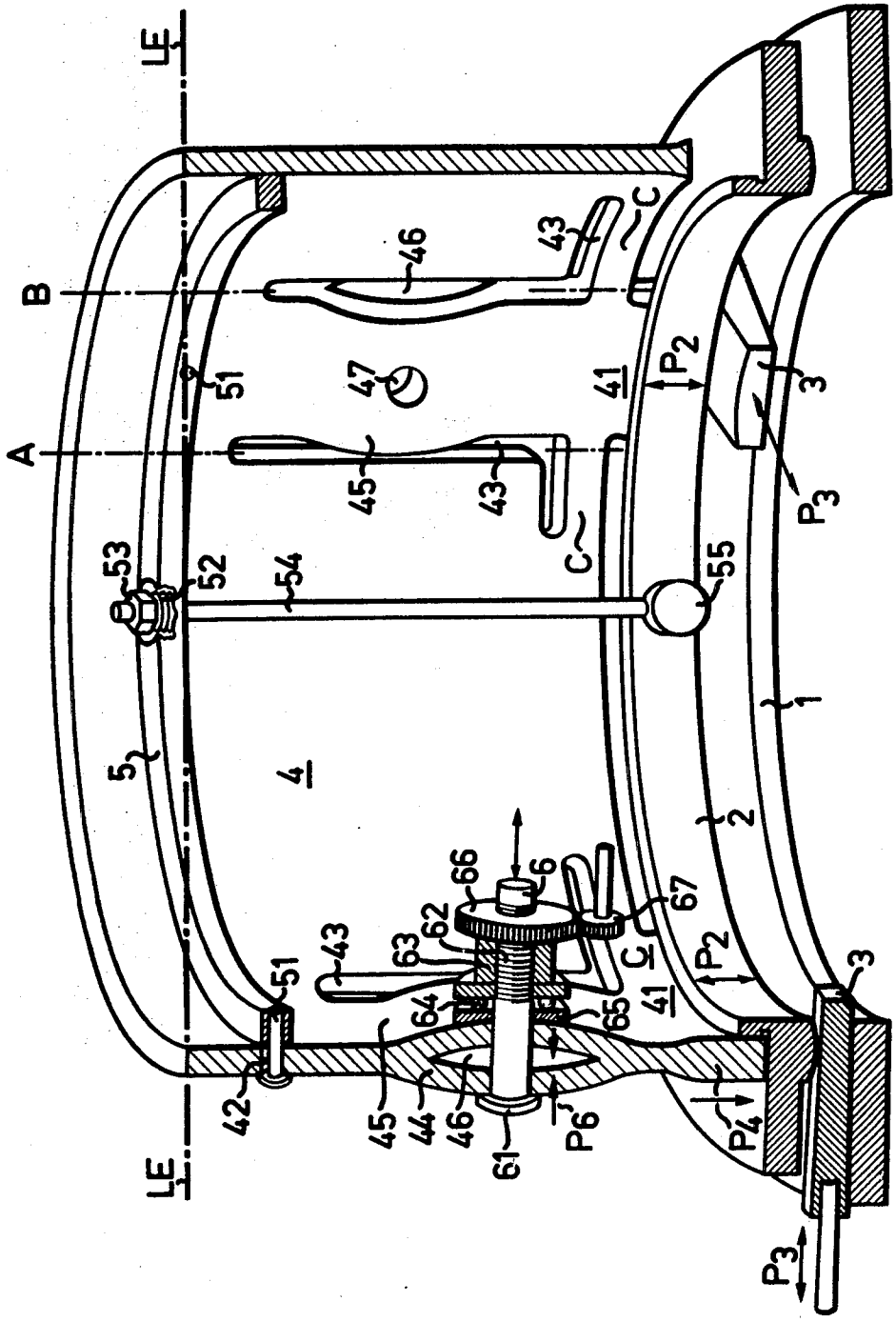
Sept. 28, 1971 K. BAUR 3,608,364

ADJUSTING ARRANGEMENT

Filed July 3, 1968



INVENTOR:
KARL BAUR

By: Michael S. Striker
Attorney

United States Patent Office 3,608,364 Patented Sept. 28, 1971

3,608,364

ADJUSTING ARRANGEMENT

Karl Baur, Neuenburg, Switzerland, assignor to Contraves AG, Zurich, Switzerland

Filed July 3, 1968, Ser. No. 742,372
Claims priority, application Switzerland, July 6, 1967, 9,574/67
Int. Cl. G05d 3/00
U.S. Cl. 73—88 8 Claims

ABSTRACT OF THE DISCLOSURE

An adjusting device for effecting precision length adjustments. A stressable structural member has two spaced end sections an intermediate section integral with the end sections and split in the direction from one to the other of the end sections so that it is provided with a center gap of substantially lenticular cross-sectional configuration. A stressing arrangement serves to compress the intermediate section transversely of this gap to varying degrees, whereby the longitudinal extension of the member increases as the intermediate section is progressively compressed and decreases as the intermediate section is progressively relieved of compressive stress transversely of the gap.

BACKGROUND OF THE INVENTION

The present invention relates to an adjusting arrangement in general, and more particularly to an adjusting arrangement for effecting precision length adjustments.

In many applications, for instance in the precise adjustment and positioning of astronomical devices and the like, it is necessary to effect very precise adjustments of the positioning. For this purpose it is known to vary the longitudinal extension of certain structural members. However, if the length adjustments which are to be obtained are very small, for instance on the order of between 0.1 and 2μ, and if it is necessary that they be exactly reproducible, then the known arrangements of this type are insufficient for the desired purposes because they admit of unintended variations in the selected length of the structural member, and on the other hand, are not precise enough to provide for the minute length variations which it is desired to obtain.

It is therefore an object of the invention to overcome these disadvantages.

A more particular object of the invention is to provide an adjusting arrangement capable of providing precise, and precisely reproducible length variations of structural members, which length variations are of small but precisely adjustable magnitude.

SUMMARY OF THE INVENTION

In accordance with these objects, and others which will become apparent hereafter, one feature of my invention resides in providing, in an arrangement of the type here under discussion, a stressable structural member having two end sections which are spaced in a predetermined direction and a middle section which includes an intermediate portion between and integral at its opposite ends with the end sections. A stressing portion is juxtaposed with this intermediate portion and rigid with the aforementioned opposite ends thereof, and this stressing portion defines with the intermediate portion a gap having a given maximum width transversely of the aforementioned predetermined direction. Stressing means is associated with the intermediate portion and with the stressing portion and is operative for varying the width of the gap to thereby obtain concomitant variations in the distance between the aforementioned end sections.

The stressable structural member, which may obviously be of various different configurations ranging for example from a rod to a flat or annular wall, may in a currently preferred embodiment of my invention be split in its middle section. In other words, the middle section intermediate the end sections may be split, advantageously in such a manner as to obtain two portions which bulge in directions oppositely away from each other and symmetrically to the plane of symmetry with the intersecting end sections and the middle section. I thus obtain between these portions a gap of substantially lenticular cross-sectional configuration. By subjecting the opposite portions to compression across this gap in direction towards one another against the elastic restoring force of the material of the structural member, I cause small changes in the distance between the end sections of the structural member, that is I vary the longitudinal extension of the structural member. The extent of longitudinal variation will of course depend on the extent to which I compress the opposite portions towards one another, and to reverse the thus-obtained elongation of the structural member I need merely relax this compression.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single figure is a diagrammatic partly sectioned elevation of an arrangement comprising my invention in one embodiment thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the drawing I have shown by way of example a single instance of an application of my present invention. It is to be understood, however, that this is not to be considered limiting in any way and constitutes merely a specific application of my invention for a specific problem.

The drawing is assumed to illustrate a supporting arrangement for a precision clinometer, for example a phototheodolite. The measuring instrument itself is not illustrated because it is not essential for an understanding of the invention.

Reference numeral **1** in the drawing designates a base or supporting ring which is suitably mounted on a base, for example a non-illustrated pedestal. A second ring mount **2** overlies the supporting ring **1** and its distance from the latter is adjustable, as is its horizontal alignment by means of three wedge members **3** which are interposed between the ring mounts **1** and **2** at equi-angularly spaced locations, that is at locations which are offset circumferentially from one another by 120°. It should be mentioned here, if it is not already obvious, that the mounting arrangement illustrated is circular, the portion which is not shown not requiring such illustration because the invention may be readily understood from what has been reproduced in the drawing.

To obtain height adjustments of the member **2** with reference to the member **1**, or to obtain horizontal adjustments of the member **2**, the wedge members **3** are moved in the direction of the arrows **P3** by suitable non-illustrated drive arrangements, for instance screw spindles or the like. This effects adjustment of the member **2** in the direction of the arrows **P2**, and it is obvious that horizontal adjustment is obtained by moving only certain of the members **3**, or by moving the the members **3** to different extents. Of course, the drive arrangements for the

members 3 may be suitably constructed, for instance so that if they are operated by hand a full turn of the screw spindle may effect a tilting of the ring member 2 to a given extent, for instance 12 seconds of arc. However, what has been described thus far is not novel and does not constitute a part of the invention.

The ring member 2 supports a cylindrical member 4 having an upper edge face whose plane LE is identified by the chain line and on which a precision measuring device, such as a phototheodolite or the like, is supported. To obtain accurate readings of such devices it is necessary that they be precisely adjustable in a horizontal plane, and accordingly the upper edge face of the cylindrical member 4 must similarly be precisely adjustable in a horizontal plane, with the angular deviation of the plane LE—and thereby of the supported measuring device—from the exact horizontal plane not being permitted to exceed 0.1 second of arc at any circumferential point of the member 4. The member 4 is provided in this embodiment with three downwardly projecting legs or supporting portions 41 (only two shown) which rest on the ring member 2 above the wedge members 3. Strong spring-biassing means is provided for biassing the member 4 downwardly against the ring 2, and thus against the ring 1. For this purpose the member 4 is provided with the illustrated circular flange 5, having secured thereto radially outwardly projecting bolts 51 which extend into openings 42 which are provided in the member 4 upwardly above the legs 41. Rods 54 are secured with their lower ends 55 to the ring member 2, or if desired to the ring member 1, and their upper ends extend through the flange 5 and carry stacks 52 of dished springs which can be compressed in a biassing sense, that is in a sense causing the member 4 to be pressed downwardly against the members 1 and 2, by tightening the nuts 53 screwed onto the upper free ends of the rods 54. It will be appreciated that a suitable number of such rods will be provided. This, however, is also not novel and is illustrated only by way of example and for better understanding of the invention.

Because of the required precision adjustment which has been discussed before, one embodiment of my invention is incorporated in the illustrated construction. Specifically, the member 4 is provided upwardly above the legs 41, and thus at three equi-angularly spaced locations with a slot in its intermediate section, that is between the upper edge face and the respective leg 41. Thus, in the slotted regions I provide two wall portions 44 and 45 which are respectively deformed radially outwardly and radially inwardly so as to bulge in the manner illustrated, and they define between themselves a lenticularly-configurated gap 46. It will now be appreciated that any one of the wall portions of the member 4 which is thus configurated, that is a portion extending from the respective leg 41 to the upper edge face above this leg 41, may be in itself considered the equivalent of an independent structural member provided with my novel invention. In the illustrated embodiment, however, three such "structural members" are integrated as part of the member 4. Evidently, a rod or other member similarly slotted comes within the scope of the present invention.

The member 4 may be provided in form of a steel casting, if desired, with the wall portions 44, 45 and the lenticular gap therebetween being provided during the casting operation.

In further accordance with the invention the wall portions 44 and 45 of the illustrated embodiment are provided with centrally located registering radial bores 47, and through each set of these bores a spindle 6 (one illustrated) extends. The spindle 6 has a head 61 which engages the outer side of the wall portion 44 and a free end which projects inwardly through the wall portion 45 is provided with a fine-adjustment screw thread 62. A sleeve-shaped nut member 63 is threaded onto the screw thread 62 and bears upon the wall portion 45 via a thrust bearing 64 through which it transmits stresses in its axial direction to the wall portion 45 through the intermediary of a ring member 65.

The nut member 63 constitutes the drive wheel of a multi-stage reduction gear of which I have illustrated only the gear wheels 66, 67. Evidently, the specific construction of such a gear may be selected as desired. It will for instance be understood that the gear may be driven via a servomotor, or that it may be operated by hand. It is possible for example to construct the reduction gear that there is a reduction of 1:3,200 between the (non-illustrated) actuating means for the reduction gear and the sleeve-shaped nut member 63. Of course, this gear ratio is given only by way of example and is by no means to be considered limiting.

Operation of the reduction gear, that is turning of the nut member 63 in a sense causing it to exert stresses on the wall portion 45, the wall portions 44 and 45 are compressed towards one another across the gap 46 in the direction of the arrow P6. This results in a concomitant longitudinal extension of the member 4 in the direction of the arrow P4. This extension takes place, of course, only in the region of the member 4 where my invention is incorporated. The member 4 is provided at opposite sides of the respective slotted portions with substantially L-shaped cut-outs 43 so as to facilitate bending of the wall of the member 4 in the region of the zones C which occurs when the elongation just described takes place. Evidently, the elongation can be reversed by reducing the compression stresses acting upon the wall portions 44, 45. By suitable adjustment the length variations, or in this embodiment the height variations which can be obtained in this manner and which are very small, can be very precisely selected and are of course reproducible at will. If desired, the gear reduction ratio and the pitch of the screw thread 62 for the nut means 63 may be so selected that a given number of turns of the (non-illustrated) drive or actuating member for the reduction gear—for example twelve such full turns—result in a tilting of the upper edge face of the member 4, that is of the plane LE of this upper edge face, with respect to the two horizontal plane by one second of arc. In any case, however, the arrangement can be made so precise that adjustments on the order of 0.1 second of arc can still be obtained with great precision and can be reproduced at will.

It will be appreciated that this is by no means the only application for the present invention. For instance, the invention can be embodied in a differently configurated structural member and can be used for adjusting a positioning or supporting mechanism for a tool in a machine, or for other purposes.

It will also be appreciated that the invention is applicable not only to the slotted configuration shown by way of example in the drawing, but that it is also conceivable to construct a structural member in such a manner as to for example eliminate one of the wall portions 44 or 45. If, for example, it is assumed that the structural member were to comprise only the upper and lower sections and for example the wall portion 44 with the wall portion 45 not being integral as shown, then such a wall portion corresponding to the wall portion 45 could be separately provided and for example welded to the structural member. This would of course result in a construction whose operation would be the same as what has been described above.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an adjusting arrangement, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

What I claim is:

1. A support structure capable of providing extremely accurate level adjustment, comprising an annular support; a cylindrical structural member of elastically deformable material mounted on said support with its longitudinal axis in upright orientation and having an upper axial end face, said cylindrical structural member having a circumferential wall integrally provided at least at three equiangularly spaced locations with respective pairs of juxtaposed, laterally spaced wall portions and the wall portions of each pair each having a top and bottom end and being so formed as to be integral with each other at the respective ends, thereby defining between said juxtaposed wall portions of each pair a respective gap; and a force applying means provided at each of said gaps and operatively connected to the respective juxtaposed wall portions for applying a force in a direction across the respective gap and transverse to the longitudinal axis of said cylindrical structural element so as to cause the respective juxtaposed wall portions to elastically deform when force is applied, thereby inducing a stress in the elastically deformable material causing said material to yield in elastic strain deformation, whereby to obtain precise adjustment of said upper axial end face with reference to a given plane by requisite operation of the respective force applying means.

2. A structure as defined in claim 1, wherein said structural member consists of metallic material.

3. A structure as defined in claim 1, wherein said wall portions member and said circumferential wall are of one piece with one another.

4. A structure as defined in claim 7; said force applying means comprising screw-threaded means extending across said gaps connecting said wall portions and being operative relatively for deflecting the latter across the respective gap to lesser or greater extents at the will of an operator and for obtaining lesser or greater adjustments.

5. A structure as defined in claim 8, said force applying means further comprising turning means associated with said nut means and including reduction-gear means for facilitating turning of said nut means.

6. A structure as defined in claim 5; and further comprising thrust-bearing means interposed between said one wall portion and said nut means for transmitting stresses therebetween.

7. A structure as defined in claim 1, said circumferential wall of said cylindrical structural member being split at the respective circumferential locations to thereby provide the respective pairs of juxtaposed wall portions; and wherein said gaps are of substantially lenticular cross-sectional configuration.

8. A structure as defined in claim 4, one of said wall portions of each pair being provided with an opening facing the other wall portion, and wherein said screw-threaded means comprises a bolt extending through said opening and having one end rigid with said other wall portion and an other end projecting outwardly through said opening of said one wall portion; said force applying means further comprising nut means threaded onto said other end and being threadedly displaceable thereon to thereby engage said one wall portion and effect inward deflecting of said wall portions across the respective gap.

References Cited

UNITED STATES PATENTS

943,063	12/1909	Cooke	248—178
3,122,840	3/1964	Karstens	33—207
652,404	6/1900	Sharp	254—126
3,317,187	5/1967	Steppon	254—126

FOREIGN PATENTS

139,122	7/1959	Russia	73—95

RICHARD C. QUEISSER, Primary Examiner

M. SMOLLAR, Assistant Examiner

U.S. Cl. X.R.

33—207; 73—89; 248—179