Nov. 28, 1967 F. LESCHINGER ET AL 3,354,550

DRAWING APPARATUS INCLUDING A RUNNING CARRIAGE

Filed Jan. 27, 1966 6 Sheets-Sheet 1

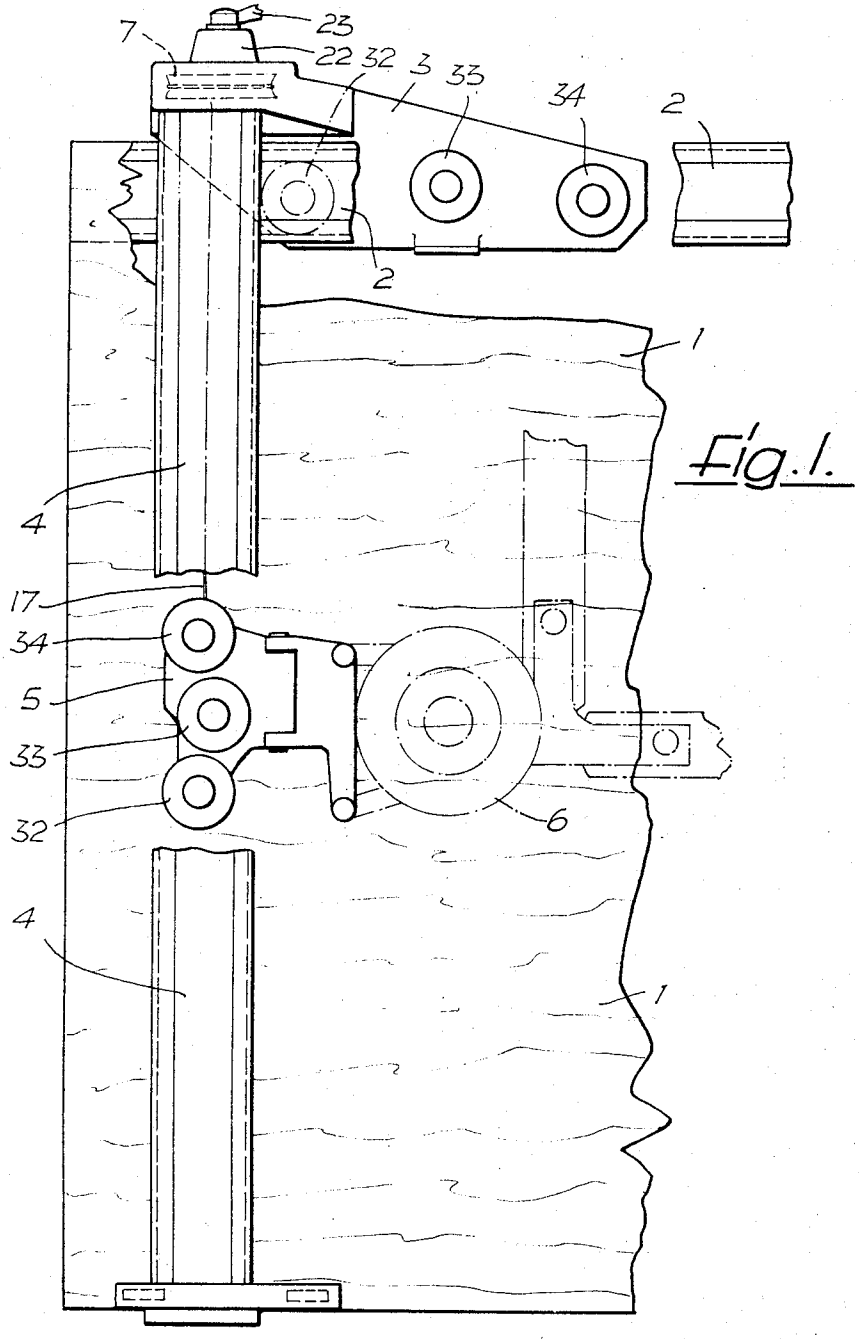


Fig. 1.

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DRAWING APPARATUS INCLUDING A RUNNING CARRIAGE

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Fig. 2.

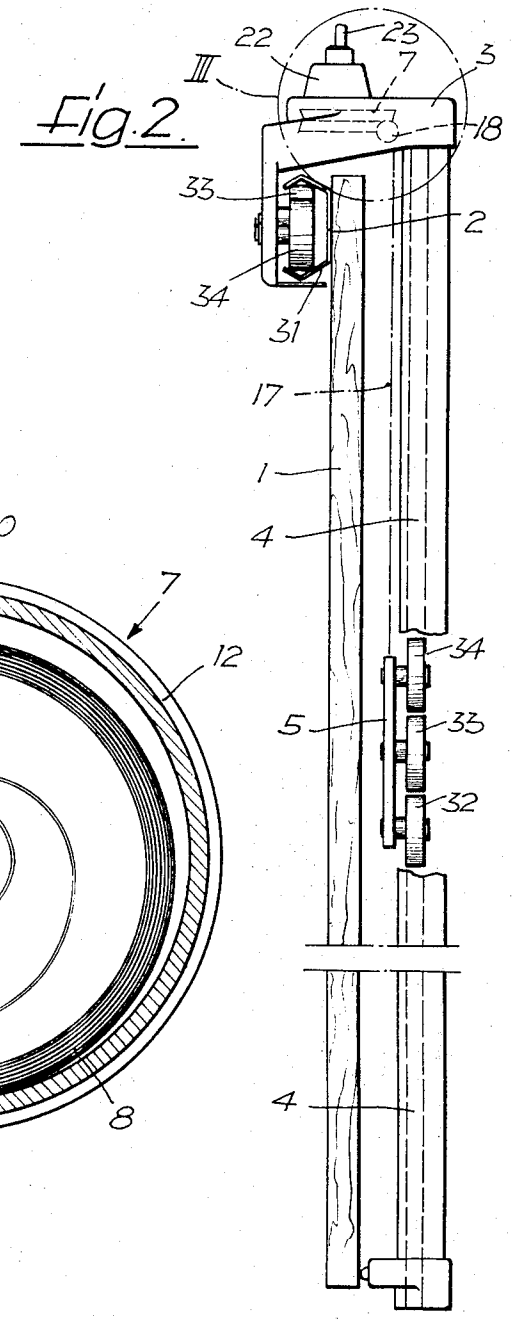
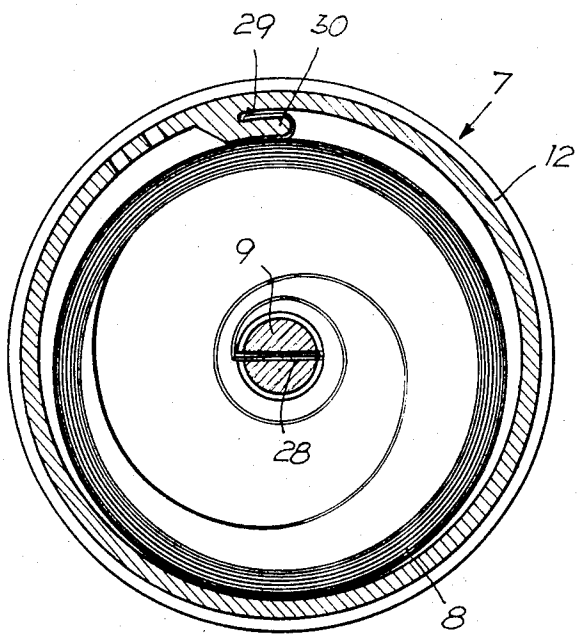


Fig. 4.



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DRAWING APPARATUS INCLUDING A RUNNING CARRIAGE

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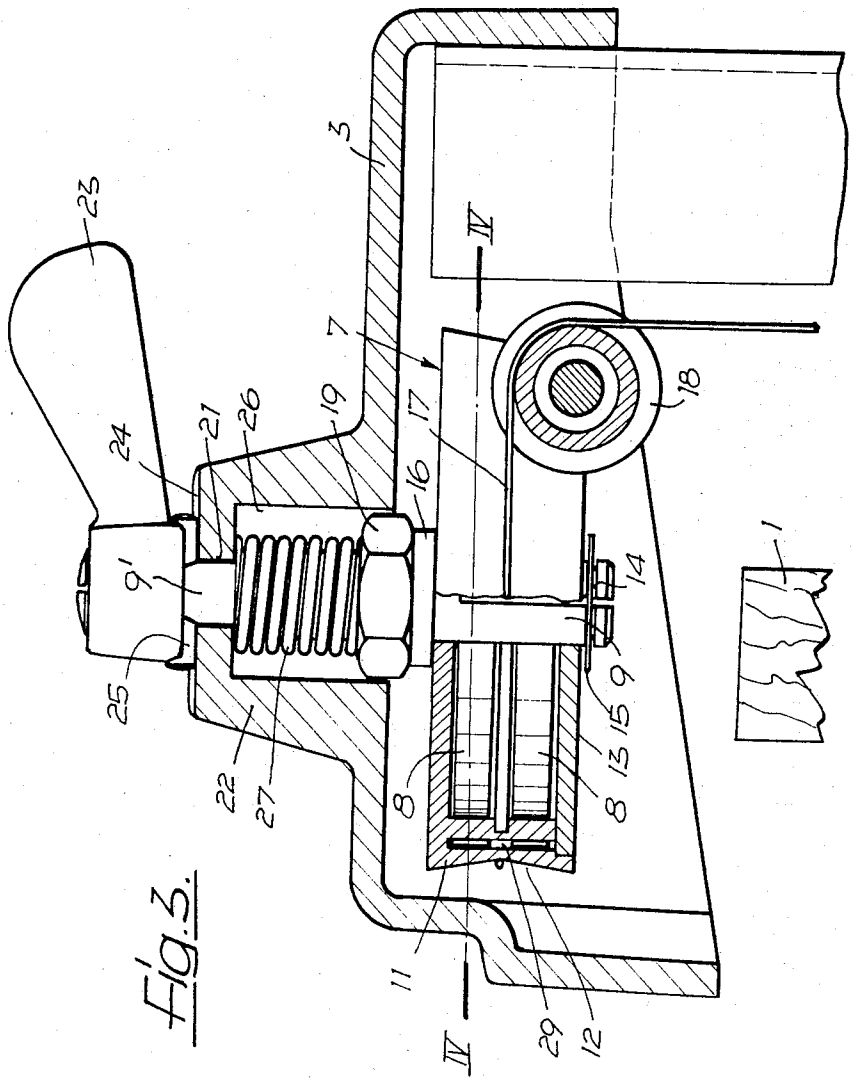


Fig. 3.

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DRAWING APPARATUS INCLUDING A RUNNING CARRIAGE

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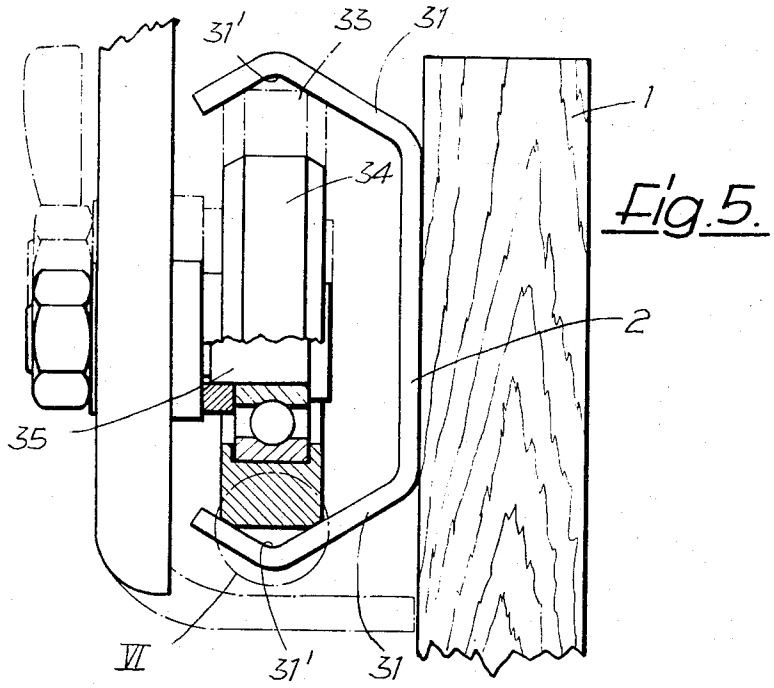
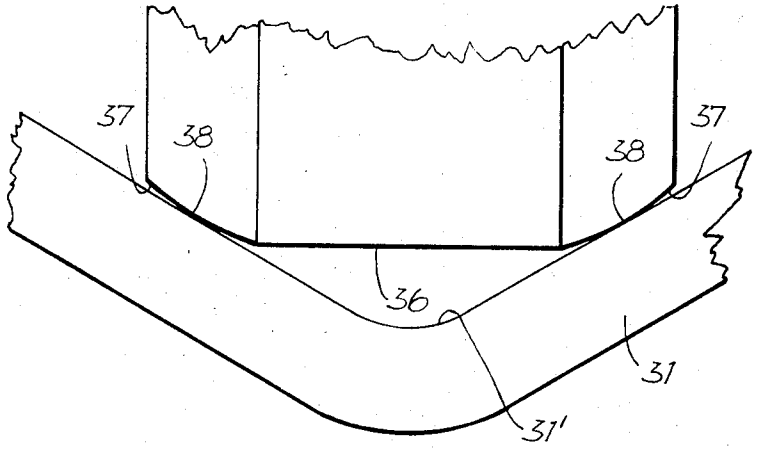


Fig. 5.

Fig. 6.



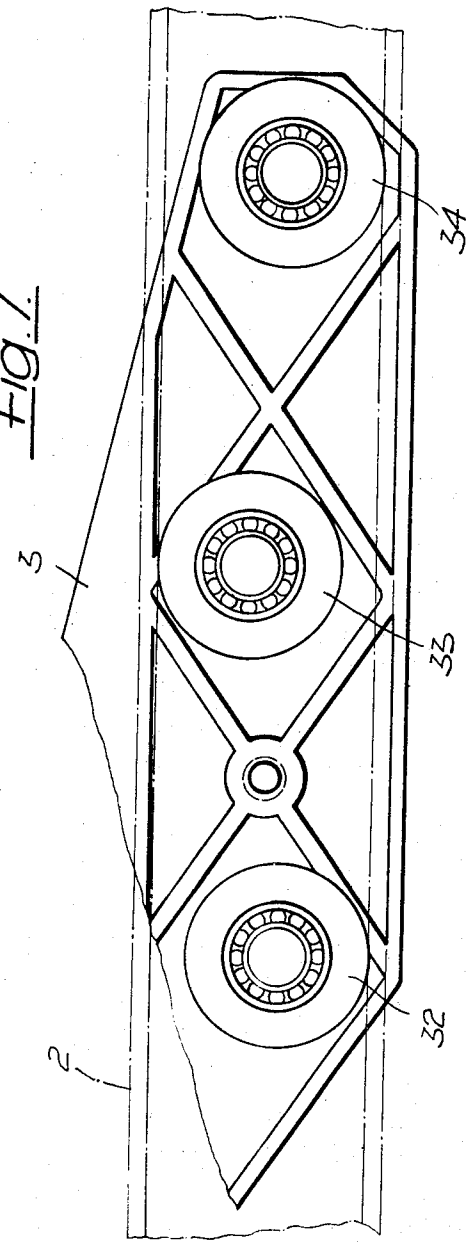
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DRAWING APPARATUS INCLUDING A RUNNING CARRIAGE

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Fig. 7.



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DRAWING APPARATUS INCLUDING A RUNNING CARRIAGE

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Fig. 8.

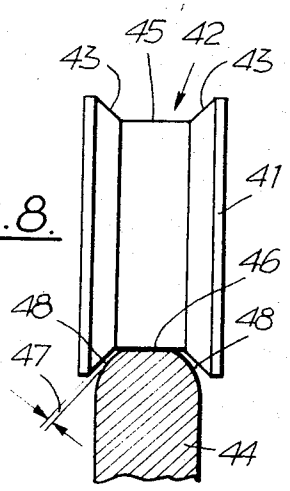


Fig. 10.

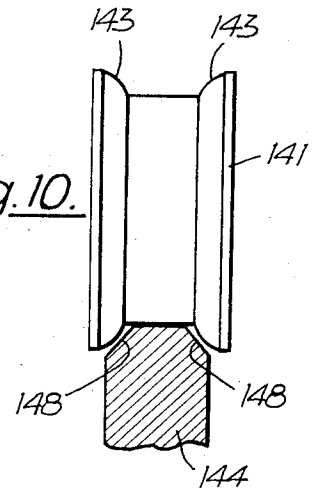
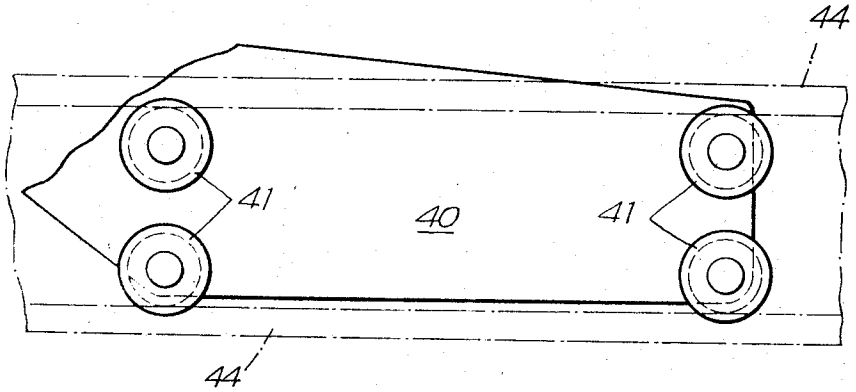


Fig. 9.



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DRAWING APPARATUS INCLUDING A RUNNING CARRIAGE

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Claims priority, application Germany, Feb. 4, 1965, N 26,159, N 17,130
9 Claims. (Cl. 33—79)

ABSTRACT OF THE DISCLOSURE

A drawing board having two perpendicular rails each supporting a running carriage, one of the rails carried by one running carriage, the other carriage carrying a drawing head. Weight balancing means for counter balancing the weight of the carriage and drawing head combination when the board is non-horizontal. The weight balancing means has a pretensionable spiral spring and housing mounted on a bearing bolt. A cable is wound around the housing and attached at its other end to the carriage and drawing head combination. Means are provided including a lever, a cam, a helical/spring and a hexagonal nut engaging the hexagonal interior of a bearing housing for adjusting and maintaining the spiral spring pretension.

The present invention relates to a drawing apparatus including a running carriage, in general, and to such apparatus which is equipped with a first running carriage guided by a horizontally disposed first rail connectable with a drawing board, which running carriage supports a second rail, which extends perpendicularly to the first rail and which is adapted for the guidance of a second running carriage, which supports a drawing head.

A drawing apparatus of this type is provided, as a rule, for drawing tables having a swingable drawing board. The drawing board stands during its practical use normally in a position inclined towards a horizontal plane or also in vertical position, so that the second rail forms normally an angle with a horizontal plane. In order to make possible in such arrangements that the second running carriage can be displaced with the drawing head as easily as possible along the inclined second rail, it is known to provide a weight balancing for the weight of the second running carriage and of the drawing head. In known drawing apparatus including a running carriage, a balancing weight guided on the back side of the drawing board parallel to the guide rail is used as for the weight balancing. By this arrangement, a very exact weight balancing is brought about. This arrangement, however, has the drawback that it requires a comparatively large space, since here a particular guide is required for the balancing weight. Furthermore, the weight of the apparatus is increased by such weight, which corresponds with the weight of the running carriage.

In the known drawing apparatus, the running carriages are guided on the rails by means of rollers. For the lateral guidance of each roller on its rail, a first U-shaped profile having outwardly diverging inner faces of the profiled leg members and serving as first lateral engaging faces, are provided on one of these two parts and a second profile interengaging the first U-shaped profile is provided on the other of these two parts, which second profile has lateral faces serving as second lateral engaging faces for the engagement with the first lateral engaging faces of the first profile.

This arrangement of the rollers and of the rails is required for the reason, because the gravity force is, at

different inclinations of the drawing board, not only vertical but also inclined or parallel to the roller axes of the running carriages, so that the rollers load their rails not only vertically, but also laterally. The lateral roller load results also in connection with the unavoidable non-symmetrical loads of the running carriages.

In the known apparatus, the first and second engaging faces are designed such, that they engage either with the total overlapping engaging faces or, at least, in form of an engaging line. Due to the rotating movement of the rollers during displacement of the running carriage, this engaging face and this engaging line, respectively, is then turned such, that a comparatively large friction resistance is created. For this reason, the known running carriages have a comparatively heavy run, which is the case in particular, when the angle between the direction of the gravity force and of the roller axes is smaller than 90°.

It is one object of the present invention to provide a drawing apparatus including a running carriage, wherein a possibly simplest and economical structure is obtained and, in order to assure nevertheless, that the drawing apparatus functions without any faults.

It is another object of the present invention to provide a drawing apparatus including a running carriage, wherein the weight of the drawing apparatus is kept as small as possible.

It is still another object of the present invention to provide a drawing apparatus including a running carriage, wherein the weight balancing device is designed such that it requires as little space as possible.

It is a further object of the present invention to provide a drawing apparatus including a running carriage, wherein, in combination with a possibly simplest and economical structure, non-objectionally and very exact running characteristics of the running carriages are obtained.

It is still another object of the present invention to provide a drawing apparatus including a running carriage, wherein a small weight and a possibly simplest and economical structure is applied.

It is yet a further object of the present invention to provide a drawing apparatus including a running carriage, wherein the rollers and the rails are designed such, that in case of a lateral load possibly lowest friction forces occur between the rollers and the rails, so that a possibly light run of the running carriage is obtained.

It is also still a further object of the present invention to provide a drawing apparatus including a running carriage, wherein, between the first and the second lateral engaging faces of the rollers and of the rails, a point contact is arranged.

It is, furthermore, an object of the present invention to provide a drawing apparatus including a running carriage, wherein at least one spiral spring is provided as a balancing weight, which spiral spring is disposed between a bearing bolt connected with the guide rail and a spring housing rotatably mounted on the bearing bolt, which spring housing forms a winding roller for a cable connected with the running carriage. Spiral springs have the characteristic, that the spring force opposing the turning of one spring end relative to the other spring end about the longitudinal axis of the spring increases very slowly in dependency upon the angular path during rotation of the moved end. In spite of the application of a spring, the running carriage can be stopped in any position along the rail, without being withdrawn by the spring, which occurrence is unavoidable in known drawing apparatus by application of a spring as a weight compensation. Due to the fact, that the spiral spring is disposed in a spring housing forming a winding roller, it requires only very little space. Also the weight of the spiral spring is comparatively low. The spring housing can be made of synthetic material, so that the latter does not influence to

any great extent the weight of the apparatus. Also the bearing bolt can be comparatively small and light, for instance of light metal.

In an advantageous embodiment of the present invention, two spiral springs, disposed parallel relative to each other, are provided. Experiments and calculations by the inventors have disclosed that, by the application of two spiral springs disposed parallel relative to each other, the flat range of a force-path-diagram is appreciably enlarged and the increase of the force can be appreciably reduced within this range.

A particular advantage of the present invention resides in the fact that the spiral spring and the spiral springs, respectively, can be selected such, that the holding force, caused by the spiral springs within the flat range of the force-path-diagram, is at such ratio to the friction force effective upon the running carriage and the weight of the running carriage, that in case of a change of the inclination of the drawing board, the reduction of the weight component of the running carriage, effective against the force of the spiral spring, is compensated by the increase of the friction force between, for instance, a drawing head connected with the running carriage and its scales, on the one hand, and the drawing board, on the other hand, so that it is always assured, even at different inclinations of the drawing board, that the running carriage remains in the position into which it has been moved.

In order to obtain, nevertheless, in cases in which such compensation in the most extreme inclination positions of the drawing board, for instance, in the horizontal position and in the vertical position, is not completely possible, that the running carriage remains always in the set position, it is provided in an advantageous embodiment of the present invention, that for the selective adjustment of the pre-tension of the spiral spring, the bearing bolt is rotatably connected with the guide rail and is equipped at its end freely projecting from its rotary bearing, with a resting member, which, in order to retain the latter in the resting position, a spirally wound torsion spring is provided between a rotary bearing of the bolt and a nut screwed on the outer thread of the bolt, which nut is non-rotatably, but axially displaceably connected with the rail and is disposed at such distance from the spring housing that, upon rotation of the bearing bolt to a minimum pretension of the spiral spring, the nut abuts the spring housing and, thereby, limits the setting of this minimum pretension. By this arrangement it is obtained in a very simple manner that, by means of the resting member the pretension of the spiral spring can always be adjusted to the inclination of the drawing board. Due to the fact that, upon rotation of the bearing bolt, the nut abuts the spring housing at a minimum pretension of the spiral spring, in a surprisingly simple manner, it is prevented that, by improper handling of the resting device, the cable, connecting the spring housing with the running carriage, slides off its guide rollers. The spirally wound torsion spring can thereby be measured such, that its windings enter into engagement with each other at the highest permissible pretension of the spiral spring and, thereby, prevent a further rotation of the bearing bolt. By such arrangement, it is assured that the adjustment of the pretension of the spiral spring cannot lead to a disturbance of the function of the weight balancing.

The point-contact engagement of the lateral engaging faces, which is a desirable aim of the present invention, is obtained such, that for creation of a lateral point-shaped engagement between each roller and its guiding rail, the lateral engaging faces of one of these parts are convex cambered.

In a further advantaegous embodiment in which each roller of the running carriage has at its periphery a groove for the formation of the first U-shaped profile, the inner lateral walls of the groove form the first lateral engaging faces for the rail formed as a second profile, in accordance with a characteristic of the present invention, the base of the groove is formed as cylindrical running face for the engagement on the rail, which interengages between the first engaging faces formed by the inner side walls of the groove. By this arrangement, it is brought about in an advantageous manner, that normally the running carriages run on the cylindrical running faces of the rollers, so that thereby the lateral engaging faces, having point-contact only, are not subjected to wear, particularly if a play is provided here between the inner walls of the roller groove forming the first engaging faces and the lateral faces of the rail forming the second engaging faces.

In a further advantageous embodiment, in which the rail constitutes the first U-shaped profile and the roller has a profile interengaging the U-shaped profile of the rail, the two leg members form, in accordance with another characteristic of the present invention, concave angles pointing toward each other with vertex lines extending parallel to the rail axis and each of the faces pointing towards each other forms two first engaging faces and the running faces for the rollers interengaging the inside of the profile rail.

By such arrangement, it is brought about that the running carriage can be designed very small. Due to the fact, that the rollers engage with their edges, serving as second engaging faces, the first engaging faces forming jointly an angle, a perfect guidance of the rollers is obtained. The rail can be manufactured very easily with the required precision. Furthermore, the running faces of the rollers are protected against damages. Also, the entire running carriage can be designed so small, that it does not project beyond the guide rail, so that a small and space-saving structure is achieved which also esthetically is particularly effective in its appearance.

In an advantageous embodiment of the present invention, it is provided that the edges of each roller engaging the two first engaging faces of each profiled leg member, which engaging faces define an angle therebetween, are formed as convex cambered faces. By such arrangement, particularly good running characteristics are obtained, since the rollers now engage the running rails by point contact only. As particularly suitable, it has been found thereby that the rail is of metal and the rollers of friction-resistant synthetic material, since by such composition, a particularly quiet and noise-free run of the rollers within the rail is assured.

With these and other objects in view which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a top plan view of a drawing board with a first embodiment of an apparatus designed in accordance with the present invention;

FIG. 2 is an end view of the drawing board with the apparatus shown in FIG. 1;

FIG. 3 is a fragmentary section shown at an enlarged scale of a portion according to the line III in FIG. 2;

FIG. 4 is a section along the lines IV—IV of FIG. 3;

FIG. 5 is a fragmentary section of the upper portion of the drawing board in a side elevation shown at an enlarged scale and partly in section;

FIG. 6 is a fragmentary showing of a portion of FIG. 5 indicated by the line VI in FIG. 5;

FIG. 7 is a bottom plan view of a running carriage of the apparatus disclosed in FIG. 1;

FIG. 8 is a fragmentary elevation of a second embodiment of the arrangement, similar to that shown in FIG. 6;

FIG. 9 is a bottom plan view of a running carriage, similar to the showing in FIG. 7, in accordance with the embodiment of FIG. 8; and

FIG. 10 is an elevation of a third embodiment similar to the showing in FIGS. 8 and 9.

Referring now to the drawings, and in particular to FIGS. 1–7, the apparatus designed in accordance with the present invention comprises a first guide rail 2, which is secured to the upper horizontal edge of a drawing board 1, supporting a first running carriage 3. The latter carries a second guide rail 4 extending over the drawing board 1 perpendicularly to the first guide rail 2 for guiding a second running carriage 5, with which a drawing head 6 is swingably connected.

Since the second guide rail 4 for the second running carriage 5 forms an angle relative to a horizontal plane in all working positions, in which the drawing board 1 is not disposed in a horizontal position, the second running carriage 5 is pulled always downwardly by its weight along the guide rail 4. In order to compensate for the force caused by the weight of the running carriage 5 and the drawing head 6, two parallel arranged spiral springs 8 are provided in a spring housing 7, which spiral springs 8 are disposed between a bearing bolt 9 connected with the first running carriage 3 and, thereby, with the second guide rail 4 and the spring housing 7 rotatably mounted on the bearing bolt 9.

This spring housing 7 comprises a pot 11, in which the outer face of the substantially circular side wall forms a groove 12 extending about the entire pot, and a cover 13. The bolt 9 extends with its free end in bearing bores provided in the center of the bottom and of the cover 13 of the housing 7 and is equipped with a groove 14 adapted to receive a snap ring 15, in order to prevent an axial movement of the housing 7, and the bolt 9 is equipped further with a collar 16 for its engagement at the bottom of the pot 11. The entire housing 7 forms in this manner a winding roller for a cable 17, which is fed over a guide roller 18 and is connected with the second running carriage 5.

-The bearing bolt 9 is equipped above the collar 16 with outer thread for a hexagonal nut 19 and continues at its end connected with the first running carriage 3 into a pin 9', which enters a bore 21 of a pot-shaped bearing member 22 of the first running carriage 3. A manually operated lever 23 is secured to the end of the pin 9' projecting from the bearing member 22. The manually operated lever 23 has a resting cam 25 for engagement with resting grooves 24 extending radially from the bore 21 at its lower end pointed to the bearing member 22.

The hollow space or chamber 26 of the bearing member 22 has a hexagonal inner face corresponding to the substantially prismatic hexagonal outer face of the hexagonal nut 19, so that the nut 19 is axially displaceable in the hollow chamber 26, but is not rotatable. The length of the bearing bolt 9, and in particular the distance of the collar 16 from the manually operated lever 23 are measured such, that the nut 19 enters the chamber 26 in each of its positions on the bolt 9. A helically wound tension spring 27 is provided between the nut 19 and the bottom of the bearing member 22 on the bolt 9, which spring 27 is so long, that it must be compressed for securing the manually operated lever 23 on the pin 9', so that due to the force of the spring 27, the resting cam 25 is resiliently yieldingly pressed into the resting groove 24.

Each of the two springs 8 engages with one end a diametrically disposed slot 28 of the bearing bolt 9 and is secured with its other end on a projection 30 forming a slot 29 such, that its exerts a rotary moment upon the housing 7 relative to the position of the bearing bolt 9 determined by the resting cam 25, whereby the cable 17 is wound on the housing 7 and whereby the second running carriage 5 is pulled upwardly. By rotation of the manually operated lever 23, the pretension of the spring can be adjusted such, that it exerts a counter-effect against the weight component being effective upon the second running carriage 5. By such arrangement, the setting for a predetermined inclination range of the drawing board 1 is chosen such, that the difference between the weight

component at the largest inclination and the pulling force upon the cable 17 caused by the rotary moment of the spiral spring 8 is slightly smaller than the friction force of the running carriage 5 and of the scales of the drawing head 6 supported on the drawing board, which counter-acts the displacement of the running carriage 5. If this setting of the pretension of the spiral spring 8 is performed in the uppermost position of the running carriage 5 and if the springs 8 are dimensioned such, that the increase of the pulling force effective upon the cable 17 caused by the tensioning of the spiral spring during the downward movement of the vertical running carriage, does not reach the value of the above-stated friction force, due to the low inclination of the spring characteristic, then the second running carriage stops in any position, without being pulled down by its own weight or is pulled upwardly by the force of the spiral springs. Upon reducing the inclination of the drawing board, the weight component becomes smaller. However, the friction force, being effective upon the second running carriage 5, increases, so that also at lesser inclinations, the above-stated conditions are assured. Due to the fact that two spiral springs 8 are disposed parallel relative to each other, a particularly flat characteristic of the spring force increase is obtained, so that particularly favorable conditions result. If the drawing board is to be used in very extreme inclination positions, then the pretension of the springs 8 can be adjusted by means of the manually operated lever 23.

By setting of a pretension of the spiral springs 8, which is too great, the spring will be damaged. On the other hand, if the tension of the springs 8 is too low, the cable 17 can drop off the guide roller 18 and can lead to disturbances thereby. In order to avoid this drawback, the nut 19 is disposed in such position on the bolt 9, that upon de-tensioning of the springs 8 to the minimum permissible value by rotation of the bearing bolt 9 by means of the manually operated lever 23, the nut 19 secured by the bearing member 22 relative to this rotation abuts on the collar 16, and, thereby, a further rotation for reduction of the pretension of the springs 8 is prevented. Furthermore, the helically wound tension spring 27 is dimensioned such, that, upon tensioning the springs 8 by rotation of the bolt 9, the nut 19 displaces itself axially from the collar 16 on the bolt 9, the windings of the spring 27 engage each other, when the highest possible tension of the spiral springs 8 is obtained. By this arrangement, a further tensioning of the spiral springs 8 is prevented by the nut 19.

Thus, by the nut 19, not only a perfect mounting of the bearing bolt 9 is obtained, but also a security, that the spiral springs 8 cannot be adjusted to too low or too high a tension by means of the manually operated lever 23. The helically wound tension spring 27 serves thereby not only for the production of the yielding force, which is required for the engagement of the resting cam 25 in the resting groove 24, but also for the limitation of the maximum pretension of the spiral springs 8.

The housing 7 can be produced advantageously of synthetic material, so that it can be injection molded in a few producing steps and has a low weight.

Both guide rails 2 and 4 are U-shaped profiles, both leg members 31 of which form concave angles 31' pointing towards each other. Each of the faces of the leg members 31 pointing towards each other forms two first engaging faces for rollers 32, 33, and 34 interengaging the inner faces of the guide rails 2 or 4. These rollers are rotatably mounted on eccentric pins 35 connected with each of the two running carriages 3 and 5 rotatably and settable. The eccentric pins 35 are arranged such, that the axes of the two outer rollers 32 and 34 are disposed in a plane parallel to the longitudinal axis of the guide rails 2 or 4 and engage, thereby, one leg 31, while the center roller 33 is mounted in laterally displaced position, so that it engages the opposite leg 31.

As can be particularly ascertained from FIG. 6 of the drawings, the rollers **32**, **33** and **34** have a substantially cylindrical peripheral face **36**, the edges of which, serving as second engaging faces, form convex cambered faces **37**, which engage substantially with one point **38** only the legs **31** of the guide rails **2** and **4**. By this arrangement particularly good running characteristics are brought about.

The rollers **32**, **33**, and **34** are made of a synthetic wear-resistant material. The rails **2** and **4** are made of metal, so that a particularly quiet and noise-free run of the rollers results within the rails **2** and **4**.

Referring now again to the drawings, and in particular to FIGS. 8 and 9, different embodiments are disclosed herewith, according to which both running carriages **40** are equipped with four rollers **41** each, which have a groove **42** at their periphery for the formation of a U-shaped profile, the inner side walls **43** of the groove **42** forming first lateral engagement faces for the rails **44**. The base **45** of the groove **42** is formed as cylindrical running face for the engagement with a plane face **46** of the rail **44**, which interengages with play **47** between the first lateral engaging faces formed by the inner side walls **43** of the groove **42**. The inner side walls **43** of the groove **42** are, thus, of conical shape. The rail edges running on both sides of the rail face **46** are formed as convex cambered faces **48** for the formation of two lateral engaging faces.

By the design of the rollers and of the rail **44**, it is brought about, that in normal position, the rollers **41** run with the cylindrical groove base **45** on the face **46** of the rail **44**, so that due to the play **47**, practically **no friction** occurs. Upon lateral loading of the running carriage **40**, the rollers **41** engage then with one side wall **43** the convex cambered face **48** of the rail **44**, so that, thereby, between these two lateral engaging faces, only a point contact takes place, through which the friction is reduced to a minimum.

Concerning the embodiment disclosed in FIG. 10, the same effect can be obtained as in the embodiments disclosed in FIGS. 8 and 9, even when the edges of the rail **144** are designed as plane inclined faces **148** and the inner side walls **143** of the groove of the rollers **141** are convex cambered. Otherwise, the embodiment according to FIG. 10 corresponds exactly with the embodiment disclosed in FIGS. 8 and 9.

While we have disclosed several embodiments of the present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense, the scope of the present invention being determined by the objects and the claims.

We claim:

1. A drawing apparatus comprising

a first rail disposed parallel and adapted to be connected to a drawing board,

a first running member comprising a first running carriage movable and guided along said first rail, and

a second rail carried by said first running carriage and extending perpendicularly to said first rail and disposed parallel to said drawing board;

a second running carriage movable and guided along said second rail,

a drawing head carried by said second running carriage,

weight balancing means for balancing the weight of said second running carriage and of said drawing head, to be operative upon swinging said second rail into a plane inclined relative to a horizontal plane,

said weight balancing means comprising at least one spiral spring,

a bearing bolt connected with said second rail,

a spring housing rotatably mounted on said bearing bolt,

said spiral spring being secured at one end to said bolt and at the other end to said spring housing,

said spring housing constituting a winding roller, and

a cable wound on the outer periphery of said spring

housing and having a free end secured to said second running carriage,

said bearing bolt being rotatably mounted in said first running member, in order to permit a selective presetting of said spiral spring,

a rotary bearing disposed on said first running member and rotatably supporting said bearing bolt,

the latter projecting with its free end from said rotary bearing,

a resting member provided at the free end of said bearing bolt,

said bearing bolt having an outer thread,

a nut screwed on said outer thread of said bearing bolt,

said nut being axially movable, but non-rotatably connected with said first running member,

a helically wound compression spring disposed between said rotary bearing and said nut, in order to hold said resting member in any one of a plurality of resting positions, and

said nut spring being spaced apart from said spring housing such, that upon rotation of said bearing bolt for a minimum tension of said spiral spring, said nut abutting said spring housing and thereby limiting the adjustment for said minimum tension.

2. The drawing apparatus, as set forth in claim **1**, which includes

a collar provided on said bearing bolt to operate as abutment member for said nut, on the one hand, and for said spring housing, on the other hand.

3. The drawing apparatus, as set forth in claim **1**, wherein

said helically wound compression spring is designed such, that its windings engage each other in the position for the highest permissible tension of said spiral spring, whereby a further rotation of said bearing bolt is prevented.

4. The drawing apparatus, as set forth in claim **1**, wherein

said rotary bearing for said bearing bolt defines a chamber receiving said helically wound compression spring, and includes a bottom portion having a bore,

said bearing bolt is mounted in said bore of said bottom portion and by means of said nut on the inner wall of said chamber, and

said nut and said inner wall have complementary relative rotation preventing faces.

5. The drawing apparatus, as set forth in claim **1**, wherein

each of said running carriages has rollers for guidance along the corresponding rail,

one of said rollers and of said corresponding rail, constituting engaging parts, has a first U-shaped profile including outwardly diverging inner faces of the leg portions of said U-shaped profile serving as first lateral engaging faces on one of said parts, and a second profile interengaging said first U-shaped profile,

said second profile has lateral faces serving as second lateral engaging faces for engagement with said first engaging faces of said first profile, and

said lateral engaging faces of one of said parts have a convex curved cross-section, in order to bring about point contact between each of said rollers and the corresponding rail.

6. The drawing apparatus, as set forth in claim **5**, wherein

each of said rollers has at its periphery a groove, in order to form said U-shaped profile,

the inner lateral walls of said groove constitute said first lateral engaging faces for said rail constituting said second profile,

the base of said groove is formed as cylindrical running face for engagement with said rail, which interengages between said first engaging faces formed by said inner lateral walls of said groove.

7. The drawing apparatus, as set forth in claim 6, wherein

said inner lateral walls of said groove serving as said first engaging faces are of conical shape and the edges of said rails serving as said second lateral engaging faces form convex shaped faces.

8. The drawing apparatus, as set forth in claim 6, wherein

said inner walls of said groove forming said first engaging faces engage with play, said lateral faces of said rail forming said second engaging faces, upon engagement of said rail with said cylindrical groove base.

9. The drawing apparatus, as set forth in claim 5, wherein

said rails are of metal, and

said rollers are of friction-resistant synthetic material.

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