Jan. 23, 1940. C. P. POND 2,188,231

SASH-OPERATING DEVICE

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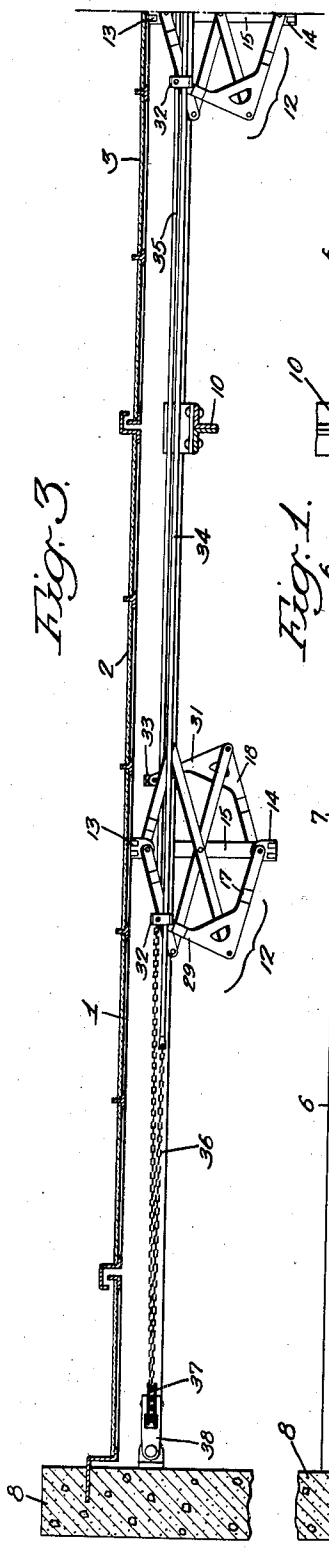


Fig. 3.

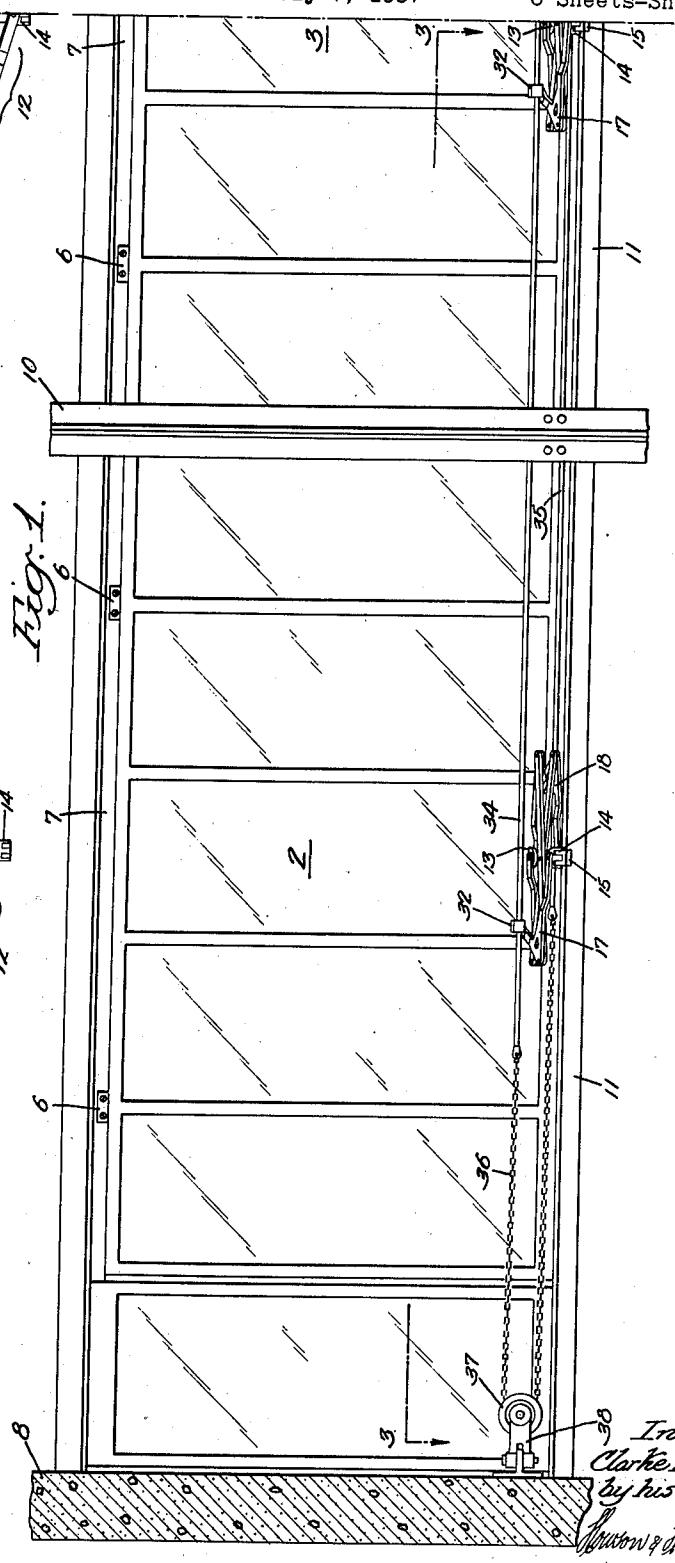


Fig. 1.

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SASH-OPERATING DEVICE

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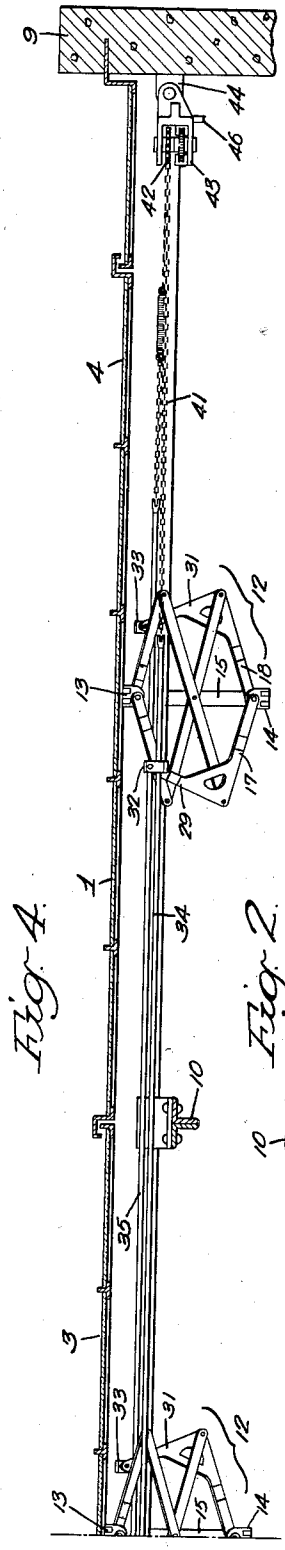


Fig. 4.

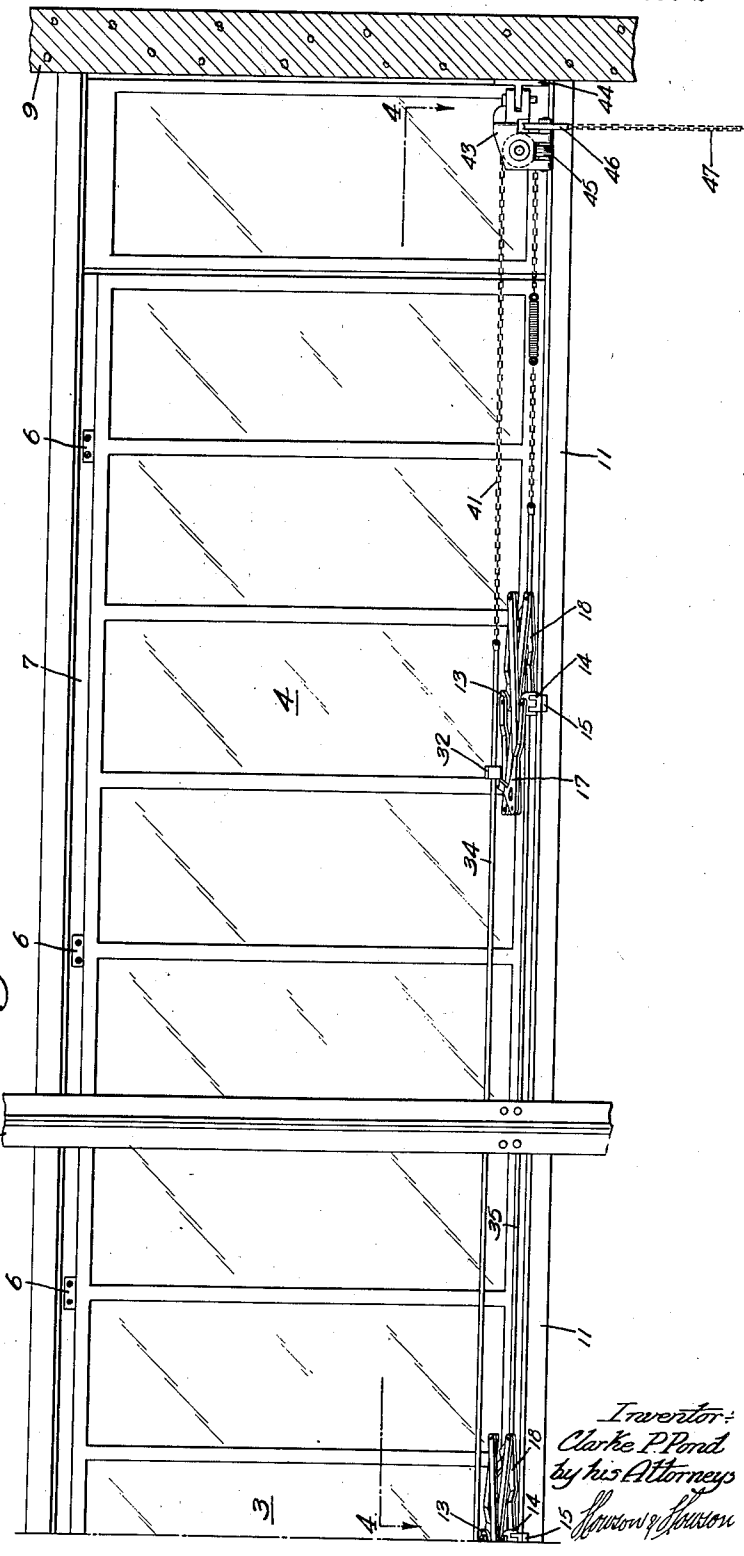


Fig. 2.

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SASH-OPERATING DEVICE

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Fig. 5.

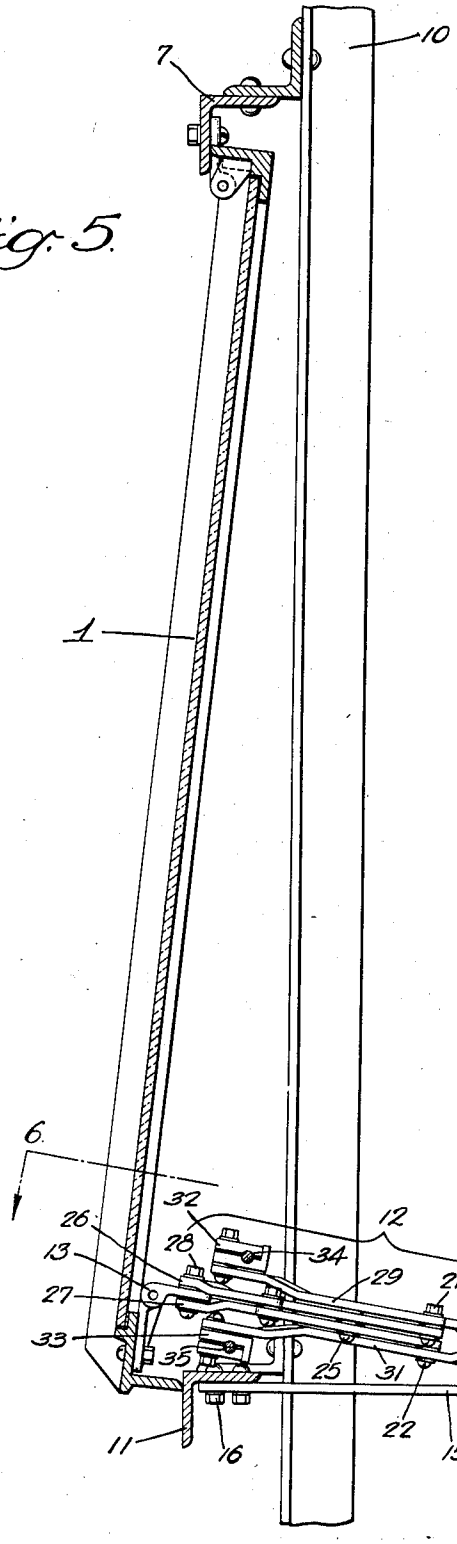
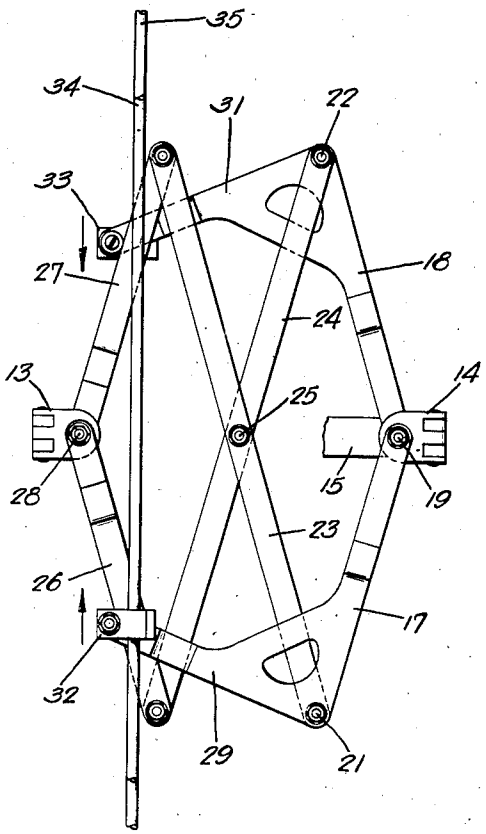


Fig. 6.

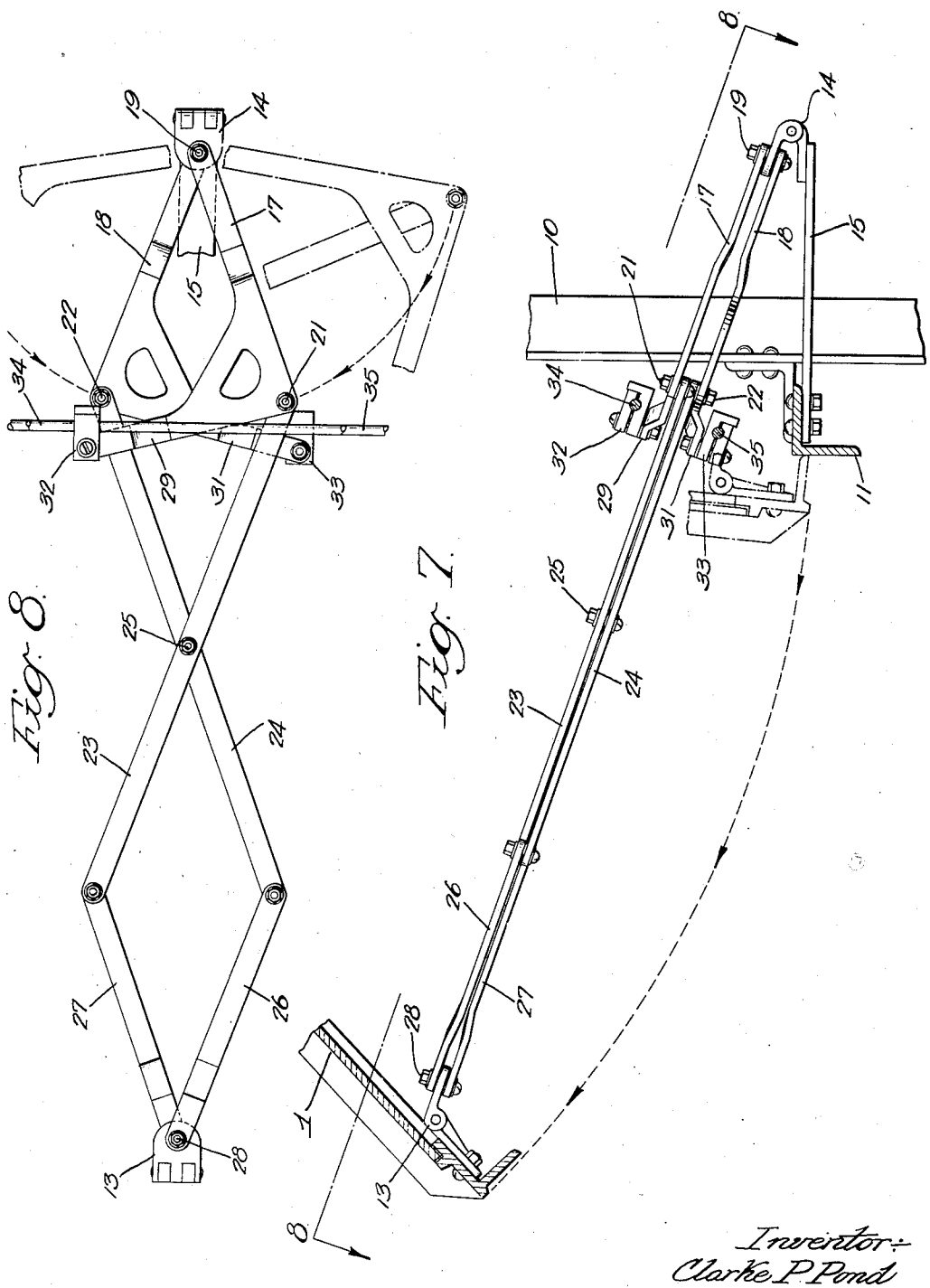


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SASH-OPERATING DEVICE

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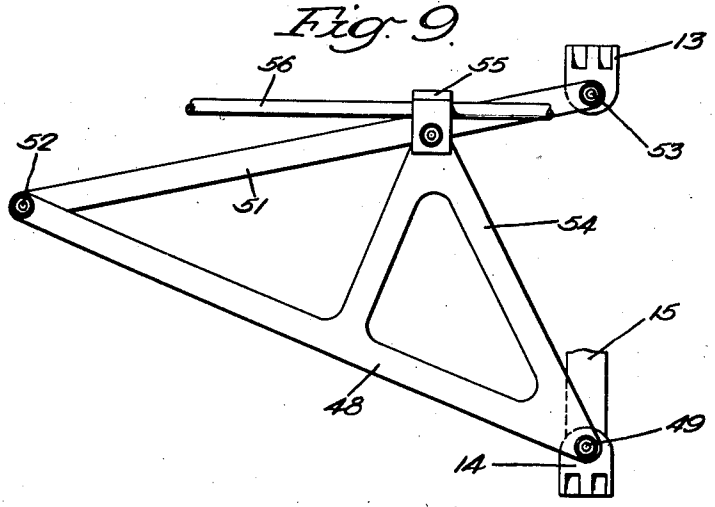
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Jan. 23, 1940. C. P. POND 2,188,231

SASH-OPERATING DEVICE

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Fig. 9.



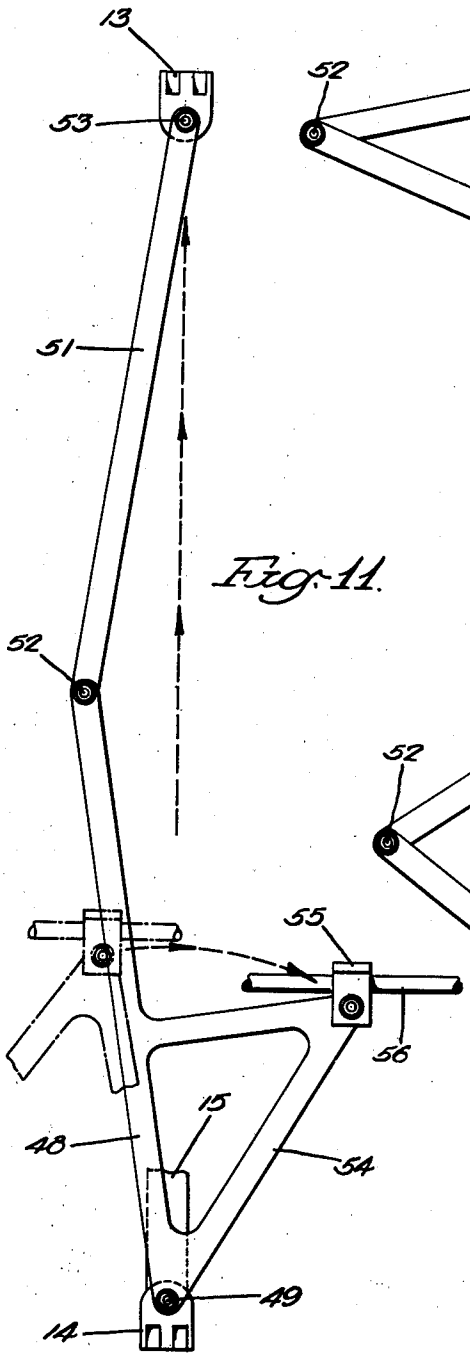


Fig. 11.

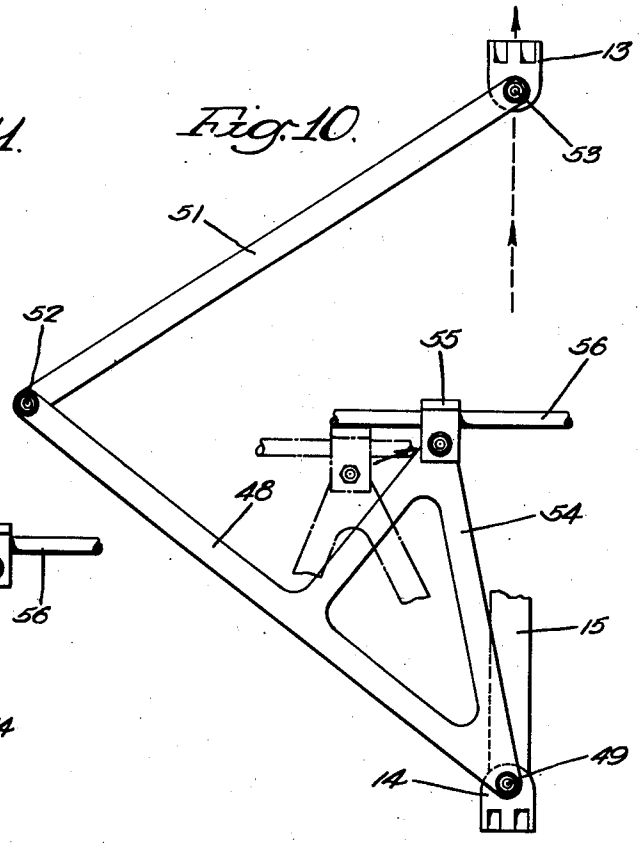


Fig. 10.

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SASH-OPERATING DEVICE

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Fig. 12.

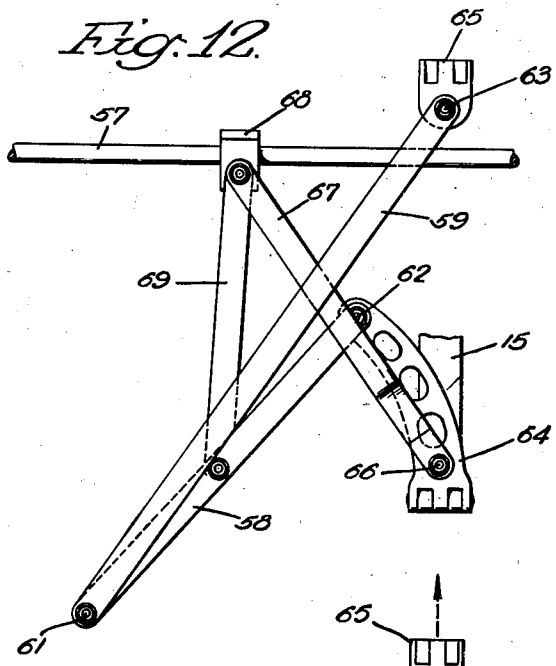


Fig. 13.

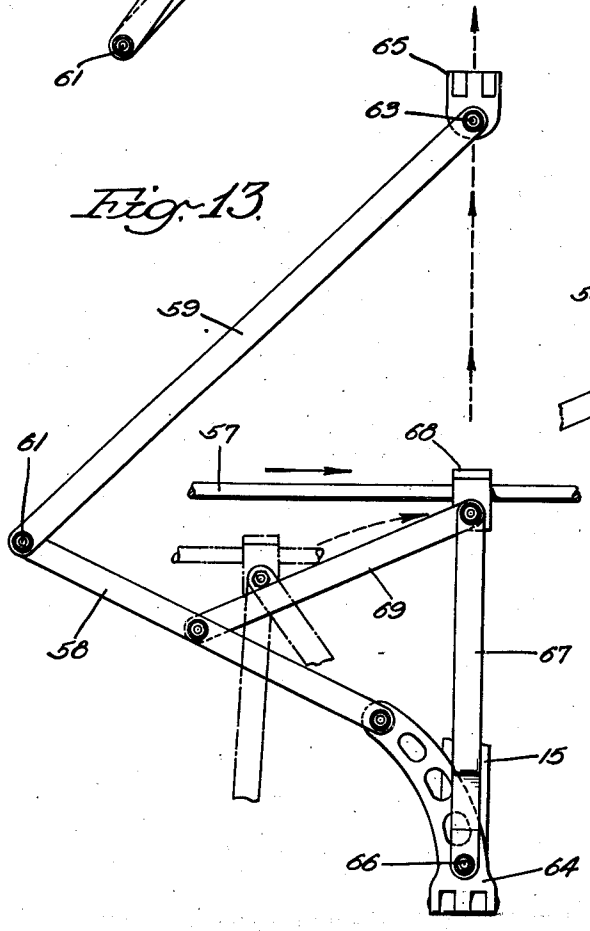
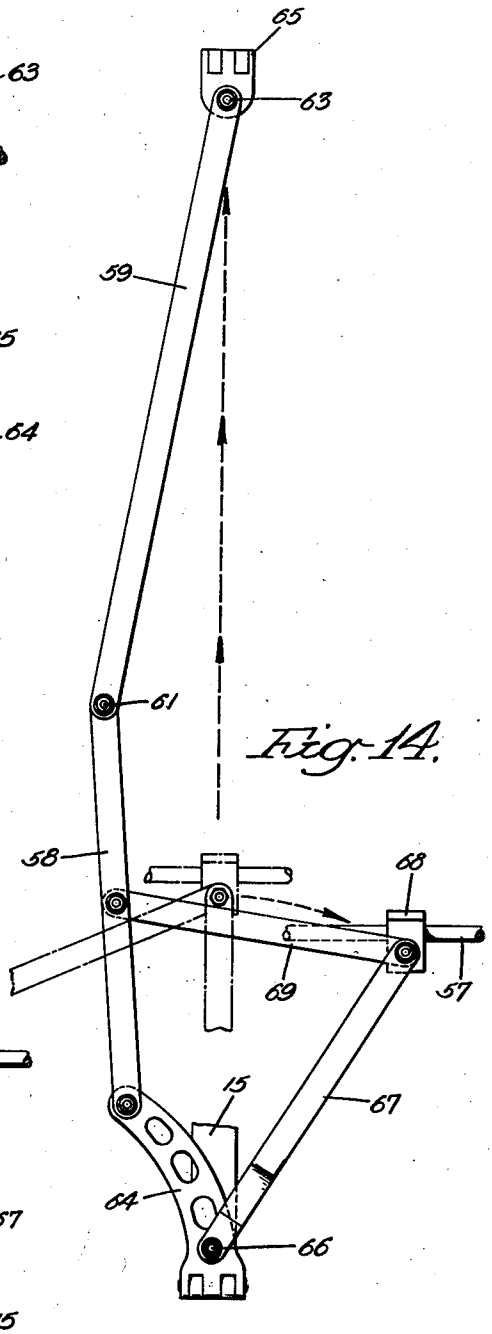


Fig. 14.



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Patented Jan. 23, 1940 2,188,231

UNITED STATES PATENT OFFICE

2,188,231

SASH-OPERATING DEVICE

Clarke P. Pond, Philadelphia, Pa.

Application July 7, 1937, Serial No. 152,449

7 Claims. (Cl. 268—22)

This invention relates to improvements in operating devices for window sash, shutters and the like, and relates more particularly to improvements in devices for operating continuous sash of the type now commonly employed in factory and similar buildings. More specifically, the invention relates to operating devices of the character employing lever systems adapted for attachment to the lower part of a horizontally hinged sash in a position more or less at right angles to the sash when the latter is closed, and operative to adjust the sash between the said closed and open positions by expansion and contraction along a variable line substantially parallel to the chord of the arc defined by the movement of the lower edge of the sash, said expansion and contraction being effected through the medium of transmission elements connected to said systems and movable longitudinally in a direction substantially parallel to the hinge axis of the sash and transverse to the direction in which the systems operate.

Heretofore, devices of this character have been so constituted that the said lever systems have been required to extend to undesirably great distances inwardly from the sash line, and their mode of operation has been such as to necessitate the location of the said transmission elements in positions relatively remote from the sash line in the interior of the building. One object of the invention is to provide an operating device of the stated character comprising a system of levers so organized and assembled as to be capable of operation from a position closely adjacent the sash whereby the power transmission elements required to operate the devices may be positioned relatively close to the latter. The invention in this respect affords the material advantage of removing the transmission elements from a position in which they involve a potential interference with traveling cranes, columns or other structural and mechanical features of the building to an otherwise unoccupied and waste space immediately adjoining the sash and between the sash and the structural uprights which conventionally support the sash frames. In this phase also, the invention has the further material advantage of facilitating installation of the operating mechanism, in that by the practice of the invention, it is possible to locate the transmission elements in the aforesaid otherwise unoccupied space immediately adjacent the sash so that special provision for accommodating the transmission mechanism and levers to obstructions, such as columns and the like, is avoided.

Still another advantage of my invention in the respects recited above resides in the fact that it permits the manufacture and erection of standardized operating devices for general use, and avoids the prior necessity for extra engineering expenses in the way of drawings and field measurements.

A further object of the invention is to provide an operating device of the character described wherein the extent to which the device projects into the interior of the building from the sash line may be materially decreased, and whereby the transmission lines which constitute the principal source of interference in building construction and occupancy are entirely removed from the column area to the space between the sash and the structural uprights which support the sash frames, which space is normally unoccupied and unobstructed.

A still further object of the invention is to provide an operating device of the character set forth comprising a series of levers or arms attached to the sash and so designed as to provide a suitable medium for transmission of power with leverage generally increasing with the load.

The invention further resides in the structural details and mechanical features hereinafter described and illustrated in the attached drawings, in which:

Figure 1 is an elevational view of one end of a continuous top hinged sash provided with operating mechanism made in accordance with my invention, Fig. 2 being an elevational view of the opposite end of said sash system and of the operating device;

Figs. 3 and 4 are, respectively, sectional plan views taken on the lines 3—3 and 4—4, respectively, of Figs. 1 and 2;

Fig. 5 is a vertical sectional view on the line 5—5, Fig. 1;

Fig. 6 is a plan view of the operating lever system viewed from the line 6—6, Fig. 5;

Fig. 7 is a vertical sectional view similar to Fig. 5 but showing the sash in the elevated position;

Fig. 8 is a fragmentary plan view similar to Fig. 6 showing the lever system in the extended or open sash condition;

Fig. 9 is a detached plan view of a modified form of lever assembly constituting a modification within the scope of the invention;

Fig. 10 is a plan view showing the operating device of Fig. 9 in a partially extended position;

Fig. 11 is a similar plan view showing the op-

erating device of Figs. 9 and 10 in the fully extended position;

Fig. 12 is a detached plan view of a lever assembly constituting a still further modification, and

Figs. 13 and 14 are plan views of the assembly of Fig. 12 and showing the mechanism respectively in the partially and fully extended positions.

With reference to Figs. 1 to 4 of the drawings, I have therein illustrated at 1 a continuous line of sash consisting of a plurality of separate sash units 2, 3 and 4 which are independently suspended by hinges 6 from a transverse beam 7, said beam being supported at its ends in the walls 8 and 9 of the building, and intermediate its ends upon upright structural members 10, as shown more specifically in Fig. 5. As shown in this latter figure, the sash elements are supported in a normal closed position in a plane somewhat inclined to the vertical, the bottom of the sash in this position engaging a sill member 11 which extends continuously the full length of the sash and is itself suitably supported upon the uprights 10. To each of the sash units is connected an operating device made in accordance with my invention and designated generally in Figs. 1 to 5, inclusive, by the reference numeral 12, and these devices are adapted to be operated simultaneously and in synchronism so as to effect the simultaneous movement of the sash units between their open and closed position.

With reference to Figs. 5 and 6, each of the operating devices 12 consists of a pantograph or lazy-tong system of levers one end of which is connected through a hinge joint 13 to the lower edge portion of the associated sash unit, the other end of said system of levers being similarly connected through a hinge joint 14 with the inner end of bracket arm 15, the outer end of this arm being secured, as indicated at 16 in Fig. 5, to the structural member 11 which forms the sill of the sash. The system of levers 12 illustrated in Figs. 5 to 8, inclusive, is in the nature of a pantograph, being shown in Fig. 6 in the contracted or retracted condition which it assumes when the sash is in the normal or closed position, see Fig. 5; and in Fig. 8, I have shown the lever system in the extended or projected position which it occupies when the sash is in the elevated or open position. As shown in Fig. 6, the lever system comprises two bell crank members, the arms 17 and 18 of which are pivotally connected at 19 to the hinge 14. To each of these arms is pivotally connected, at 21 and 22 respectively, a second lever arm, 23 and 24, these arms intersecting and being pivotally connected together at their mid sections, as indicated at 25. The outer ends of the arms 23 and 24 have pivotally connected thereto outwardly converging arms 26 and 27 respectively, both of which are pivotally connected at 28 to the hinge 13 attaching to the sash. This lever system departs from the conventional lazy tong formation by the inclusion of the bell crank members, the arms 17 and 18 of which form the terminal levers of the lazy-tong system and the arms 29 and 31 of which extend in the direction of the sash. Each of these arms 29 and 31 carries at its outer end and pivotally connected thereto a clamp, 32 and 33 respectively, and these clamps are adapted respectively to grip transmission rods 34 and 35 which extend parallel to the plane of the sash and in the space immediately adjoining the sash and outwardly of the structural members 10.

Referring again to Figs. 1 to 4, it will be noted that the rods 34 and 35 extend continuously over the major length of the continuous line of sash 1. As shown in Fig. 1, the terminal ends of the rods 34 and 35 at that end of the sash are connected by a chain 36 which extends around an idler pulley 37 pivotally supported upon a horizontally swinging bracket 38, this bracket being pivotally supported for said horizontal swinging movement upon a bracket 39 secured to the wall 8. The opposite ends of the rods 34 and 35 are similarly connected by means of a chain 41 which passes around an operating pulley 42 supported in a swinging block 43 on a wall bracket 44. This pulley 42 is operatively connected through a worm wheel (not shown) with a worm 45 journaled in the block 43, the worm 45 being connected with a chain pulley 46, and a chain 47 engages this pulley and provides for turning the latter from a point below the sash line. By means of the chain 47 and the interconnecting elements, the pulley 42 may be operated to draw the chain 41 in either direction, thereby effecting the simultaneous movements of the transmission rods 34 and 35 in opposite directions required to open and close the sash units.

Referring now to Figs. 6 and 8, it will be apparent that if, with the lever system in the retracted condition as shown in Fig. 6, the rod 34 is moved in the direction indicated by the arrow with a consequent equal movement of the rod 35 in the opposite direction, the ends of the arms 29 and 31 connected to these rods through the clamps 32 and 33 will be drawn together, with the result that the lever assembly will be extended, as shown in Fig. 8. In this movement, the clamps 32 and 33 may move to positions on opposite sides of the center line of the lever assembly, as shown in Fig. 8, from the positions shown in Fig. 6 which they normally occupy when the lever assembly is in the retracted position, so that their respective lines of movement are approximately symmetrical with respect to said center line. Thus the points 32 and 33 move in arcs about the point 19 with the crowns of said arcs facing the sash, and due to the substantially symmetrical lateral displacement of these points in respect to the axis of movement of the system in fully extended and fully contracted positions, as shown in Fig. 6 and 8, chords of said arcs are substantially parallel to the plane of the sash member. This construction insures a minimum lateral displacement of the transmission members 34 and 35 towards and away from the sash with the result that the entire operating mechanism may be mounted in a very restricted space. Furthermore, since the effective lever arm about which the clamps 32 and 33 move is a straight line between the pivotal connection of these clamps with the arms 29 and 31 and the pivotal connection 19 between the arms 17 and 18 and the hinge 14, it will be apparent that during this entire movement a highly favorable leverage relation is maintained between the transmission rods 34 and 35 and the lever mechanism. It will be apparent also, with respect to the lever assembly per se, that the arms 17 and 23, and similarly the arms 18 and 24, constitute in effect an elbow joint wherein one end of the joint represented by the pivot point 19 remains relatively fixed, whereas the other end of the joint represented by the pivot 25 is constrained to move in a vertical plane which extends substantially at right angles to the plane of the sash. As this elbow joint is extended by action of the transmission rods upon the arms

29 and 31, which arms are connected as previously described to the arms 17 and 18 at the relatively fixed end of the elbow joint, the effective leverage imposed through this joint upon the sash progressively increases until when the sash is elevated to its extreme position, as shown for example in Figs. 7 and 8, the leverage is at a maximum, which compensates automatically for the increasing load of the sash as it moves to its fully open position upon the operating mechanism and the peak loads that would otherwise fall in full degree upon the transmission rods 34 and 35 and the associated operating members.

With reference to Figs. 5 and 7, it will be noted that during the movement of the sash from the closed to open position, the angularity of the lever system considered as a unit with respect both to the support bracket 15 and to the sash continuously changes. This relative movement of the lever system as a whole is provided for in the hinge joints 13 and 14 which respectively connect the system to the sash and to the bracket arm 15. This changing position of the lever system also requires a corresponding movement of the transmission rods 34 and 35, and the previously described operating mechanism, by which these rods are longitudinally shifted to open and close the sash, is of a character permitting this substantially vertical movement of the rods 34 and 35 with the lever system.

In Figs. 9 to 11, inclusive, I have illustrated a modified form of lever system which while different in form from the system previously described and illustrated in the preceding figures of the drawings, operates on essentially the same principle, and accordingly falls within the scope of the invention. In this case, instead of the double system of levers previously described and the two transmission rods 34 and 35 which are associated therewith, I employ a single elbow joint consisting of an arm 48 of the bell crank member 48—54, said bell crank being pivotally connected as indicated at 49, to the hinge joint 14, and a link 51 having one end pivotally connected at 52 to the outer end of the arm 48 and its opposite end pivotally connected at 53 to the hinge joint 13. The arm 54 of the bell crank 48—54 carries at its outer end a clamp 55, through the medium of which the bell crank 48—54 is connected to the operating rod 56. Instead of two transmission rods of the tension type employed in the previously described embodiment, I use in this case a single rod 56 of the push-pull type, suitable mechanism well known in the art being provided for longitudinally moving this rod to effect the desired movement of the lever system. Fig. 9 shows the lever system in the position which it assumes when the sash is in the closed position. In Fig. 10, the levers have been adjusted to a position in which the sash is partly opened, it being noted that the movement of the rod 56 to the right from the position in which it is shown in Fig. 9, which position in Fig. 10 is shown in broken lines, has caused the arms 54 and 48 to be drawn to the right from their original position, and since the outer end of the arm 51 which attaches to the hinge 13 is constrained to move in a vertical plane at right angles to the plane of the sash, the elbow joint constituted by the levers 48 and 51 has been opened, thereby forcing the sash away from its original closed position. In Fig. 11, this movement of the levers has been carried to the point where the sash is fully open, the elbow joint 48—51 being now substantially in the straight or fully open position. It will be apparent that in this case, as in the previously described embodiment, the position of the arm 54 with regard to the relatively fixed pivot 49 and to the rod 56 affords a highly favorable leverage for actuation of the lever system; and it will be noted further that as the sash moves towards the fully open position, the movement of the elbow joint 48—51 affords a continuously increasing leverage advantage which compensates for the increasing load placed upon the lever system by the elevated sash. Furthermore, the point of connection between the transmission member 56 and the bell crank arm 54 is such as to insure substantially equal lateral displacement thereof with respect to the axis of action of the lever system when in fully contracted and fully extended positions thereof as shown in Figs. 9 and 11. This insures a minimum lateral displacement of the transmission member 56 toward and away from the sash member in moving between fully open and fully closed positions of the window.

Still another embodiment of my invention is illustrated in Figs. 12 to 14, inclusive. This embodiment also employs a single transmission rod 57 of the push-pull type. The lever system in this case consists of the typical elbow joint consisting of the lever arms 58 and 59 which are pivotally connected together at 61, and which have their outer ends respectively pivotally connected at 62 and 63 to hinge joints 64 and 65 corresponding respectively to the hinge joints 14 and 13 of previously described embodiments. Also pivotally connected to the hinge joint 64, as indicated at 66, is a lever arm 67, and the outer end of this arm which is pivotally connected to the clamp 68 is also connected through a link 69 to the lever arm 58 of the elbow joint. Movement of the rod 57 to the right from the position shown in Fig. 12, wherein the lever system occupies a position corresponding to the closed position of the sash, swings the lever 67 about its pivot 66 and draws the arm 58 of the elbow joint outwardly, as shown in Fig. 13, wherein the lever system is shown in a partly extended position. Continued movement of the rod 57 in the same direction eventually causes a substantially full extension of the elbow joint 58—59, as shown in Fig. 14. It will be apparent that the same favorable leverages exist in this embodiment of my invention as in the embodiments previously described, as well as the same features of design which insure a minimum lateral displacement of the operating member 57 with respect to the window sash.

It is to be noted that each of the embodiments of my invention described above comprises a lever system, or a plurality of such systems, so mounted and operated that in any position of the sash the said system occupies a position approximately parallel to the chord of the arc through which the bottom of the sash moves; and that the system adjusts itself automatically into the different planes required to maintain this approximate positional relation to the sash. It is to be noted further that in each instance the lever system, or systems, is designed and proportioned to insure a minimum lateral displacement of the transmission member toward and from the plane of the sash, by constraining the point of connection between the lever system and the transmission member to move in an arc substantially symmetrically disposed with respect to the axis of movement of the lever system, and with the crown of the arc facing the sash. By reason of this construction operation of the system or sys-

tems may be effected through the medium of transmission elements located closely adjacent the sash and between the sash and the sash-supporting structural uprights, said elements being movable longitudinally in a direction paralleling the sash and transverse to the direction in which the said lever system operates.

It will be apparent that there may be a considerable further modification in the form and relative arrangement of the elements of the lever system without departure from the invention. It will be apparent also that the inner or relatively fixed end of the lever system may be secured to any available relatively fixed support, and, therefore, the use of the bracket arm 15 connected to the structural member adjoining the sash lintel is not an essential element of the assembly. By using a bracket support of this character, however, the device is rendered entirely independent of the structural parts of the building which are not directly associated with the window or sash structure.

Particular attention is directed to the fact that my invention as described above provides for location of the transmission lines, through which operation of the lever systems is effected, within the space immediately adjoining the sash frame and the normal plane of the sash when the latter is in the closed position. In the present instance, the transmission lines occupy the space between the normal sash plane and the structural members 10 which support the sash, which space is obviously unavailable for other useful purpose and is outside of the normal area of occupancy of the building. By reason of the location of the transmission lines closely adjacent and above the sash lintels, the transmission lines are substantially concealed from the interior of the building. Also by reason of the character of the lever systems employed, the overall length of these systems is relatively small, so that they project only to a relatively small extent into the interior of the building. It will be apparent that by a practice of the invention, it is possible to produce the sash-operating device on a standardized basis without consideration to the variations in building structure, which with the prior devices required for each installation a special design of operator or substantial variations in the basic design.

I claim:

1. In a window construction, a supporting framework, a top-hung, outwardly-opening sash member hingedly supported from the framework, an inwardly directed bracket member carried by said framework, a system of levers for opening and closing the window, one end of said lever system being connected to the bracket and the other end of said system of levers being connected to the sash member, and actuating means for the lever system including a longitudinally movable transmission member, means for mounting the same between said supporting framework and the sash member when in closed position, means for operatively connecting the transmission member to the system of levers, said system of levers including means for constraining the path of movement of the point of connection between said transmission member and said system of levers to an arc, the chord of which lies substantially parallel to the plane of the sash.

2. In a window construction, a supporting framework, a top-hung, outwardly-opening sash member hingedly supported from the framework, an inwardly directed bracket member carried by said framework, a system of levers for opening and closing the window, one end of said lever system being connected to the bracket and the other end of said system of levers being connected to the sash member, and actuating means for the lever system including a longitudinally movable transmission member, means for mounting the same between said supporting framework and the sash member when in closed position, means for operatively connecting the transmission member to the system of levers, said system of levers including means for constraining the path of movement of the point of connection between the transmission member and said system of levers to an arc crossing and substantially symmetrically disposed with respect to the axis of movement of said system of levers.

3. In a window construction, a supporting framework, a top-hung, outwardly-opening sash member hingedly supported upon said framework, an inwardly directed bracket member carried by said framework, a system of toggle levers operatively connected between the bracket and the sash, means for expanding and contracting said levers to open and close the sash, said means including a longitudinally movable transmission member, means for mounting said transmission member between the supporting framework and said sash when in closed position, means for longitudinally moving the transmission member, said system of levers including a bell crank lever, one arm of which is pivotally connected to said bracket and forms the terminal lever of the system of toggle levers, and means for connecting the other arm of said bell crank to said transmission member, said system of levers including means for constraining the path of movement of the point of connection between said bell crank and said transmission member to an arc, the chord of which lies substantially parallel to the plane of the sash.

4. In a window construction, a supporting framework, a window sash hingedly mounted upon said framework, a system of lazy-tong levers, means for operatively connecting said system of levers to the supporting framework and to the window sash, and means for expanding and contracting said system of levers to open and close the window including transmission members, means for mounting the transmission members between the supporting framework and the sash, means for moving the transmission members longitudinally in opposite directions, said system of levers including a pair of bell crank levers, one arm of each bell crank being connected to the supporting framework and forming the terminal levers of the lazy-tong system, and means for connecting the opposite ends of said bell crank levers, respectively, to said transmission members on opposite sides of the axis of movement of the lazy-tong system, said system of levers including means for constraining the points of connection between said bell crank levers and said transmission members, respectively, to arcs, the respective chords of which lie substantially parallel to the plane of the sash.

5. In a window construction, a supporting framework, a top-hung, outwardly-opening sash member, means for hingedly supporting said sash member from said framework, means for opening and closing the sash member comprising a system of levers, means for anchoring one end of said system inwardly of the plane of said supporting framework, means for connecting the other end of said system to said sash, actuating

means for extending and contracting said system of levers, said actuating means including a transmission member, means for mounting said transmission member between the plane of said supporting framework and said sash when in closed position, means for moving said transmission member longitudinally, means for connecting said transmission member to said system of levers, the point of connection between said transmission member and said system of levers, when the window is closed, being disposed laterally of the axis of movement of said system and which point is movable about an arc, the crown of which faces the sash, to a corresponding position on the other side of said axis when the window is fully opened.

6. In a window construction, a sash member, means for hingedly supporting said sash member, means for opening and closing the sash member comprising a system of levers, means for anchoring one end of said system, means for connecting the other end of said system to said sash, actuating means for extending and contracting said system of levers, said actuating means including a transmission member, means for mounting said transmission member adjacent said sash, means for moving said transmission member longitudinally, means for connecting said transmission member to said system of levers, said connection means including a pair of link members, means pivotally connecting one end of each link to said transmission member, means pivotally connecting the other end of one of said links to a lever of said system of levers and means for pivotally connecting the other end of said other link to a point adjacent the anchored end of said lever system whereby to constrain the path of movement of the point of connection between the transmission member and said system of levers to an arc the crown of which faces the sash and the chord of which is substantially parallel to the plane of the sash.

7. In a window construction, a supporting framework, a top-hung, outwardly-opening sash member hingedly connected to the framework, a bracket member carried by said framework and extending inwardly therefrom, a lever system for opening and closing the sash, means connecting the opposite ends of said system to the sash and to the bracket, respectively, a push-pull type transmission member mounted outside the plane of said framework and close to the inner face of the sash member when closed, and means operatively connecting said transmission member and said lever system.

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