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Hagen et al.

[11] **3,857,618**

[45] **Dec. 31, 1974**

[54] **SYNCHRONIZATION AND PRECISION SEQUENCING OF BALL RETAINER RELATIONSHIP TO ONE-HALF OF SLIDE MOVEMENT**

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[52] **U.S. Cl.** **308/3.8,** 312/331

[51] **Int. Cl.** **F16c 29/00**

[58] **Field of Search** 308/3.8; 312/341, 343, 312/344, 331, 332, 348, 333, 350, 110

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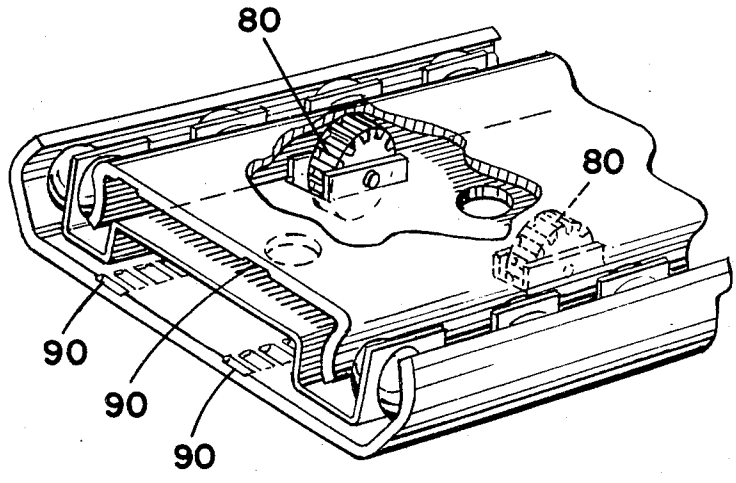
Assistant Examiner—R. H. Lazarus
Attorney, Agent, or Firm—J. Carroll Baisch

[57] **ABSTRACT**

A telescoping ball bearing synchronized slide mechanism for drawers or the like having inner and outer slide members held together by ball bearings, the balls being operably disposed in a ball retainer between the inner and outer slide members. One or more pinions are mounted to the ball retainer and each of the slide members are provided with a longitudinally extending rack with which the pinion or pinions mesh.

When the slide mechanisms are installed, one of the slide members, as the outer slide member, is stationary while the other slide member of inner member is movable. The pinion and rack arrangement maintains the movable or inner slide member, the outer slide member and ball retainer in proper and definite relationship with the ball retainer moving exactly one-half the distance and/or speed as the movable or inner slide member moves.

7 Claims, 11 Drawing Figures



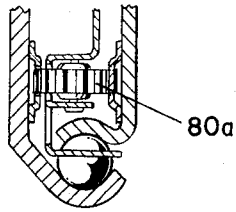


Fig. 6

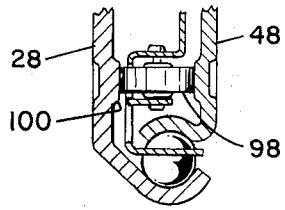


Fig. 8

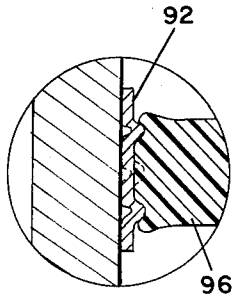


Fig. 7

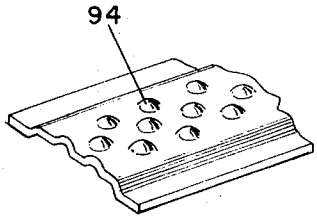


Fig. 9

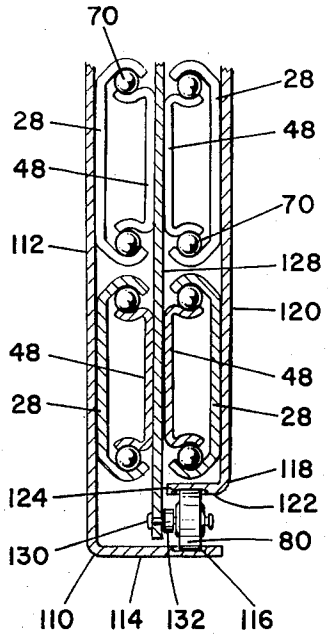


Fig. 10

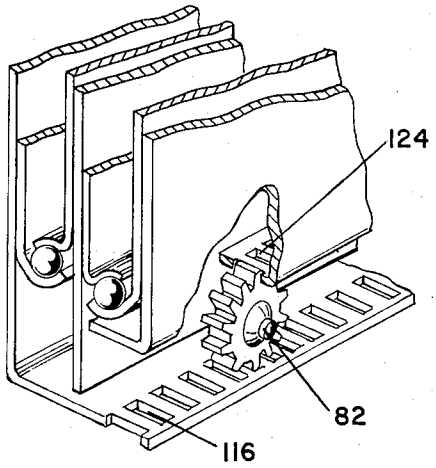


Fig. 11

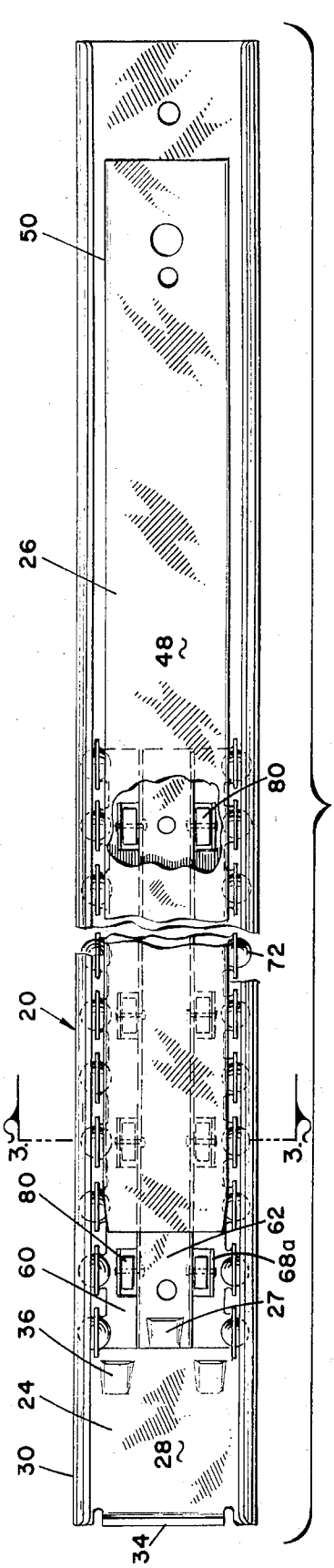


Fig. 1

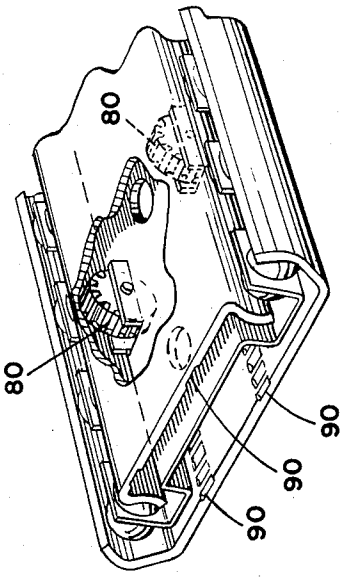


Fig. 5

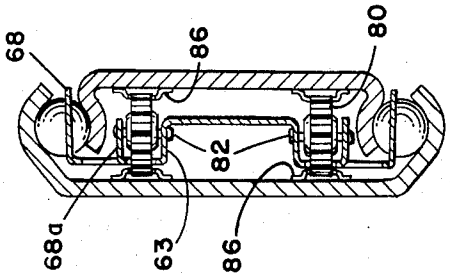


Fig. 3

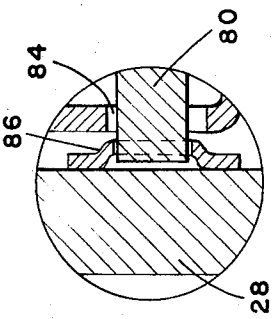


Fig. 4

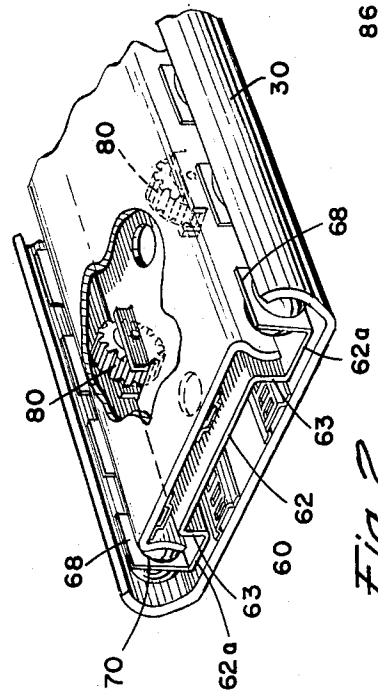


Fig. 2

SYNCHRONIZATION AND PRECISION SEQUENCING OF BALL RETAINER RELATIONSHIP TO ONE-HALF OF SLIDE MOVEMENT

CROSS-REFERENCES TO RELATED APPLICATIONS

APPLICANTS: MAGNUS F. HAGEN AND FRED A. JORDAN

TITLE: PRECISION TELESCOPING BALL BEARING DRAWER SLIDE SUSPENSION FOR WOOD AND METAL FURNITURE PRODUCTION

SER. NO. 226,424, now U.S. Pat. No. 3,778,120

FILED: FEB. 15, 1972

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates generally to telescoping ball bearing slide mechanisms and relates more particularly to means for synchronizing the relationship of the ball retainer of the slide mechanism with the telecoping slide members thereof.

Description of the Prior Art

Telescoping ball bearing slides such as those covered by the Fred Alex Jordan U.S. Pat. No. 3,205,025, are held together through the formed shapes of the inner and outer slide members by precision ball bearings. The movement of the balls between the two slide members will make a "moving member" telescope to the left or to the right of the stationary member at double the speed or double the dimensional travel distance as the balls move from a zero point to either left or right. In other words, a point on the moving slide member from a zero position will have travelled twice the distance at any given time as the balls.

If it would be possible to have a precision forming process and fitting of the balls within the inner slide member and the outer slide member so that the circumference of the balls are in contact at the very exact spots of the ball surface relative to the outer member as the opposite ball surface relative to the inner member, the distance of travel of the moving slide member relative to the ball would be exactly one-half.

Since the foregoing processes and the fitting of balls relative to slide members can never be that exact, a problem of ball skidding occurs. This is due to the fact that circumference engagement points of the ball on the moving member relative to the stationary member engagement points on the circumference of the ball are not exactly in line. Also, if there is any tolerance condition from the moving member to the stationary member which causes side pressure against the balls and brings the relationship of stationary member ball circumference engagement points relative to the moving member ball circumference engagement points into different ball circumference opposing points there will also be the problem of "skidding". Thus the skidding of the balls will affect the exact relationship of travel distance of the moving member relative to ball movement.

SUMMARY OF THE INVENTION

The present invention comprises a telescoping ball bearing slide mechanism having telescoping inner and outer slide members and a ball retainer between said members with the ball retainer retaining ball bearings in operative position. The ball bearings are positioned in ball bearing races of the inner and outer members and hold said members together. When installed, one of the slide members is stationary while the other is movable. Usually, the outer slide member is attached to adjacent parts of a cabinet desk or the like and is stationary while the inner member is attached to the drawer and moves with respective movements of said drawer. The ball retainer moves with movements of the movable slide member but at half the speed and/or distance thereof.

In other words, a point on the moving slide member will have travelled twice the distance at any given time, as the balls.

In order to prevent skidding of the balls and effect positive synchronization of the parts of the slide mechanism one or more pinions or gears are mounted on the ball retainer and each of the slide members are provided with a longitudinally extending rack with which the pinion or pinions mesh.

When the slide mechanisms are installed, one of the slide members, as the outer slide member for example, is stationary while the other slide member, or inner member, is movable. The pinion and rack arrangement maintains the movable or inner member, the outer slide member and the ball retainer in proper and definite synchronized relationship with the ball retainer moving exactly one-half the distance and speed as the movable or inner slide member.

OBJECTS AND ADVANTAGES OF THE INVENTION

The problem of "ball skidding" affects the precision performance of the mechanism. Heretofore, there has been no way to prevent this "skidding" of balls, and it is an object of this invention to solve the ball skidding problem.

It is another object of the invention to provide a telescoping ball bearing slide mechanism wherein the relationship between the slide members and the ball retainer are precisely synchronized.

Still another object of the invention is to provide a mechanism of this character having an exact translation of ball movement equalling one-half that of the moving member movement speed and/or distance.

A further object of the invention is to provide a mechanism of this character wherein there is positive rigid control of the relationship between the movable slide member and the ball retainer with the latter moving at one-half the speed and/or distance of said movable slide member.

A still further object of the invention is to provide a mechanism of this character whereby the ball retainer may be utilized to effect movement of the inner slide member relative to the outer slide member in relationship to a force applied to the ball retainer.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings, which represent one embodiment. After considering this example, skilled persons will understand that many variations may be made without departing from the principles disclosed and I contemplate the employment of any structures, arrangements or modes of operation that are properly within the scope of the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

Referring to the drawing, which is for illustrative puposes only:

FIG. **1** is a plane view of a portion of a telescoping ball bearing slide member embodying the present invention;

FIG. **2** is an enlarged end portion thereof showing the mechanism telescoped;

FIG. **3** is a sectional view taken on line **3—3** of FIG. **1**;

FIG. **4** is an enlarged view of the circled parts of the mechanism in FIG. **3**;

FIG. **5** is an enlarged view of the end portion of an alternative arrangement in which the rack or track is formed from the slide members;

FIG. **6** is an enlarged fragmentary view of an alternative arrangement;

FIG. **7** is an enlarged fragmentary view of another alternative arrangement;

FIG. **8** is an enlarged fragmentary sectional view of another alternative arrangement;

FIG. **9** is a fragmentary perspective view of an alternative rack;

FIG. **10** is a cross-sectional view of still another alternative arrangement; and

FIG. **11** is an enlarged perspective view of the pinion and rack arrangement of the mechanism shown in FIG. **10.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more particularly to FIGS. **1, 2, 3** and **4,** there is shown a slide mechanism, indicated generally at **20,** embodying the present invention. It is to be understood, of course, that there are two slide mechanisms for a desk or other drawer, one at each side of the drawer.

Each slide mechanism comprises a pair of slide members, an outer member indicated generally at **24** and an inner slide member indicated generally at **26.** One of the slide members is attached to the side of a drawer and the other is attached or secured to the adjacent side of the desk defining the drawer opening, there being sufficient clearance for the slide between the side of the drawer and the adjacent sides or parts of the desk defining the sides of the drawer opening. Normally, the small or inner slide member is secured to the side of the drawer while the larger or outer slide member is secured to the adjacent part or wall of the desk defining the drawer opening. Slide members **24** and **26** are generally channel shaped and formed of sheet metal by stamping, these parts being made with great accuracy.

Outer member **24** has a longitudinally extending center wall **28** which may be termed the bottom of the channel. Along each side edge of the bottom **28** there is an outwardly and laterally extending ball race **30** that is concave and convex in cross section with a concave surface facing inwardly so that said surfaces are oppositely arranged relative to each other and are spaced apart laterally relative to the length of the wall **28.**

At one end of the outer member **24** has a flange **34** that is turned laterally at an angle substantially normal to the plane of the bottom wall **28** and in a normal direction to the ball races **30.** However, the flange **34** extends but part way across the channel so as to leave clearance space at each end for the ball races of the inner slide member when the device is assembled as described hereinafter.

At its other end, the member **24** is open and at a location intermediate the ends of member **24** there is a tongue **36** cut from the bottom wall, said tongue being about one-third of the distance from the open end of the member **24** relative to the length of said member **28.** The sides of the tongue are cut parallel to each other in laterally spaced relationship and the inner end of said tongue is free and formed by a cut connecting the adjacent ends of the side cuts. At one end the tongue is integral with the metal of the bottom wall **28** while the other end is free and said tongue is bent inwardly into the channel so that said free end is positioned inwardly of the inner surface of wall **28** and provides stop means of a ball retainer. Wall **28** is also provided with various openings, not shown, for reception of screws, not shown, whereby said member **24** is secured to a support such as the part of the desk defining the side walls of the drawer opening or the like.

Stop or tongues **36** are cut from the bottom wall **28** adjacent the flange **34,** said tongues being bent inwardly to act as stops.

Inner slide member **26** also has a bottom wall, indicated at **48,** along the longitudinally extending sides or side edges of which are laterally turned ball races **50** which are oppositely arranged and arcuate in cross-section with the concave surfaces arranged oppositely respective adjacent ball races **30** of the outer slide member, said races **50** being spaced from said adjacent races **30.**

One end of the inner slide member **26** has a flange **27** turned inwardly at an angle normal to the wall **48,** the opposite end of the member **26** being open. Flange need not extend entirely across the channel of the inner member, the purpose of said flanges being to engage each other when the slide members **24** and **26** are fully telescoped together to thereby limit telescoping movement thereof. Thus, the members **24** and **26** have longitudinal movement relative to each other and may be extended and telescoped. Wall **48** of the inner member **26** also has openings therein for screws, not shown, whereby said member **26** is attached to the side wall of a desk drawer.

Slide members **24** and **26** are arranged so that their open sides face each other and disposed between said members, in the space between the parallel walls **28** and **48** is a ball retainer, indicated generally at **60.**

Ball retainer **60** is also channel shaped and has a bottom wall comprising a shallow, reverse channel portion **62** which extends longitudinally of the retainer. The side walls **63** of the reverse channel portion **62** connect with the side parts **68** of the ball retainer and from the outer edges of the ball retainer, there extends a series of ball retaining arms **68** and spaced apart longitudinally of the ball retainer **60.** The arms at one side of the ball retainer end generally are parallel to those at the opposite side thereof, and said arms are at substantially right angles to the bottom portions **62***a* and generally parallel to the walls **63** of the reverse channel portion **62.** The arms **68** are provided with respective aligned openings **70** for reception of ball bearings **72,** said openings **70** being of smaller diameter than the balls **72.**

When the ball retainer is operably disposed in the slide mechanism between the inner and outer member, the balls **72** are operably positioned in the races **30,** as

best shown in FIG. 2. The sides 68 of the ball retainer may exert a slight pressure or tension on the balls against the races to minimize or eliminate retainer vibration and possible noise.

In order to prevent skidding of the balls and effect positive synchronization of the parts of the slide mechanism, a meshing wheel and rack arrangement is shown in FIGS. 1 to 4 as a pinion 80.

As best shown in FIGS. 3 and 4, a pair of pinions 80 are provided and are mounted on pins 82 which extend outwardly at each side of each pinion.

Each of the pins 82 is mounted in openings provided thereto in an arm 68*a* of the ball retainer and the wall 63 of said ball retainer. The bottom wall 62*a* of the ball retainer is provided with an opening or slot 84 through which the pinion 80 extends. A rach 86 is secured to the bottom wall 28 of the outer slide member by any suitable means such as welding, brazing, or the like and this rack has teeth for meshing with the teeth of the pinion 80. Rack 86 extends longitudinally in the path travelled by the pinion 80 when the slide mechanism is extended or telescoped. A second rack, best shown in FIGS. 2 and 3, is attached to the inner side of the wall 48 of the inner slide member. This rack is secured to the wall 48 by welding, brazing or other suitable means and also extends longitudinally along the path travelled by the pinion 80 upon relative movements of the inner and outer slide members. Preferably, the pinions should be arranged in transversely aligned pairs, although the mechanism would work with a single pinion and rack arrangement. In FIG. 1, a plurality of pinions are used and they all mesh with the respective racks attached to the outer and inner slide members.

When the slide mechanisms are installed, one of the slide members as the outer slide member, for example, is stationary while the other, or inner slide member, is movable. The pinion and rack arrangement maintains the movable or inner slide member, the outer slide member and the ball retainer in proper and definite synchronized relationship with the ball retainer moving exactly one-half the distance and speed as the movable slide member. Thus, the slide members and the ball retainer are positively maintained in their proper relationship at all times.

Referring to FIG. 5, there is shown an arrangement similar to that of FIGS. 1 through 4 except that the racks are formed integrally with the respective parts 28 and 48 of the outer and inner slide members, said racks being given the reference numeral 90.

In FIG. 6, there is shown a similar arrangement to that of FIGS. 1 through 4. In FIG. 6, however, the pinion indicated at 80*a*, is of plastic such as nylon, phonel, dural or other suitable material.

The arrangement shown in FIG. 7, has a rack 92 that is attached to the parts 28 and 48 of the outer and inner slide members. This rack, best shown on FIG. 9, has a dentated surface 94. That is, this surface has a series of projections with which the pinion is adapted to engage. The pinion in this arrangement, is indicated at 96 and is of resilient material such as a plastic, for example, or it may be of rubber so as to allow the projections 94 to be securely engaged.

In FIG. 8, the pinion indicated at 98, is of rubber, as in the arrangement of FIG. 7. However, in FIG. 8, the racks indicated at 100 are formed on the inner faces of the parts 28 and 48 of the respective outer and inner slide members.

Referring to FIGS. 10 and 11, there is shown an arrangement having a plurality of slide mechanisms operably interconnected.

There is what will be termed an outer L-shaped or bracket member 110 to which the bottom walls 28 of a pair of superposed slide mechanisms are secured by welding, spot welding, brazing or other suitable means. These slide members are secured to the vertical part 112 of the L-shaped member and the lower end thereof. There is a part or bottom part 114 termed horizontally at substantially right angles beneath said pair of slide members. The part 114 has a rack 116 extending longitudinally thereof, said rack comprising a plurality of longitudinally spaced transversely extending teeth, the rack being adjacent the free edge of the part 114.

There is a second L-shaped member or bracket 118 which may be considered as the inner L-shaped member. This L-shaped member 118 includes a vertical part 120 and a horizontal part 122 turned laterally inwardly in upwardly spaced relation with the part 114 of the L-shaped member 110. Part 122 has a longitudinally extending rack 124 comprising a plurality of transversely extending teeth that are longitudinally spaced apart, the rack 124 being an aligned parallel relationship to the rack 114.

There is a second pair of superposed slide mechanisms having their bottom walls 28 secured to the vertical part 120 of the L-shaped member or bracket 118. These slide members are secured to the inner side of the vertical part 120 by welding, spot welding, brazing or any other suitable means.

Between the superposed pairs of slide mechanisms, there is a central or intermediate member 128 or plate to which the bottom walls 48 of the inner slide mechanisms are secured by welding, spot welding, brazing or any other suitable means.

There is a pinion 80 operably disposed between the racks 116 and 124, said pinion being mounted on an axle or axle pin 82 having one end received in an opening provided therefore in the lower end of the intermediate member or plate 128. The free end, said pin which extends through said opening, is rivited over at 130 to secure the pin in position, there being an enlarged part 132 between the pinion 80 and the member 128 to properly space the pinion from said plate so that said pinion is in proper operative position with respect to the racks 116 and 124.

With this arrangement, the inner slide members, move with the intermediate member or plate 128, while the L-shaped members 110 and 118 are adapted relative to moving longitudinally to each other and it may be said that they are telescopically arranged so as to telescope or to be extended. When installed, one of the L-shaped members will be secured to a fixed part of a desk or the like, while the L-shaped member 120 is secured to the drawer or the moving part. Since the pinion is positively meshed or engaged with the respective racks 116 and 124, the moving L-shaped member, with its attached parts, will at all times be positively synchronized with respect to the intermediate member 128 and the parts carried thereby.

By proper engagement of pinion wheels attached to the ball retainer, engaging into the tracks of stationary section, as well as moving section, an exact translation of ball movement equaling one-half of the moving

member movement speed and/or distance, will be effected.

Even if the ball would be under a "skidding" influence, the bridged ball retainer holding the balls in the opposite ball races, and with the pinion wheels in engagement with the rack of the stationary as well as the moving member, skidding of the balls thus assuring absolute control is prevented of the balls so that they, and hence the ball retainer, move at one-half the speed and distance as the movable member.

This type of control as described above will be obvious that it applies to a telescoping slide where the moving member would telescope outside of the stationary member. It will also apply to a linear motion slide mechanism where the inner moving section is between the ball bearings and which may be a small moving section within a long, bridged ball retainer of a stationary section. In such long, bridged ball retainer section, a multiple number of pinion wheels may be employed as shown in FIG. 1 which engage the tracks of the smaller moving section at all times, and if one pair or a single pinion wheel leaves the engagement with the moving section, another wheel will have taken its place.

As described above, the moving member can be either the inner section or outer section.

Another feature of this invention is that the ball retainer itself may be utilized to effect a purposeful function. For instance, if a bracket or some other kind of hold-on section is attached to the ball retainer, it is possible to have a small inner slide section which is synchronized by the pinion wheels and tracks or racks to move in relationship to the drawers. Thus, it would require a forced movement of the ball retainer within one-half of the area necessary to move the inner member. This translation could be important in many applications.

With the same relationship, it is possible to attach an object to the ball retainer and exert a force upon the inner slide member or outer slide member, whichever one is to be the moving part, and thus effect a movement of the object attached to the ball retainer.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit or scope thereof or sacrificing its material advantages, the arrangement hereinbefore described being merely by way of example and I do not wish to be restricted to the specific form shown or uses mentioned except as defined in the accompanying claims.

I claim:

1. Synchronized elements for telescoping ball bearing slide mechanisms, comprising:

an outer slide member of generally channel shape and having a longitudinally extending bottom wall and oppositely arranged ball races along the side edges of the bottom wall, said ball races being concave in cross section and having said concave portions facing inwardly;

an inner slide member of generally channel shape and having a longitudinally extending bottom wall and oppositely arranged ball races along the side edges of the bottom wall, said ball races being concave in cross section and having said concave portions outwardly, the inner slide member being operably disposed within the outer slide member;

bearing balls disposed in adjacent concave portions of said ball races of the respective outer and inner slide members;

a ball retainer operably disposed between the outer and inner slide members for retaining the balls operably in the ball races;

a pair of mesh wheels adjacent opposite sides of the slide mechanism operably connected to the ball retainer and movable in accordance with relative longitudinal movements of the slide members;

and racks comprising a separate part on the bottom walls of the inner and outer slide members, said racks being in the path of movement of the meshing wheels and cooperating therewith

wherein the ball retainer has longitudinally extending bottom parts and a reversed raised channel shaped longitudinally extending part connected with said bottom parts by connecting walls normal to the bottom parts, said ball retainer having retainer arms with openings in at least some of said retainer arms for retaining balls in longitudinally spaced relationship; pivot pins having end portions operably received in openings provided therefor in each of the connecting walls of the ball retainer, the meshing wheels being mounted on said pivot pins for operable rotation;

said wheels extending through openings in one of the bottom parts of the ball retainer for engagement with the adjacent racks in order to maintain a synchronized relationships between the ball retainer and the slide members.

2. The invention defined by claim **1** wherein the meshing wheel is of resilient material.

3. The invention defined by claim **1** wherein the meshing wheel is of plastic.

4. The invention defined by claim **2** wherein the surfacing of the rack is dentated.

5. The invention defined by claim **1** wherein the meshing wheel is a pinion and the racks have teeth with which the teeth of the pinion mesh.

6. A synchronized telecoping ball bearing slide mechanism, comprising:

an outer L-shaped member having a longitudinally extending rack on the horizontal part of the L;

an inner L-shaped member having a rack on the horizontal part thereof and parallel to the rack of the outer L-shaped member, said horizontal part being spaced from the L-shaped part of the outer L-shaped member;

an intermediate member;

a meshing wheel pivotly mounted to said intermediate member for meshing with said racks;

a pair of slide mechanisms, each having an outer slide member with a bottom part and ball races along the edges of said bottom part, said bottom parts being secured to respective L-shaped members;

inner slide members for respective outer slide members, each of the inner slide members having a bottom wall secured to the intermediate member, said inner slide members having ball races along the side edges thereof operably arranged with the ball races of the outer slide members;

and ball bearings between adjacent races of the inner and outer slide members.

7. The invention defined by claim **6** wherein the meshing wheel is a pinion and the racks comprise teeth with which the teeth of the pinion mesh.

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