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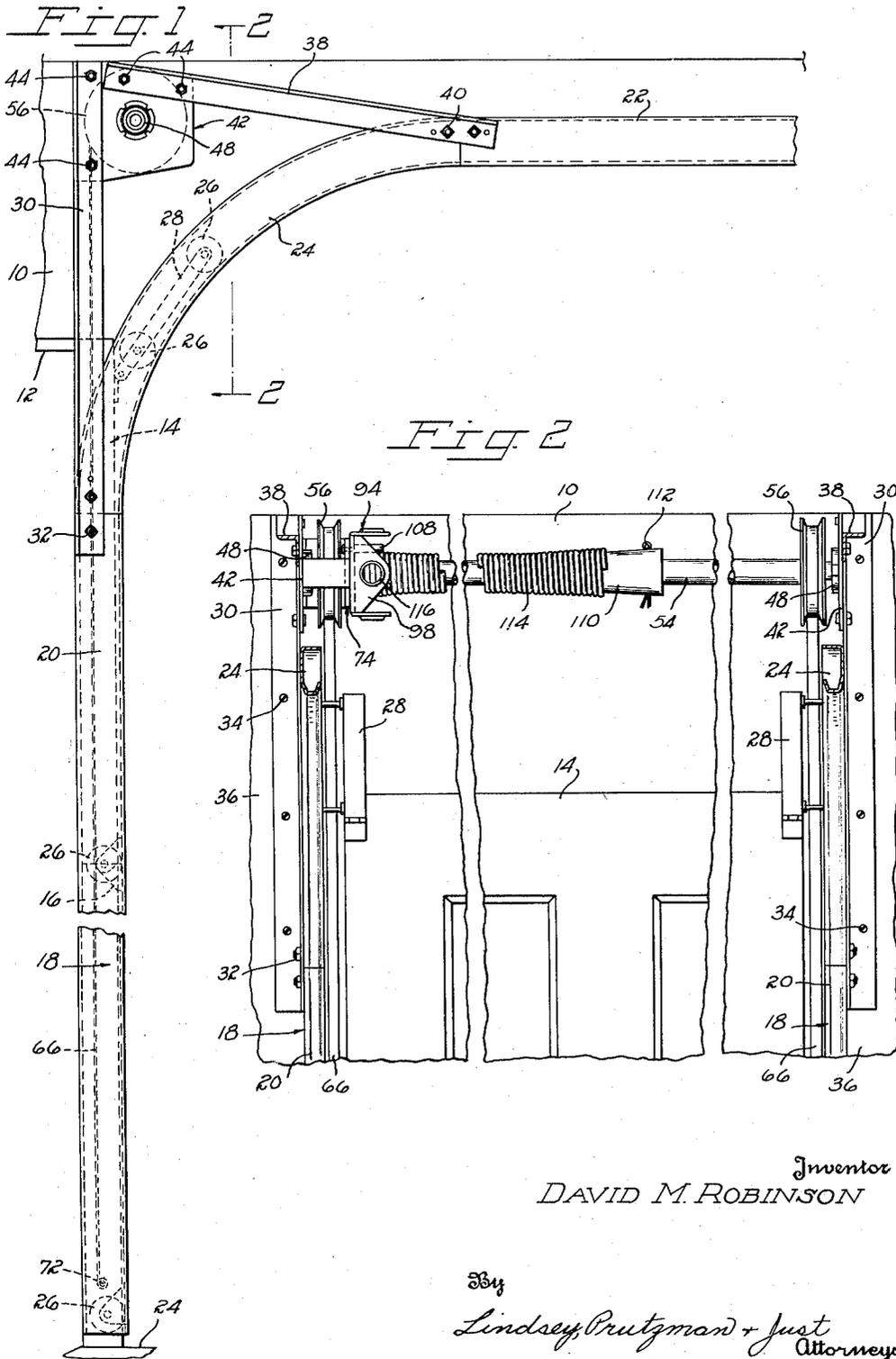
D. M. ROBINSON

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COUNTERBALANCING MECHANISM FOR ARTICULATED OVERHEAD DOORS

Filed Feb. 18, 1950

2 SHEETS—SHEET 1



Inventor  
DAVID M. ROBINSON

334  
Lindsey Prutzman + Just  
Attorneys

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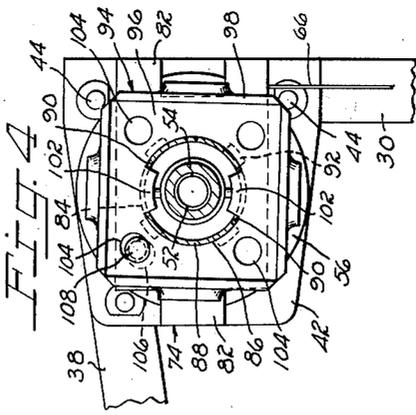
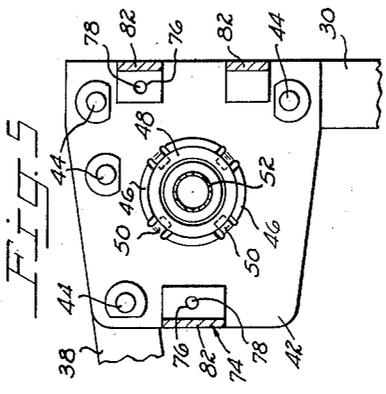
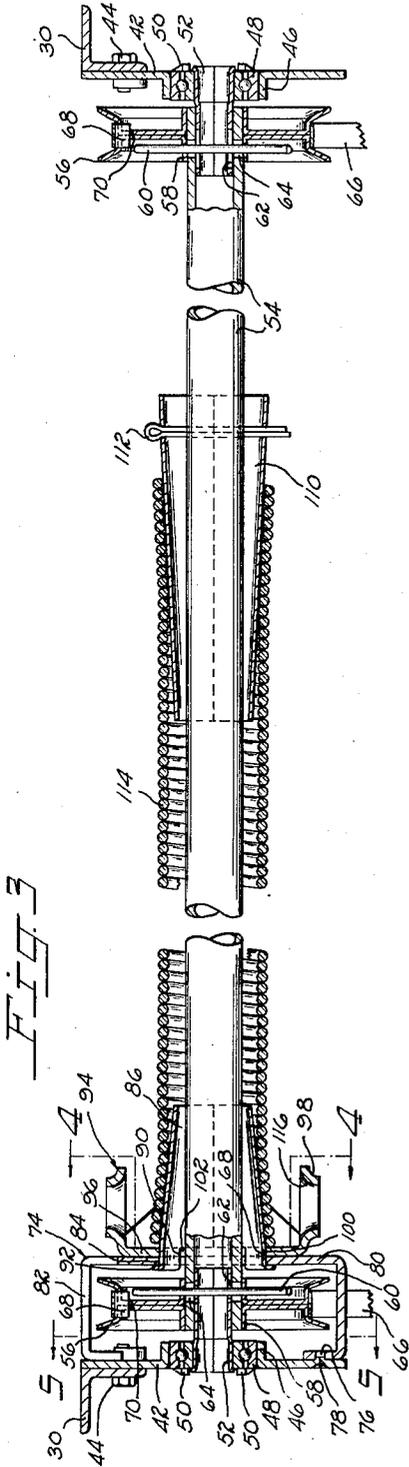
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Inventor  
DAVID M. ROBINSON

33y  
Lindsey Prutzman & Just  
Attorneys

# UNITED STATES PATENT OFFICE

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## COUNTERBALANCING MECHANISM FOR ARTICULATED OVERHEAD DOORS

David M. Robinson, New Britain, Conn., assignor  
to The Stanley Works, New Britain, Conn., a  
corporation of Connecticut

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This invention relates to improvements in an articulated overhead door and, more particularly, to the hardware by which such door is supported and operated and by which the door may with ease be elevated from a closed vertical position to an open overhead position or lowered to said closed position from said open overhead position, said hardware being of the type embodying a torsion spring which counterbalances the weight of the overhead door.

It is an object of the present invention to provide improved hardware for supporting and operating an articulated overhead door of the character described, which hardware is simple to install and adjust, rugged and durable in use, and more efficient in operation than hardware presently used for similar purposes.

Another object of the invention is to provide improved means for supporting and varying the tension of the torsion spring employed by such hardware, whereby the operation thereof is rendered highly efficient.

Details of the foregoing objects and of the invention, as well as other objects and advantages

thereof, are shown in the accompanying drawings, in which like reference numerals have been used to indicate similar parts throughout, there is illustrated a suitable mechanical embodiment of the invention. The drawings, however, are for purposes of illustration only and are not to be considered as limiting the invention, the scope of which is to be determined entirely by the scope of the appended claims.

In the drawings:

Fig. 1 is a vertical view illustrating one side of a garage doorway and showing in dotted lines an articulated door in closed position, the improved hardware being illustrated in assembled form as applied to the garage doorway and door.

Fig. 2 is a fragmentary, foreshortened, vertical view taken on the line 2—2 of Fig. 1 and illustrating a garage door and the supporting and operating means therefor as viewed from the inside of the door.

Fig. 3 is a longitudinal, horizontal, sectional view showing details of the part of the hardware illustrated in Figs. 1 and 2 and shown on a larger scale than in said figures.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3, and

Fig. 5 is a sectional view taken on line 5—5 of Fig. 3.

Referring to the drawings in detail, the nu-

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merals 10 generally indicates part of the structure of a garage building provided with side walls and a front wall having a door opening 12 which is closed by a door 14. The door 14, as illustrated, is of the type known in the art as an articulated overhead door. Such door is opened by moving the same from the closed, vertical dotted-line position thereof shown in Fig. 1 to a horizontal overhead open position within the garage building. The door is closed by moving it from the horizontal, overhead position to the vertical position thereof.

The door is composed of a plurality of articulated sections connected by hinges 16 and the various sections of the door are supported and guided by tracks 18 disposed at each side of the door opening 12 and fastened by suitable brackets to the door jamb. The track comprises vertical sections 20 and horizontal sections 22, the latter being supported from the ceiling or otherwise of the garage. The vertical sections 20 are connected to the horizontal sections 22 by curved sections 24 of the track, whereby the track is substantially continuous from adjacent the door sill 24 of the garage to the outer ends of the horizontal sections 22. As is evident from Fig. 2, the track 18, in cross section, is approximately C-shaped for purposes of accommodating guide rollers 26 which are rotatably supported within the various sections of the track. It is conventional practice to provide a roller 26 adjacent each hinge 16 at the side edges of the door 14 and the side edges of the bottom portion of the lowermost door section. The top of the door is pivotally connected at its side edges to arms 28, each of which support a pair of rollers 26.

Connected at its lower end to each track adjacent the junction of the upper end of the vertical section 20 thereof with the curved section 24 is a vertically disposed supporting member 30 which, in the embodiment shown herein, comprises an angle iron. One such member 30 is secured to each track by a plurality of bolts 32 which extend through one flange of each angle iron supporting member, as clearly shown in Fig. 1. The other flange of each supporting member 30 may be attached by a plurality of screws 34 to the inner face of the door jamb 36, as is clearly shown in Fig. 2.

A brace 38, comprising an angle iron in the illustrated embodiment, is secured at one end to each track by bolts 40 adjacent the junction of the curved section 24 of the track with the horizontal section 22 thereof. The other end of each brace 38 extends substantially to the upper end

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of the supporting member 30 attached to each track. A bearing plate 42 is secured to the ends of each supporting member 30 and brace 38 by a plurality of bolts 44, as shown in the various figures.

Each bearing plate is provided centrally thereof with an interrupted cylindrical flange 46, the flanges of the two bearing plates extending toward each other, as shown in Fig. 3. The flanges provide a seat for a ball bearing assembly 48, the outer race of which preferably is press fitted into the flange 46. As will be seen from Figs. 3 and 5 particularly, there is disposed between the interrupted sections of each flange 46 a plurality of fingers 50 which are initially formed so as to be offset somewhat from the plane of each bearing plate 42 in a direction opposite to the flanges 46. With the fingers so disposed, the ball bearing assemblies 48 are inserted within the seat formed by the flange sections from the free ends thereof until the ball bearing assemblies 48 engage fingers 50. If desired, the free ends of the interrupted sections of the flanges 46 may be made sufficiently long that, after the bearing assemblies are mounted within the flange seats, the tip ends of the flange sections may be bent slightly over the edge of the outer race of each bearing assembly to hold said assemblies locked within the flange seats and against fingers 50.

Mounted within the inner race of each ball bearing assembly 48 is a bearing tube 52. Preferably, the tubes 52 are press-fitted within said races and flared at the outer ends thereof, as illustrated in Fig. 3. The bearing tubes extend outward from the ball bearing assemblies in the two bearing plates 42 and are directed toward each other, as also shown in Fig. 3. Extended between the bearing plates 42 and telescopically engaging the bearing tubes 52 at its opposite ends is a tubular shaft 54. The fit between the shaft 54 and the bearing tubes 52 is preferably close so as to prevent any unnecessary play between said tubes and shaft. Surrounding each end of the shaft 54 is a flanged pulley or sheave 56 which may be formed in any suitable manner. In the embodiment illustrated herein, the sheaves 56 are formed from two sheet metal sections joined together to comprise a sheave having a hub 58 which closely engages the outer diameter of the shaft 54. The hubs 58, shaft 54, and bearing tubes 52 have diametrically opposed and radially aligned openings which receive an anchor pin 60 for purposes of preventing rotation between said sheaves, shaft and bearing tubes.

The openings 62 in the bearing tubes 52 are preferably elongated axially and the openings 64 in shaft 54 are also preferably somewhat elongated axially to permit automatic self-adjustment of bearing tubes 52 relative to the ends of the shaft 54 so as to compensate for normal installation inaccuracies as well as shrinkage or expansion of the door jamb during use, without interfering with the operation of the hardware as it is intended to be used. Such self-adjustment is therefore permitted while the pins 60 prevent relative rotation between the various parts through which the pins project in the assembled hardware.

Coiled within the base of each circular channel in each sheave 56 is a flexible strip 66 which is preferably made from flat stock. The outer end of each strip which is coiled about each sheave 56 is bent inward to provide a securing end 68 disposed in a suitable slot 70 extending radially inward from the base of the channel in each sheave

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56, as is clearly shown in Fig. 3. When the hardware is installed and the strips 66 are mounted in operative position, the ends 68 of each strip are inserted within the slots 70 and one or more convolutions of the strip are coiled about each sheave 56. The overlying convolutions of the coils of strips 66 will serve to maintain the returned end 68 thereof within the slots 70 provided therefor. The other end of each strip 66 is secured by any suitable means such as a pin 72 which projects outward from one edge of the lowermost section of the articulated door 14, as shown in Fig. 1, one pin projecting from each side edge of said section.

The sheaves 56, being both pinned to the shaft 54, will be rotatable in unison therewith. When the sheaves are rotated clockwise as viewed in Fig. 1, the strips 66 will be coiled progressively upon the sheaves and effect a raising of the door 14 from its vertical closed position to its horizontal, overhead, open position. In the latter position, the various articulated sections of the door will be disposed in the horizontal sections 22 of track and part of the curved sections 24 thereof.

The weight of the door is either largely or completely counterbalanced by means now to be described. Fixed to the lefthand bearing plate 42, as viewed in Fig. 3, is a bearing plate bracket 74. The bracket 74 may be secured to said bearing plate by any suitable means such as bolts or by providing interengaging positioning means such as apertures 76 and projections 78 thereon and spot welding or otherwise uniting the same. The bracket 74 comprises a plate 80 from which a plurality of arms 82 extend perpendicularly, the outer ends of said arms being bent as illustrated in Fig. 3 for purposes of attachment to the bearing plate bracket 74 to the bearing plate 42 in the manner described hereinabove. The plate 80 is provided centrally thereof with a bearing aperture 84. The larger end of a tapered spring sleeve 86 is rotatably supported within said bearing aperture 84, said larger end 88 being preferably substantially cylindrical. The cylindrical end 88 is provided with a plurality of inwardly extending cut-outs 90, as clearly shown in Figs. 3 and 4, and the portions of the outermost end of the cylindrical end 88 of the spring sleeve 86 between the cut-outs 90 are bent outward to provide radial locking flanges 92 which slidably engage one surface of the plate 80 of the bracket 74, as shown in Fig. 3.

A spider 94, comprising a centrally apertured plate 96 having a plurality of ears 98 bent perpendicularly thereto from the edges thereof, is rotatably disposed in juxtaposition to the other surface of the plate 80 from that engaged by locking flanges 92. The central aperture of plate 96 of spider 94 is similar in size to bearing aperture 84 of plate 80 and said central aperture of plate 96 receives the cylindrical end 88 of spring sleeve 86. Extending inward from the perimeter of the central aperture 100 of plate 96 are a plurality of locking dogs 102 which extend into the bottom portions of the cut-outs 90 of spring sleeve 86, as is clearly shown in Figs. 3 and 4. The locking dogs 102, being disposed within the bottoms of the cut-outs 90, thereby cooperate with locking flanges 92 of spring sleeve 86 to position the spring sleeve 86 and spider 94 against axial movement relative to plate 80 of bearing plate bracket 74.

The plate 96 of spider 94 is also provided with a plurality of locking apertures 104 which are spaced radially outward from the central aper-

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ture 100 of said plate, the radial distance of the center of each aperture 104 from the axis of rotation of the plate being equal to the radial distance between said axis of rotation and the center of an aperture 106 formed in plate 80 of bearing plate bracket 74, as illustrated in Figs. 2 and 4. Said apertures are for purposes of receiving a locking pin 108, the function of which is described herein-after.

Fixed to the shaft 54 at a position a substantial distance from spring sleeve 86 is a tapered anchor tube 110. The tube 110 is mounted relative to spring sleeve 86 so that the tapers of the two extend toward each other. Anchor tube 110 is non-rotatably held to shaft 54 by any suitable means such as a heavy cotter pin 112 which extends through said tube and shaft. Surrounding shaft 54 is a substantial length of a heavy coiled torsion spring 114, the inner diameter of which is preferably greater than the smaller end of the sleeve 86 and tube 110 but less than the diameter of the larger end of said sleeve and tube. The spring 114 is preferably of the type having abutting convolutions and it is assembled so as to frictionally engage the outer surfaces of said sleeve and tube as illustrated in Figs. 2 and 3. Such assembly can be achieved by working the ends of the spring respectively onto said sleeve and tube by turning the spring relative to each in the direction of the spiral of the spring. However, upon attempting to rotate the spring relative to said tube or sleeve in an opposite direction, the friction between the engaged coils of the spring and the tube and sleeve will be increased in the same manner as a spring clutch functions so as to effectively, frictionally connect said ends of the spring to said tube and sleeve. The positioning of the spring 114 between the tube 110 and sleeve 86 and the nature of the spring serve to prevent appreciable movement thereof longitudinally of shaft 54.

From the foregoing description, it will be seen that one end of the spring 114 is frictionally connected to anchor tube 110 which is non-rotatably fixed to shaft 54. The sheaves 56 around which the flexible strips 66 are coiled are also both non-rotatably fixed to the shaft 54. The opposite end of spring 114 is frictionally connected to spring sleeve 86. The spring sleeve 86, during the attachment of the hardware to the door and door jamb, is freely rotatable relative to the plate 83 of bearing plate bracket 74, said sleeve 86 being rotatable about the axis of shaft 54. The spider 94 is keyed to the spring sleeve 86 by means of dogs 102 and the ears 98 of the spider 94 are each provided with an opening 116 into which an end of a bar or piece of pipe of suitable size may be inserted for purposes of rotating said spider to vary the tension of the spring 114.

After the above described hardware has been connected to the door jamb and other supporting surfaces of a garage or other building in which an overhead door is to be installed, the lower ends of the flexible strips 66 are attached respectively to the pins 72 fixed to the opposite side edges of the lowermost section of the articulated door 14 as described hereinabove. The hardware is then in condition for the spring 114 to be placed under tension for purposes of counterbalancing the weight of the door and also for supplying force largely or entirely capable of raising the door from a closed vertical position to an overhead, substantial horizontal, raised position as referred to hereinabove. Such tensioning of the spring 114 may be accomplished in several ways. That is, the spring may be initially tensioned while the

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door 14 is disposed in its vertical closed position, as illustrated in Fig. 1, or the spring may be tensioned while the door is in its raised, overhead horizontal position. Less initial winding of the spring will be required if the spring is tensioned while the door is in the latter position. Assuming, for example, that the door is in the latter position, the major portion of the flexible strips 66 will be coiled around the sheaves 56. To initially tension the spring under these circumstances, a bar or piece of pipe such as referred to above may be inserted in one of the openings 116 in the ears 98 of the spider 94 and the spider may be rotated in a direction to wind the spring 114 and place it under tension. If there is not sufficient space within the garage, for example, to permit a full 360° of rotation of the spider 94 when the bar is inserted in one of the openings 116, the spider may be rotated as much as possible when the bar is inserted in one of the openings 116 and, after moving the spider a partial revolution, locking pin 108 is inserted through aperture 106 in bracket 74 and one of the locking apertures 104 in spider 94 which is moved into alignment with said aperture 106. The locking pin will serve to hold the spider against rotation by the force of the spring 114 acting upon spring sleeve 86 to which the spider is keyed. The bar may then be inserted in the opening 116 of another ear 98 of the spider and the locking pin 108 is withdrawn from the aforementioned apertures to permit further rotation of the spider and spring sleeve 86 for purposes of further tensioning spring 114. Such tensioning of spring 114 will be continued until the spring is placed under the desired amount of tension for purposes of enabling the spring to either partially or completely counterbalance the weight of the door during the raising of it from its closed to its open position.

After the spring 114 has been placed under such desired amount of tension as aforesaid, the door may be lowered from its raised, overhead position to its vertical closed position and such lowering of the door will simultaneously rotate both sheaves 56 due to the unwinding of the flexible strips 66 therefrom. The rotation of the sheaves will also rotate shaft 54 and anchor tube 110 in a direction to further wind spring 114 and progressively place it under further tension. The spring 114 will be under its greatest tension so as to exert its greatest torsional force when the door is fully extended into its closed, vertical position illustrated in Fig. 1. Also, the coils of flexible strips 66 will be at their smallest external diameter under these positions, thereby presenting their shortest lever arms for application of the force of spring 114.

Depending upon the amount of initial tension placed upon the spring 114 during the initial setting of the hardware in operative condition as described above, the door 14 will either be raised automatically from its closed position to its open overhead position, or a certain amount of manual lifting of the door will be required to supplement the torsional counterbalancing force supplied by the spring 114. If the torsional force of the spring 114 is sufficient to automatically raise the door, the door will then be held in its lower, vertical, closed position by suitable lock means in accordance with customary practice. Upon releasing the bolt or bolts of the locking means, the door will then automatically be raised by the hardware described above, through the torsional force of the spring 114, from its verti-

cal closed position to its overhead open position and be guided during such movement by the tracks which support the various sections of the articulated door. However, if the torsional force of the spring 114 is insufficient to automatically raise the door upon releasing the locking means, the torsional force of the spring will nevertheless function to extensively counterbalance the weight of the door so as to require only a minimum amount of manual force to supplement the force of the spring 114 for purposes of raising the door.

It will be noted from Figs. 2 and 4 particularly that the locking pin 108 is of a character having a portion reduced in diameter adjacent one end of the pin. The length of said reduced portion is substantially equal to the combined thickness of plate 96 of spider 94 and plate 80 of bracket 74. The annular shoulders provided at the ends of said reduced portion will serve to engage the outer surfaces of the plates 80 and 96 and the force imparted to spider 94 by spring 114 will act to maintain portions of the walls of one of the locking apertures 104 and apertures 106 in engagement with the reduced portion of the locking pin 108 in a manner to prevent separation of the pin 108 from said apertures, as illustrated in Fig. 4.

If for any reason after use of the above described hardware the torsional force supplied by spring 114 becomes decreased below the desired amount, said force may easily and readily be increased to the extent desired by rotating spider 94 in a direction to wind the spring 114 further in the manner described above by means of a bar inserted in the openings 116 of arms 98 of spider 94 after removing the locking pin 108 from the apertures in which it is disposed.

At the completion of the supplemental winding of the spring, the locking pin 108 is replaced within the aforementioned aligned apertures as described above for purposes of maintaining the spider 94 locked against rotation relative to bearing plate bracket 74 during continued use of the hardware embodying the present invention.

It will thus be seen from the foregoing that the present invention provides hardware for purposes of counterbalancing the weight of an overhead door so as to either largely facilitate the raising thereof from a closed to an overhead position or for completely and automatically raising said door as aforesaid. The hardware is constructed in a manner so as to be rugged and durable and capable of long life, the details of the mechanism embodied in the hardware permitting easy and ready adjustment of the force supplied by the hardware, and such adjustment does not require special tools or a skilled operator. The construction of the hardware is also such as to render the production thereof relatively inexpensive as compared with hardware of similar nature presently in use. The installation of such hardware is simple and may be accomplished in relatively short time. The hardware also includes means for permitting automatic adjustment to compensate for normal installation inaccuracies as well as expansion and contraction of the members of the door jamb to which the hardware is attached, due to weather conditions.

While the invention has been illustrated and described in its preferred embodiment and has included certain details, it should be understood

that the invention is not to be limited to the precise details herein illustrated and described since the same may be carried out in other ways, falling within the scope of the invention as claimed.

I claim as my invention:

1. Means for adjustably supporting one end of a torsion spring for counterbalancing an overhead door and comprising in combination, a bracket arranged to be fixed relative to a door jamb and including a plate provided with a bearing aperture, a sleeve having one end rotatably supported within said aperture, said end having a cut-out extending inward therefrom and the outermost portion of said end being radially flanged and engageable with one surface of said plate, the other end of said sleeve being attachable to one end of said torsion spring and operable to support and rotate it to vary the tension thereof, a spider having an aperture receiving said sleeve and supported thereby in parallel juxtaposition to the other surface of said plate, and a dog on said spider extending inward from the periphery of the aperture therein and disposed within the bottom of the cut-out in said sleeve to key said spider and sleeve against relative rotation and cooperate with said radial flange to fix said sleeve against longitudinal movement relative to said bracket and spider.

2. In a counterbalancing mechanism for an articulated overhead door having means rotatably supporting a shaft at the ends thereof and a torsion spring through which the shaft extends, the combination therewith of a bracket fixed relative to said supporting means adjacent one end of the shaft and having a bearing aperture surrounding the shaft in spaced relation, a tapered sleeve surrounding said shaft with its large end rotatably secured in said bearing aperture, said large end having a cut-out extending inwardly therefrom, a tapered tube spaced from said tapered sleeve longitudinally of said shaft and detachably fixed against rotation relative to said shaft, the tapers of said sleeve and tube converging toward each other and said torsion spring being disposed between and frictionally connected at its ends to the tapered exteriors of said sleeve and tube, a spider having an aperture receiving said sleeve and supported thereby between said spring and said bracket, a dog on said spider extending inwardly from the periphery of the aperture therein and disposed within the cut-out in said sleeve to key said spider and sleeve against relative rotation, means on said spider arranged to receive a tool operable to rotate said spider and sleeve relative to said bracket to vary the tension of said spring, and means engageable with said spider and bracket arranged to lock said spider and sleeve relative to said bracket.

DAVID M. ROBINSON.

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