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[54] **WINDOW SASH GUIDE ASSEMBLIES FOR DOUBLE-HUNG TILT-IN WINDOWS**
11 Claims, 9 Drawing Figs.

[52] U.S. Cl. 49/151
[51] Int. Cl. E05d 15/22
[50] Field of Search 49/151, 428–431, 174, 175, 421, 419

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Primary Examiner—Kenneth Downey
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ABSTRACT: Economical sash guide assemblies incorporating guideways for the upper sash and the lower sash of double-hung windows, with recessed grooves accommodating sash cords led over stationary top sheaves to connect to extensible helical coil tension balancing springs enclosed in vertically elongated recessed cavities behind the sash guides, for counterbalancing extension and retraction in response to window sash movement by the user. These sash guide assemblies incorporate a sash cord portal permitting tilt-in pivoting movement of the lower sash about its lower edge in its lowermost, closed position. Inwardly extending studs also provide tilted support for the upper sash, which may thus be pivoted inward to an angularly slanted position. The sash guide assemblies also incorporate features permitting both sashes to be tilted down inwardly to a horizontal cleaning position at the lower end of the window sash guide assemblies.

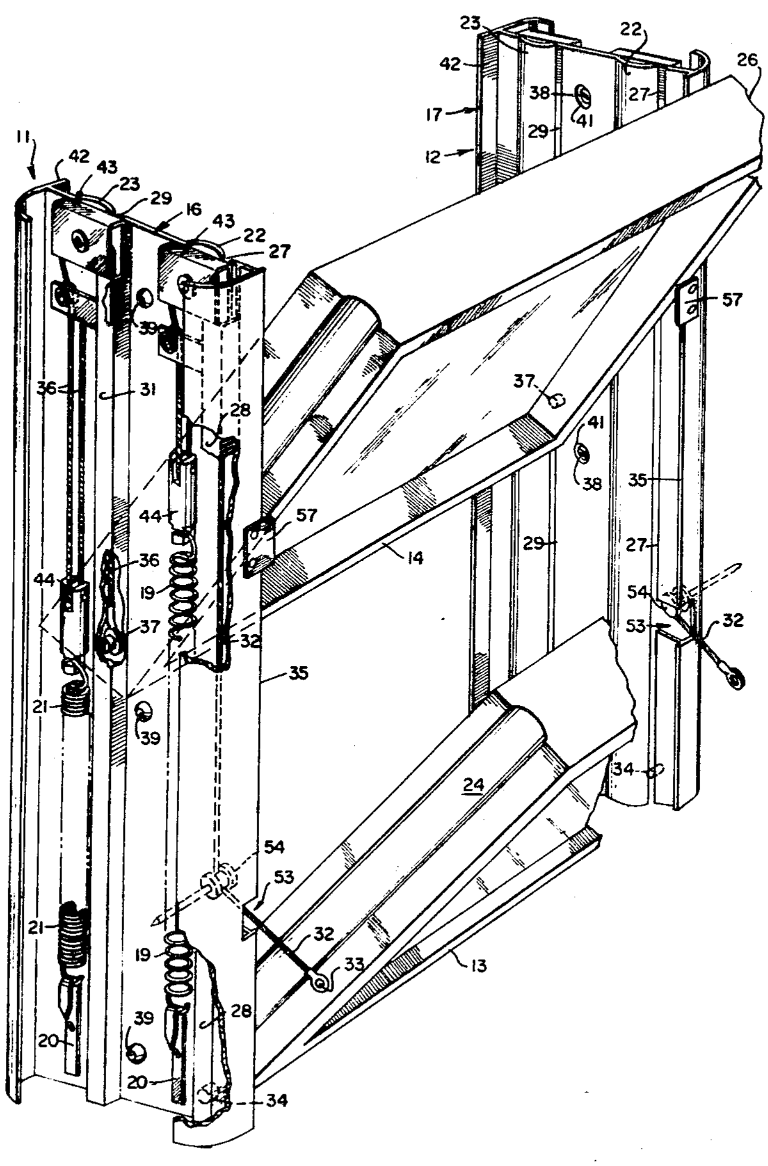

FIG. 1

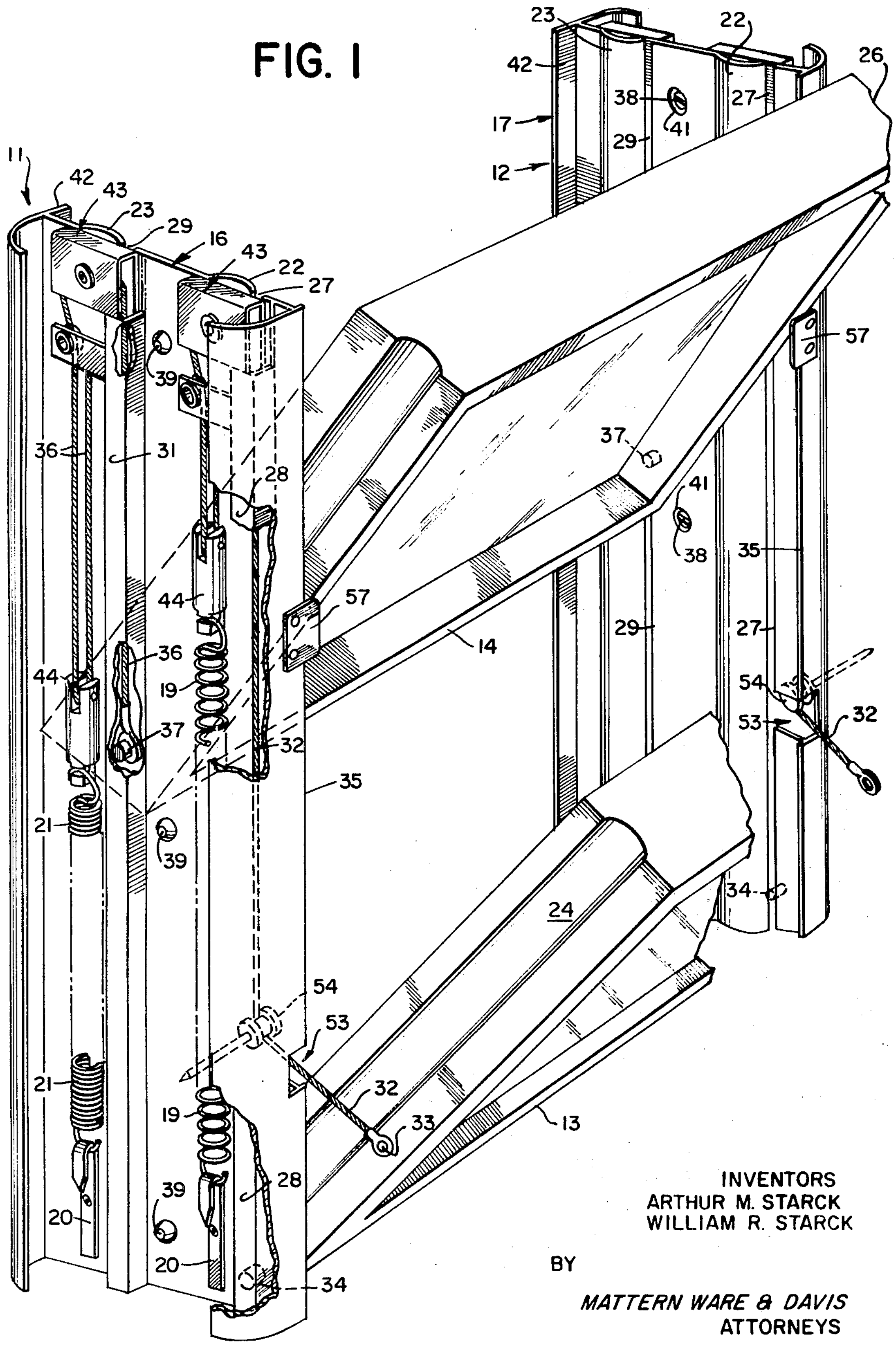

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FIG. 5

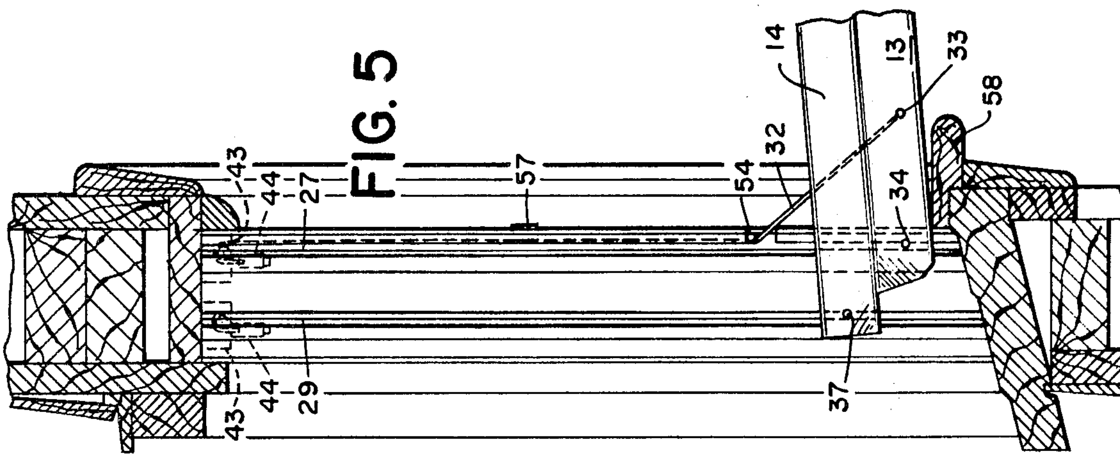


FIG. 4

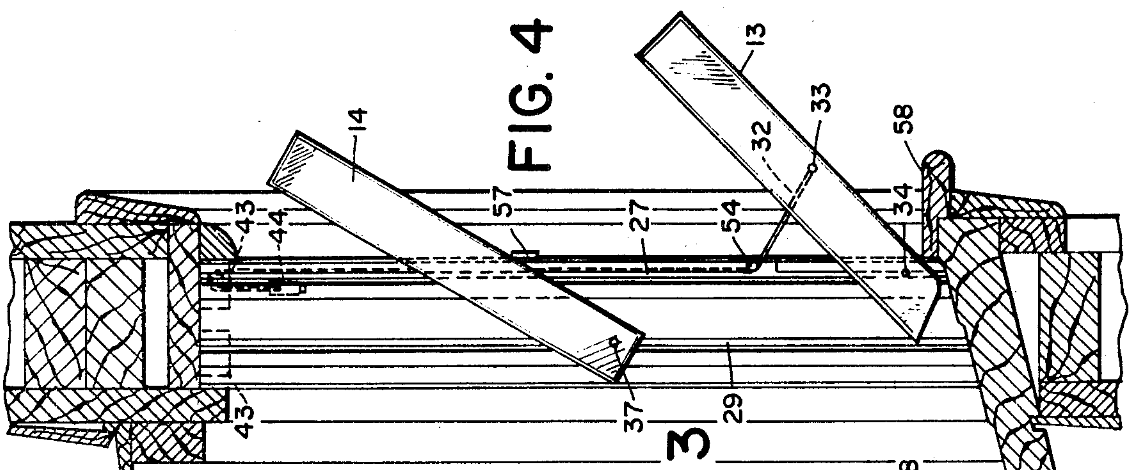


FIG. 3

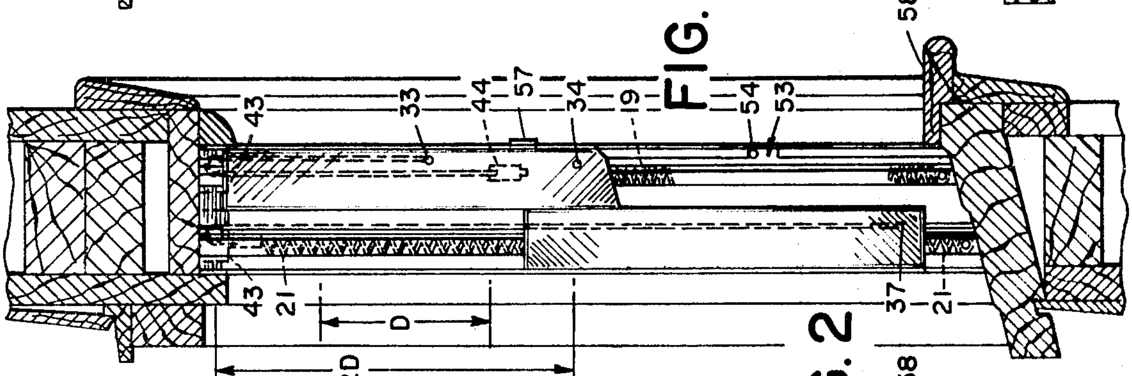
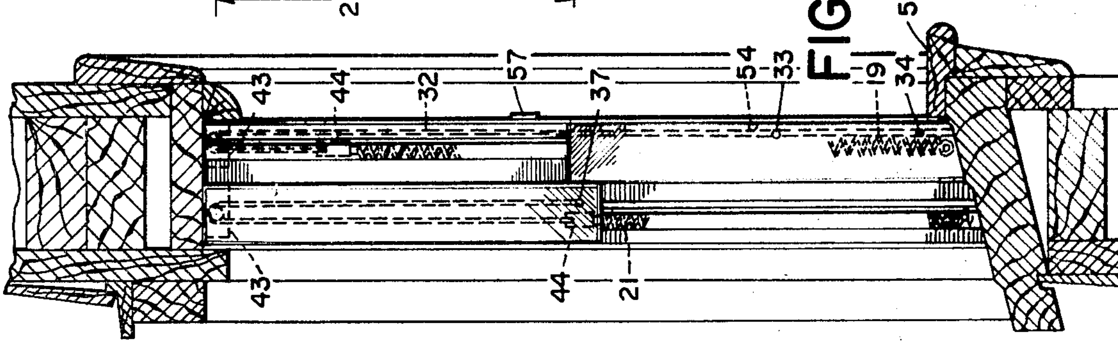


FIG. 2



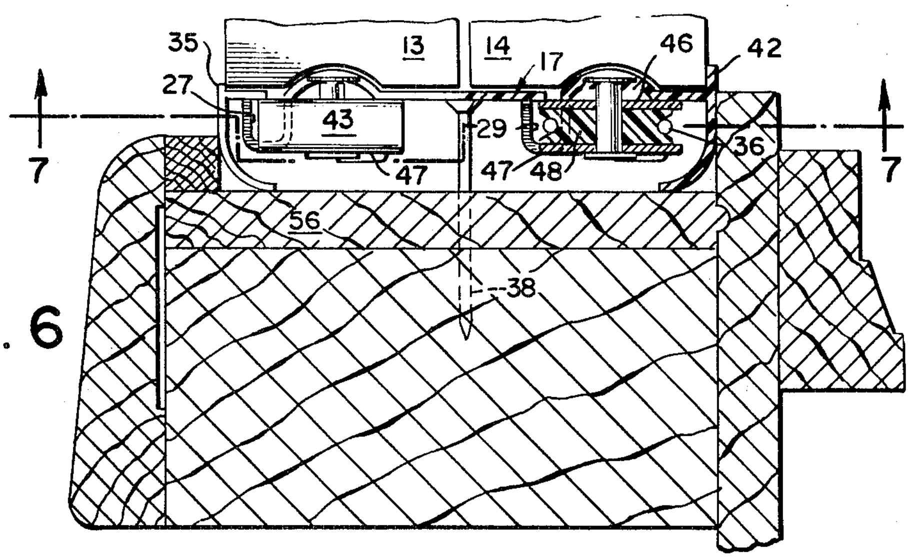


FIG. 6

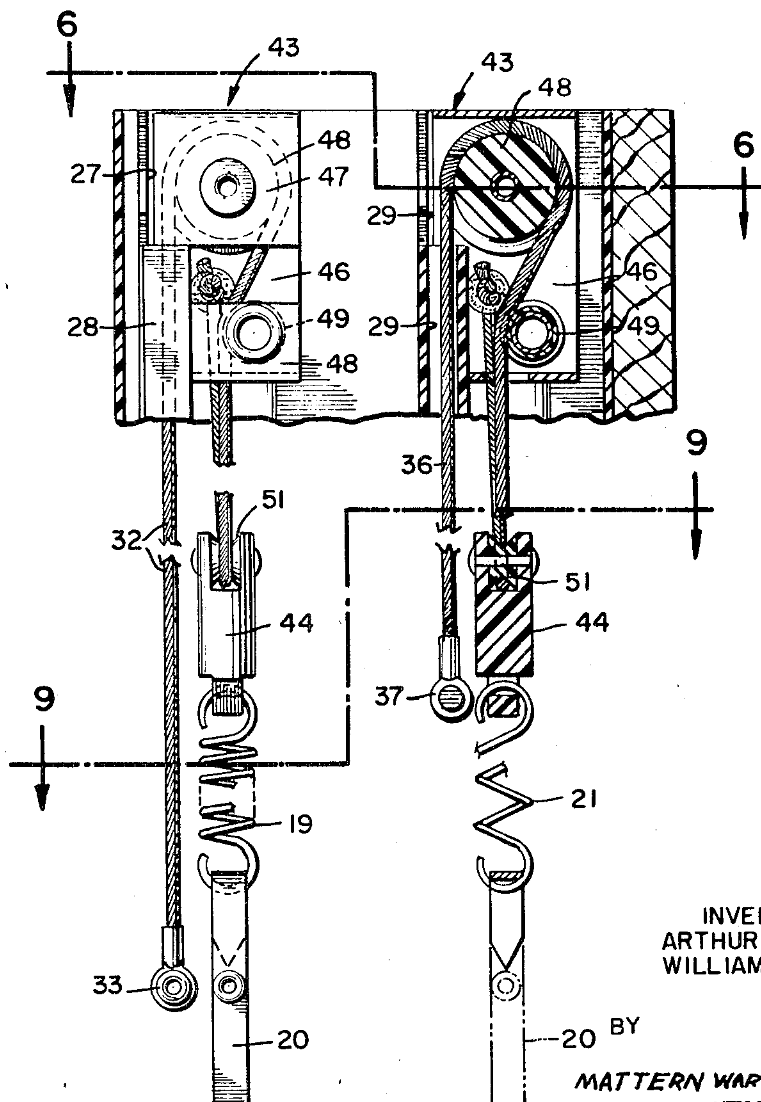


FIG. 7

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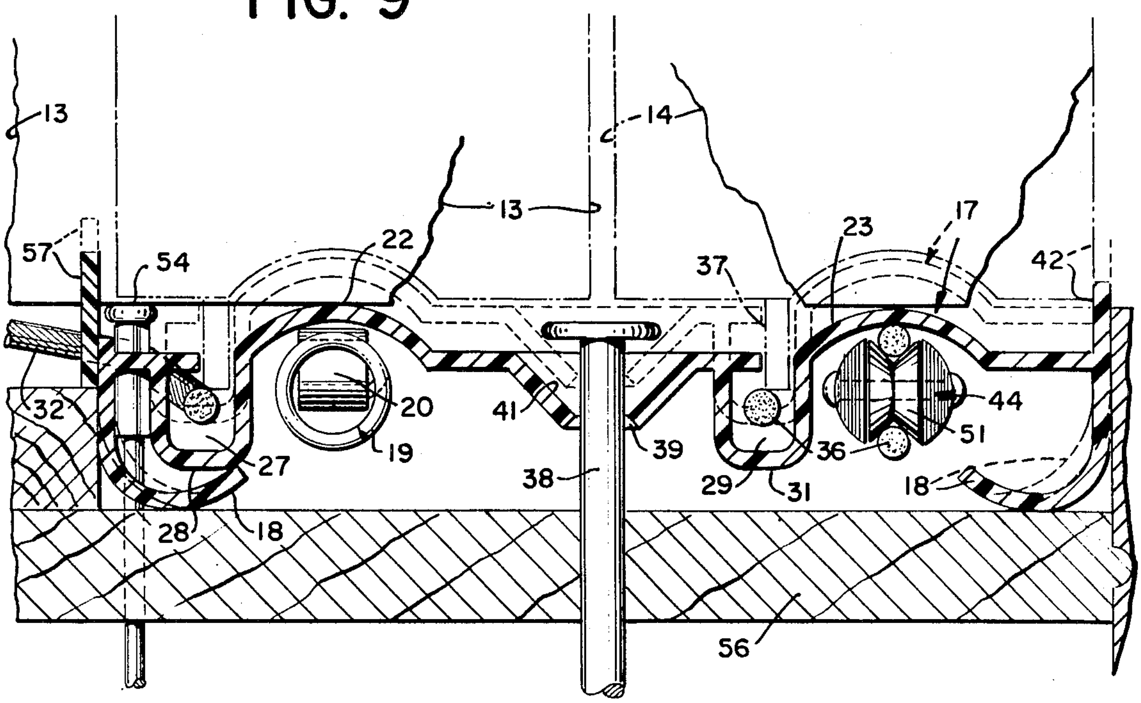
FIG. 9



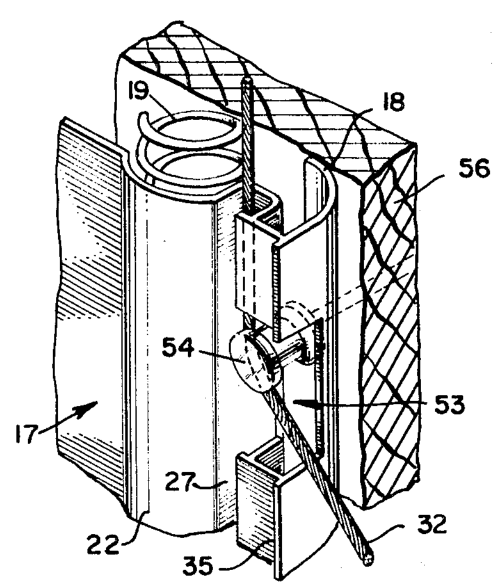


FIG. 8

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WINDOW SASH GUIDE ASSEMBLIES FOR DOUBLE-HUNG TILT-IN WINDOWS

This invention relates to window sash guide assemblies for double-hung windows, and particularly to sash guide assemblies permitting double-hung window sashes to be pivotally tilted inward by the user to oblique ventilating positions, and also to substantially horizontal cleaning positions.

BACKGROUND OF THE INVENTION

Slidably movable upper and lower sash double-hung windows have been counterbalanced by counterweights, by tension springs, by torsion spring balances and by adjustable resilient sliding friction sash guides in many different kinds of sash assemblies. Several of these sash guides and balance systems have become commercially successful, and many such devices have even permitted the detachment and removal of double-hung window sash units by the user for cleaning.

Homeowners have long recognized the desirability of inwardly tilted oblique positioning of the window sash units to provide controlled ventilation, deflecting entering breezes upwardly to promote air circulation without risk of direct drafts blowing upon occupants and disarranging papers and personal articles. The desirability of window assemblies permitting downward pivoting of the sash units to substantially horizontal cleaning positions has also been long recognized. Various proposals for tilt-in sash guide assemblies have been made from time to time, and these have generally involved complex and intricate sash-supporting mechanisms involving high manufacturing and installation costs. Accordingly, there exists a significant unfilled need for effective, practical and economical tilt-in sash guide assemblies for double-hung windows capable of providing smoothly counterbalanced vertical sliding movement of the sash units while also permitting them to be pivotally tilted inward by the user when desired.

SUMMARY OF THE INVENTION

The sash guide assemblies of the present invention incorporate extruded flexible jamb liner sash guides mounted on each side of the window opening, flanking and facing the lateral edges of the two sash units and providing trackways guiding the vertical sliding movement of both sash units. These sash guide assemblies are resiliently self-biased against the lateral sash edges, and incorporate tension-balancing springs hidden behind the extruded sash guide, and mounted for lengthwise extension and retraction in the vertically elongated space between the sash guide and the adjoining window jamb. Each balancing spring is connected by a block-and-tackle unit to a sash cord, reeved over a sheave rotatably mounted at the upper end of the extruded jamb liner sash guide unit, whose opposite end is respectively connected to one of the sliding upper and lower sash units.

The sash guide assemblies are mounted on opposite sides of the window opening, slidably engaging the opposite side edges of both the upper sash and the lower sash. These sash guide assemblies are essentially mirror images of each other, and each sash guide assembly incorporates features permitting both the upper sash and the lower sash to be tilted inwardly at oblique angles for ventilation purposes. In addition, these sash guide assemblies permit the lower sash to be tilted inwardly to a substantially horizontal inwardly projecting position for cleaning, and the upper sash unit may likewise be moved slidingly downward to its lowermost position and then tilted inwardly to a substantially horizontal inwardly projecting cleaning position, in which it lies on top of the lower sash unit.

Accordingly, a principal object of the invention is to provide a practical and economical sash guide assembly permitting vertical sliding movement of double hung window sash units while also affording tilt-in capabilities for the individual upper and lower sash units.

Another object of the invention is to provide such sash guide assemblies utilizing extensible tension balance springs cooperating with sash cords connected to the vertically slidable sash units.

A further object of the invention is to provide such sash guide assemblies incorporating tilt-stop stud projections protruding into the window opening to provide shelflike support for one tilted slidable sash unit in an inwardly tilted oblique ventilating position.

Another object of the invention is to provide such sash guide assemblies permitting the slidable sash unit to be tilted angularly inward to a substantially horizontal cleaning position.

Still another object of the invention is to provide such sash guide assemblies incorporating an interior sash retaining flange provided with a tilt-in release notch through which sash cord connections joining the sash cord to the vertically slidable window sash unit may be pivotally moved inwardly to permit pivotal inward tilting of the sash unit.

Other and more specific objects will be apparent from the features, elements, combinations and operating procedures disclosed in the following detailed description and shown in the drawings.

THE DRAWINGS

FIG. 1 is a fragmentary enlarged perspective view of a sash guide assembly of the present invention, partially broken away to illustrate the structure and operation thereof;

FIGS. 2, 3, 4 and 5 are vertical cross-sectional end elevation views of the sash guide assemblies of the present invention, showing a standard building construction window opening in which the sash guide assemblies of this invention are installed, with the sliding sash units being shown in successive different adjusted positions in these figures;

FIG. 6 is a greatly enlarged fragmentary top plan sectional view of the upper end of a sash guide assembly of the invention;

FIG. 7 is a corresponding greatly enlarged fragmentary end elevation view showing the normally hidden face of an upper end of a sash guide assembly of the present invention assembled in operating position in a window opening;

FIG. 8 is a further enlarged fragmentary prospective view of a different portion of the same sash guide assembly; and

FIG. 9 is a greatly enlarged fragmentary cross-sectional top plan view corresponding to FIG. 6, taken along the plane 9—9 shown in FIG. 7.

SELF-BIASED FLEXIBLE SASH GUIDE UNITS

As indicated in the drawings, the sash guide assemblies of the present invention incorporate two facing sash guide assemblies **11** and **12** forming sliding trackways guiding the lateral edges of a lower sash **13** and an upper sash **14** positioned in a conventional window opening to form a double-hung window. The left and right sash guide assemblies **11** and **12** incorporate respective flexible sash guide units **16** and **17** forming jamb liners secured within the window opening of the building adjacent to the vertically extending jambs defining the lateral sides of the window opening, as indicated in FIGS **6**, **8** and **9**.

These sash guide assemblies incorporate sash-balancing subassemblies connected to counterbalance the weight of the individual sash units in all vertically adjusted sliding positions up and down the sash guide trackways. The sash units are slidingly engaged in the sash guides and connected to the sash balance assemblies in such a way that the user may swing the individual sash units pivotally downward and inward from the closed position to an inwardly tilted oblique position, as illustrated in FIG. **1** and also in FIG. **4**, thus providing convenient upward deflection of entering air for ventilation purposes, while falling rain is deflected downwardly. Combination storm and screen windows installed on the exterior rims of the window openings are not affected by the sliding sash units of these window assemblies in any of their adjusted positions, as may be seen in FIGS **2**, **3**, **4** and **5**.

The sash guide assemblies **11** and **12** are preferably both formed of the same elongated extruded shape having a standardized cross section illustrated in FIG. **9**. These sash guides are well adapted to be fabricated of extruded aluminum or similar metals, or of extruded plastic materials. For example, polyvinyl chloride and its copolymers, known as "rigid vinyls," are easily extruded to form sash guides of these shapes, and provide substantially inert, flame resistant, long-lived structural units exhibiting excellent strength-to-weight ratios and good abrasion resistance. These vinyls may be "alloyed" with other polymers if desired, and may be treated with plasticizers, fillers, stabilizers and colorants to form various useful extrudable plastic compositions. Other extrudable polymers such as nylon may be used if desired to form these sash guides.

Only one extrusion die is needed to form the sash guide trackways **16** and **17** of extruded polymer material or extruded aluminum or similar metals, since the standardized sash guide cross section may be inverted and either end may be cut off at the conventional sill drainage angles of about 14°. This may be observed in the perspective view of FIG. **1** where the inverted, "mirror image" relationship of the two sash guide trackways **16** and **17** may be observed.

These trackways are also provided with rearwardly arched wing flanges **18** forming flexible curved skids engaging the opposed jamb faces of the window opening for resilient self-biasing of the trackways **16** and **17** against the lateral edges of the two sash units **13** and **14**.

Wing flanges **18** are shown in their normal protruding positions in FIGS **1, 6** and **8** and in a flexibly deformed, "compressed" condition in the laterally displaced mode of the trackway illustrated in FIG. **9** where the normal protruding mode position of these wing flanges **18** is shown by dashed lines, in which they urge the trackways laterally inward toward each other into firm seated sliding engagement with the edges of the sash units **13** and **14**.

SASH-BALANCING SUBASSEMBLIES

As illustrated in the figures, the sash-balancing assemblies incorporated in the sash guide units **16** and **17** utilize tightly coiled helical coil springs, which may be fabricated in "compressed" condition for compactness and optimum balancing capability.

Generally similar helically coiled extensible tension springs **19** and **21** are positioned in the vertically elongated concave spaces formed behind convexly arched spring cover portions **22** and **23** protruding into the window opening as shallow ribs along the full vertical length of the extruded sash guide units **16** and **17**. The ribs **22** of these mirror image sash guide units engage mating grooves **24** extending along the lateral side edges of the lower sash **13**, providing sliding engagement between sash and sash guide. Similar grooves **26** extending along the lateral side edges of the upper sash **14** receive and engage the opposed shallow protruding ribs **23** for sliding relative movement. The sash units **13** and **14** are thus positioned for sliding movement from their closed positions shown in FIG. **2** to their opposite positions shown in FIG. **3**.

The cooperation of these grooves **24** and **26** with the elongated sash guide ribs **22** and **23** is clearly shown in the top plan view of FIG. **6**.

As indicated in FIGS **6–9**, each of the facing sash guides **16** and **17** incorporates a laterally recessed cord groove **27** formed as an elongated vertical cavity within a laterally offset rigidifying projection **28** extending beside rib **22** along the entire length of each of the extruded sash guide units **16** and **17**. A corresponding cord groove **29** is formed in a corresponding offset projection **31** extending alongside the shallow protruding rib **23**. As shown in the drawings, cord grooves **27** and **29** are both positioned inwardly, on the building-interior side of their adjacent protruding ribs **22** and **23**. A lower sash cord **32** connected by a block-and-tackle assembly to lower spring **19** is positioned between the sash guide **16** and its adjacent jamb, as indicated in FIG. **9**, and extends into the upper end of the interior cord groove **27** and down the length of this groove, where its lower end is firmly anchored to the lateral side edge of the lower sash **13** by an eyelet pivotally secured to an anchor stud **33** positioned on the side of sash **13** aligned with groove **27** (FIG. **9**).

A guide pin **34** laterally extending outward from the lower lateral side edge of lower sash **13** protrudes into the cord groove **27**, cooperating with the sliding engagement of rib **22** in groove **24** in each sash guide unit. This assures aligned vertical sliding movement of lower sash **13** between the facing sash guides **16** and **17**.

In the normal or vertical position of lower sash **13**, engaged for vertical sliding movement up and down within the sash guides **16** and **17** between the positions shown in FIGS. **2** and **3**, the balancing force supplied by the extension of tension springs **19** transmitted by way of sash cords **32** is applied to lower sash **13** by anchor stud **33** at a point directly above the guide pin **34** in the plane of the interior cord grooves **27**, thus supplementing the engagement of grooves **26** with ribs **22** on each lateral edge of lower sash **13**, to provide stable, counterbalanced sliding support for the sash.

UPPER SASH-BALANCING SUBASSEMBLY

A similar pair of counterbalancing springs, sash cords and block-and-tackle subassemblies are provided for balancing the weight of the upper sash unit **14**. As shown in FIGS **1** and **7**, each upper sash-balancing spring **21** has its lower end secured to the lower end of sash guide unit **16** by a linked engagement with a hooked clip **20**, anchored to the jamb side of extruded sash guides **16** and **17**. The upper end of the upper sash-balancing spring **21** is secured by a block-and-tackle assembly to an upper sash cord **36** extending into the upper end of the exterior cord groove **29** and down the length of this vertically elongated groove to be connected directly to a laterally extending guide pin **37** protruding from each lateral side edge of sash **14** into engagement with the groove **29** in sash guide **16** or **17**. The upper sash cords **36** and guide pins **37** operating within grooves **29** thus cooperate with the sliding engagement of groove **26** on rib **23** to provide smoothly balanced sliding movement of upper sash **14** in its normal, vertical position between the two terminal positions shown in FIGS **2** and **3**.

WEATHER-STRIPPING CAPABILITY

Sash guides **16** and **17** positioned on opposite sides of the window opening in the jamb liner position are compressively engaged between the lateral side edges of the two sash units **13** and **14** and the flanking window opening, as indicated in FIGS. **1, 6** and **9**. During installation and assembly of the window, each sash guide unit **16** and **17** is anchored in its operating position juxtaposed beside the window jamb by several anchoring screws **38** extending through anchoring apertures **39** spaced apart at two, three or more widely spaced positions along the vertical length of the sash guides **16** and **17** and surrounded by generally conical counterbore portals **41** formed by stamping or otherwise deforming the extruded sash guide units **16** and **17** toward the adjacent window jamb, and thus providing space within the concave interior of the portals **41** for the heads of anchoring screws **38** or similar fastenings securing the sash guide units **16** and **17** to the jambs within the window opening. Anchoring screws **38** fit loosely within anchoring apertures **39**, permitting movement of sash guides **16** and **17** toward and away from the adjacent window jambs. When force is applied by the user tending to depress these sash guides in the direction of the window jamb, their rearwardly extending curved wing flanges **18** are deformed and depressed, causing the overall cross section of the sash guide **16** or **17** to change from that shown in FIG. **6** to that shown in FIG. **9**.

This depressible lateral movement of the sash guides **16** and **17** apart and away from each other in their installed positions illustrated in FIG. **1** facilitates the installation of the sash units **13** and **14** between the sash guides **16** and **17** in prefabricated window assemblies, ready for insertion in a window opening of a building in preassembled condition. In addition, the depressible lateral movement of sash units 16 and 17 in a direction away from each other permit these sash guide units to be installed in positions interfering slightly with the overall lateral dimensions of the two sash units with the natural resilience of the extruded sash guides 16 and 17 tending to restore each sash guide from its depressed, deformed condition shown in FIG. 9 toward its inward, relaxed condition. Each sash guide 16 and 17 is thus self-biased resiliently in close sliding engagement with the lateral side edges of the sash units 13 and 14, as shown in FIG. 6, providing both smooth sliding movement of the sash units and excellent weatherstripped air-sealing performance, minimizing penetration of wind and moisture past the edges of the sash units of the assembled window. An exterior guide flange 42 extends laterally inwardly at the exterior outdoor edge of each sash guide unit 16 and 17, forming an outermost guide preventing the outward movement of upper sash unit 14 and further assisting in weatherproofing the upper portion of the overall assembly. An opposite interior guide flange 35 likewise extends into the window opening along the building interior edge of each sash guide 16 and 17, forming a front retaining flange for lower sash unit 13.

BLOCK-AND-TACKLE BALANCING AND INWARD TILTING OPERATION

As shown in FIGS 1, 6 and 7, the block-and-tackle sash cord subassemblies connecting the tension springs 19 and 21 with respective upper and lower sash units 13 and 14 are substantially identical. These block-and-tackle subassemblies incorporate a fixed upper block unit 43, and a vertically movable spring-block unit 44 firmly secured to the upper end of each of the tension springs.

The fixed block units 43 incorporate a fixed plate 46 having reversely turned upper flange 47 and lower flange 48. The lower portions of the fixed block units 43 are cut away or recessed to cooperate with a wall cutout formed at the upper end of the projections 28 and 31 forming the interior cord groove 27 and the exterior cord groove 29 respectively. This permits the fixed block units 43 partially to overlie the open upper ends of the grooves 27 and 29, as shown in FIGS 6 and 7.

Reversely downturned upper flange 47 and fixed plate 46 are provided with aligned apertures forming trunnion-bearing supports for an upper sheave 48 whose peripheral groove extends into overlying tangent alignment with the upper end of one of the cord grooves 27 or 29, to deliver the sash cords 32 or 36 into these grooves and to receive the sash cords therefrom as the tension springs are contracted and extended by vertical movement of the sash units 13 and 14.

Reversely upturned lower flange 48 and fixed plate 46 are provided with aligned apertures forming similar trunnion bearings for an idler sheave 49, and both of the sheaves 48 and 49 are freely rotatable between the walls of their upper fixed block units 43. One side of the groove of idler sheave 49 is preferably positioned in vertical tangent alignment with the central plane of one of the spring cavities formed behind the spring cover rib portions 22 and 23 of each of the sash guide units 16 and 17.

Fixed plate 46 is also provided with an anchoring aperture receiving the fixed end of one of the sash cords 32 and 36. Accordingly, as shown in FIG. 7, the lower sash cord 32 extends from the terminal eyelet pivotally securing it to the anchor stud 33 on the lower sash unit 13, upwardly along interior cord groove 27 into tangent engagement with the central groove of the upper sheave 48, passing thereover downward into sector engagement with the groove of idler sheave 49, and thence downward in the central plane of the vertically elongated cavity behind spring cover rib portion 22 of sash guide 16 to pass beneath and around a sheave 51 rotatably mounted on a suitable rivet or similar shaft at the upper end of the movable block unit 44, which may be forked to receive and support both ends of the shaft on which sheave 51 is rotatably mounted. From sheave 51 lower sash cord 32 extends upwardly to be secured as by knotting at its fixed terminal anchor point within an anchoring aperture 52 formed in the fixed plate 46 of the upper fixed block unit 43.

As shown in the broken away schematic view of FIG. 7, upper sash cord 36 is reeved in similar fashion over corresponding upper fixed sheave 48 and idler sheave 49 and a movable sheave 51 mounted in movable block unit 44 in the same manner. The movable end of upper sash cord 36 is permanently secured to the protruding guide pin 37 extending a substantial distance into the exterior cord groove 29, while the movable end of lower sash cord 32 is pivotally secured by eyelet means to the substantially flatter anchor stud 33 which extends only slightly into interior cord groove 27.

The inwardly tilted oblique ventilating position of the two sash units 13 and 14 illustrated in FIG. 1 and also in FIG. 4 is easily and conveniently produced by manual angular displacement of the sash units. Angular inward movement of lower sash 13, pivoting about the axis of its two guide pins 34 engaged within the interior cord groove 27, is permitted at the lowermost position of lower sash 13 by portals 53 formed in the front retaining flange 35, the adjacent sash-engaging wall and a portion of the interior cord groove projection 28 of each sash guide. Portals 53 are provided at a vertical height aligned with the lowermost position of the anchor stud 33 in the lower closed position of lower sash 13, thus permitting studs 33 to move angularly inward as lower sash 13 is pivoted by the user about its guide pins 34 from its vertical position shown in FIG. 2 to any inwardly slanting inclined, oblique position, such as that shown in FIGS 1, 4 or 5.

In these angularly inwardly displaced positions, the lower sash cord 32 is drawn around a support post 54, best shown in FIGS 1 and 8, positioned in the portal 53 near lower sash cord groove 27, but displaced therefrom slightly inwardly toward the interior of the building in which the window assembly is installed. As indicated in FIG. 8, support post 54 is preferably formed as an enlarged grooved stud having an integral anchoring fastening such as a nail or screw extending laterally outward into firm anchored engagement with the adjacent window jamb 56.

The position of support post 54 just above and interiorly offset from the lowermost position of anchor stud 33 of lower sash 13 in its lower closed position is well illustrated in FIG. 2. As the lower sash is moved upwardly, anchor stud 33 ascends past support post 54, moving upward within cord groove 27. When lower sash unit 13 is angularly pivoted inwardly from its lower position shown in FIG. 2 to a tilted position such as that shown in FIG. 4, the anchor stud 33 passes beneath support post 54 through portal 53, drawing sash cord 32 around the rear face of support post 54 from a line of tangency extending down sash cord groove 27, with the exposed lowermost portion of sash cord 32 tautly extending between anchor stud 33 in the tilted position of sash 13 and the support post 54. Cord 32 continues to support substantially all of the weight of lower sash 13 in all outwardly tilted positions of sash 13.

When lower sash 13 has been tilted outward to any adjusted position, the upper sash 14 may then be tilted outward to the positions shown in FIGS 1 and 4. Outward tilting of upper sash 14 is accomplished by lowering upper sash 14 a few inches beneath its uppermost position illustrated in FIG. 2, and then by drawing the upper edge of upper sash 14 angularly inward, pivoting the upper sash unit about its laterally extending guide pins 37 engaged within its sash cord groove 29. Upper sash unit 14 may thus be tilted angularly inward into the interior of the building in which the window assembly is installed until its interior face reaches a pair of inwardly extending stud plates 57, formed integrally with or anchored to the innermost surface of the sash cords 16 and 17 at interior guide flange 35, and extending a short distance into the window opening to provide underlaying support for the upper sash 14 in its inwardly tilted position, as shown in FIG. 1. The stud plates 57 may be formed as small plates of metal or plastic, preferably of the material from which sash guide units 16 and 17 are formed, which are welded, riveted or otherwise joined to the interior faces of the sash guide units 16 and 17 in the manner shown in FIG. 1, or formed integrally therewith if desired.

The vertical position of the stud plates 57, projecting inwardly toward each other into the window opening, is determined by the angular position at which upper sash unit 14 is to rest in tilting engagement therewith, and by the balancing of the weight of the inwardly tilted upper sash unit 14 on the stud plates 57 and on the guide pins 37, to which upward balancing force is applied by the spring and sash cord balance subassemblies in each sash guide assembly 11 and 12. In returning the inwardly tilted sash units 13 and 14 to their closed vertical positions for vertical sliding movement, as shown in FIG. 2, the upper sash unit is first tilted outward to its vertical position and raised to the closed position shown in FIG. 2, and the lower sash unit 13 is then tilted outwardly toward the vertical position shown in FIG. 2, bringing anchor stud 33 into and through portal 53 beneath support post 54 into interior cord groove 27.

INWARDLY PROJECTING SASH-CLEANING POSITIONS

As indicated in FIG. 5, lower sash 13 may be further tilted inwardly, pivoting about its guide pins 34 engaged in the interior cord grooves 27 while sash 13 suspended near the stool 58, drawing sash cords 32 behind and past support posts 54 until sash 13 projects into the interior of the building in a substantially horizontal position, suspended near the stool 58 at the lower end of the window opening. In this position, sash cords 32 are drawn to their maximum length, bringing their movable spring blocks 44 to the top of their travel, "chock-a-block" with fixed block units 43 at the upper end of both sash guides 16 and 17. In this position, the exposed weather side of sash 13 is conveniently presented to the user for cleaning and polishing whenever desired.

In addition, upper sash 14 may be similarly exposed. This is accomplished by moving upper sash 14 downward to its lower position, illustrated in FIG. 3, bringing its upper edge below stud plates 57, and then drawing the upper edge of sash 14 inwardly, pivoting about its guide pins 37 engaged in exterior cord groove 29, producing angular inward pivoting movement of the upper sash 14 from the vertical lowered position shown in FIG. 3 beneath stud plates 57 to the horizontal position shown in FIG. 5, where sash 14 overlies and rests upon lower sash 13, projecting substantially horizontally into the building at the bottom of the window opening. In this position, the exterior weather surface of upper sash 14 is conveniently exposed to the user for cleaning and polishing. Thereafter, the upper sash 14 may again be pivoted counterclockwise in FIG. 5 to return to the vertical position shown in FIG. 3 and lower sash 13 may then be pivoted counterclockwise in a similar manner to the position shown in FIG. 2, restoring the entire window assembly to its normal operating condition.

The flexible resilient deformability of the sash guides 16 and 17, allowing them to be depressed as indicated in FIG. 9, provides excellent sliding engagement of the sash units 13 and 14 within the sash guides 16 and 17, while also achieving good weather-stripping sealing of the overall window assembly. The same resilient deformability of sash guides 16 and 17 contributes to the effectiveness of the inward pivoting tilting movement of the sash units 13 and 14 into the ventilating positions shown in FIG. 4 and the cleaning positions shown in FIG. 5, because pivoting torque applied by the user tending to rotate or pivot the sash units 13 and 14 inwardly about their groove-engaged projecting guide pins 34 and 37 forces the sash guide units laterally aside as the upper portions of the sash units 13 and 14 are respectively drawn into the room, their grooves 24 and 26 depress and cam aside the groove-engaged ribs 22 and 23 of the sash guide units 16 and 17, causing these units to be resiliently depressed toward the deformed position shown in FIG. 9, in which both sash units 13 and 14 are shown angularly skewed into the building from the window opening past sash guide 17, which is thus shown depressed toward its adjacent window jamb.

In a similar manner, when the sash units 13 and 14 are pivotally returned to their normal vertical sliding positions, the depressible sash guides 16 and 17 deform sufficiently to allow the reengagement of their ribs 22 and 23 with the mating lateral edge grooves 24 and 26 of the sash units as the inwardly tilted sash units return to their normal vertical sliding position, thus assuring that smooth, low-friction sliding engagement is again achieved. The portals 53 formed in flanges 35 at the interiorly projecting corner edges of the sash guides 16 and 17 cooperate with this pivoting tilting depressible displacement of the sash guide units with unusual effectiveness, permitting the sash cords and balancing subassemblies to support the weight of lower sash 13 in all of its inwardly projecting positions, and also to support the weight of both the upper sash 14 and the lower sash 13 in the cleaning position shown in FIG. 5.

The use of block-and-tackle subassemblies incorporating the fixed sheave unit 43 and the vertically movable sheave block unit 44 allows the tension load T in each of the sash cords 32 and 36 to be balanced by a "double load" 2T transmitted by movable block 44 to tension spring 19 or 21, causing extension of the spring longitudinally through a distance D equal to only one-half of the vertical travel distance 2D of the sash unit balanced thereby. By thus reducing the resilient extension of the helical springs 19 and 21, the change in the restoring force exerted by the extended springs upon block 44—the variation in balancing force—is minimized, being reduced to one-half of the corresponding variation encountered if a block-and-tackle subassembly were omitted and the sash cord 32 were connected directly to the spring. Smooth, more dependable balancing operation and the use of larger, more powerful springs are the advantageous results achieved by this assembly, and the balancing force of the single lower sash springs 19 may thus be employed to balance the weight of both sashes 13 and 14 in their inwardly protruding, substantially horizontal cleaning positions shown in FIG. 5.

Block-and-tackle subassemblies connecting tension springs to balance window sash units in double-hung windows have been proposed in U.S. Pat. Nos. 3,248,821, 2,715,747 and 2,262,990. However, the advantageous features of the present invention, combining these subassemblies with resiliently deformable self-biasing sash guide trackways and with the inward tilting features 32, 33, 53, 54, 57 provide novel and unique advantages. The assemblies of this invention thus achieve significant manufacturing economies while offering unusual operating advantages to the user.

Since the foregoing description and drawings are merely illustrative, the scope of the invention has been broadly stated herein and it should be liberally interpreted to secure the benefit of all equivalents to which the invention is fairly entitled.

What is claimed is:

1. Double-hung window sash guide assemblies for a vertically slidable lower window sash, comprising

a fixed left sash guide and a fixed right sash guide spaced apart in facing juxtaposition along opposite jambs of a window opening,

a fixed trackway joining the window sash in sliding engagement with each sash guide,

a laterally protruding sash guide pin extending horizontally from the lower side portion of each lower sash into respective vertically slidable engagement with one of said trackways,

left-and-right extensible tension balance springs, each having a lower end secured to the lower end of the respective sash guide and a free upper end,

a first sheave rotatably mounted at the upper end of each sash guide,

a sash cord passing over each first sheave and connecting the upper free end of one balance spring to the central portion of one side of the lower window sash at a point spaced upwardly above said sash guide pin by a predetermined distance,

at least one sash guide being resiliently depressible toward its jamb and away from the other sash guide to disengage the sash from the trackway for inward movement relative to the trackway, and

a support post positioned on each fixed sash guide trackway at a height above its lower end at least as great as said predetermined distance and aligned for partially wrapped engagement of the sash cord therewith when the lower sash is angularly tilted inwardly from its lowermost position pivoting about the sash guide pins, whereby the disengageable lower window sash is counterbalancingly supported by said balance springs for variably adjustable balanced positioning both when it is slidingly engaged with the trackways and when it is tiltably disengaged therefrom for ventilation or cleaning.

2. The sash guide assemblies defined in claim **1**, wherein the extensible balance springs are positioned between each sash guide and its adjacent jamb.

3. The sash guide assemblies defined in claim **1**, including an interior wing flange and an exterior wing flange each extending deformably toward the adjacent jamb.

4. The sash guide assemblies defined in claim **3**, wherein the wing flanges form curved skids arched toward each other, slidably depressible by force urging the sash guide toward the jamb.

5. The sash guide assemblies defined in claim **1**, wherein the trackway includes a mating rib-and-groove positioning the side edge of the sash in sliding engagement with the sash guide.

6. The sash guide assemblies defined in claim **1**, wherein the sash guide is provided with a vertically elongated recessed groove-receiving the sash end of the sash cord behind a vertically elongated rearwardly extending protective flange substantially hiding the cord from view.

7. The sash guide assemblies defined in claim **6**, wherein the lower end of each side of the sash is provided with the laterally protruding guide pin aligned for vertical movement up and down said sash cord groove.

8. The sash guide assemblies defined in claim **1**, further including a stud plate extending into the window opening from a sash guide into the inward movement path of a disengaged sash.

9. The sash guide assemblies defined in claim **1** further including a portal formed in the sash guide and opening into the sash cord groove with said support post being positioned therein, whereby pivoting movement of the lower sash in its lowermost position pivoting about its sash guide pins draws the sash cord around the support post and through the portal.

10. The sash guide assemblies defined in claim **1**, wherein the sash cord is reeved through a block-and-tackle of the gun-tackle type incorporating the fixed upper sheave and a running lower sheave rotatably connected to the free end of the balance spring, with the hauling part of the sash cord being connected to the sash.

11. The sash guide assemblies defined in claim **1**, wherein the two sash guides embrace a lower sash and an upper sash, together forming a double-hung window assembly.