This invention relates to a window operator and is designed primarily for operating a window sash of the type that is movable from a closed position to an inclined open position with relation to said window frame.

One object of the invention is to provide a window operator comprising a longitudinally extensible device which can be contracted to a very short compact form when the sash is moved to its closed position and which can be extended to a length sufficient to move said sash to the usual open position.

A further object of the invention is to provide such an extensible device which is extended and contracted by the rotation of a part thereof about an axis extending lengthwise of the device.

A further object of the invention is to provide a simple and efficient power operated window operator.

A further object of the invention is to provide a window operator including an extensible device and a motor and adapted to be mounted as a unit upon the window frame.

A further object of the invention is to provide a motor operated window operator in which the operation of the motor will be automatically interrupted when the sash has been moved to the limit of its movement in either direction.

A further object of the invention is to provide such a window operator which is of simple construction and which can be easily installed on the window.

Other objects of the invention may appear as the device is described in detail.

In the accompanying drawings Fig. 1 is a perspective view of a portion of a window equipped with the invention, viewed from the inner side thereof; Fig. 2 is a similar view viewed from the outer side of the window; and Fig. 3 is a longitudinal sectional view of the extensible device and its driving connections, on an exaggerated scale.

In these drawings I have illustrated one embodiment of the invention, and have shown the same in connection with a conventional projected sash window, but it is to be understood that the operator as a whole, as well as the several parts thereof, may take various forms and may be used in connection with tilt sash windows of various types without departing from the spirit of the invention.

The window shown in the drawings comprises a frame 5 having upper and lower transverse members 6 and 7 defining a sash opening in which is mounted a tiltable sash. The lower transverse frame member 7 comprises an upper inner section 8, forming a shield, to the lower portions of which is secured an outwardly extending apron 9, and a rigid bar 10 secured to the outer portion of the apron (Fig. 3). The sash 11 may be mounted on the frame in any suitable manner. In the present arrangement it is supported by arms, or links 12, pivotally connected at their lower ends with the side members of the frame and pivotally connected at their upper ends with the respective side rails of the window sash at points substantially midway between the upper and lower ends thereof, in a well known manner. The sash is thus pivotally supported for movement into vertical window closing position or into an outwardly and downwardly inclined open position. The upper portion of the sash may be guided on the frame in any suitable manner and in the present instance the upper rail of the sash is provided at each end with a so-called friction pivot 13, of a well known type which is yieldably mounted on the rail and is provided with a shoe 14 extending into a channel 15 in the adjacent window frame member, thus causing the upper portion of the sash to move in a vertical plane as the lower portion thereof is moved toward or from the window frame.

The operator comprises an extensible device 16, a supporting member 17, for the extensible device and a device for actuating the extensible device, here shown as a motor 18. The extensible device may take various forms but preferably comprises a plurality of elongate, selectively movable members. In the form here illustrated it comprises a plurality of telescoping tubular members supported one within the other for relative longitudinal movements. The outermost tubular member 19 is mounted on the frame for rotation on a longitudinal axis and is held against axial movement. Preferably it extends into and is supported by a tubular supporting structure, such as the sleeve 17. The sleeve is mounted on the window frame and in the present instance, is so mounted that it will have a limited tilting movement about a transverse axis. To this end the sleeve is provided with a downwardly extending lug 20 which is pivotally mounted on the rear end of a rigid member 21 which is secured at its forward end to the bar 10 of the window frame and is secured between its ends to the apron 9 of the window frame. The supporting sleeve 17 extends through an opening in the upwardly extending part 8 of the window frame.
the opening being of a diameter slightly greater than the diameter of the sleeve so as to permit the tilting movement of the latter and the space around the sleeve is closed by a yieldable grommet 23, preferably of soft rubber. The sleeve 17 is provided in the rear of the member 20 with an annular portion 24 of reduced diameter. Rigidly mounted on this reduced portion of the sleeve is a boss 25 adapted to support the motor 18 which is here shown as comprising an annular portion, or collar, 25 and a downwardly extending portion 26 to which the motor is secured, as by screws 27.

The motor is, in the present instance, an electric motor and is so mounted on the bracket that the shaft thereof rotates about a vertical axis. Mounted on the top of the motor casing is a gear casing 28 to receive reducing gearing which connects the motor shaft with a drive shaft 29. The gearing is not here shown but may comprise a worm and a worm gear of a known construction. The forward portion of the gear casing extends into the reduced rear end portion of the supporting sleeve 17 and the shaft 29 extends beyond said reduced portion into the body, or large diameter portion, of the sleeve. A driving member 30 is rigidly secured thereto, as by a pin 31. The driving member 30 is rotatably supported on the sleeve and, in the arrangement shown, the sleeve and the driving member are provided with opposed circumferential grooves 32 and 33 forming ball races to receive a series of bearing balls 34, which not only provide anti-friction support for the driving member but also hold the same against axial movement. The sleeve is provided with an opening 35 through which the balls are inserted in the races and which is thereafter sealed as by a plug 35a.

When the motor is in operation the outermost tubular member of the extensible device rotates constantly but is held against axial movement. This member is provided in the forward thereof with a relatively short internal screw thread 36. A second inner member 37 is a first inner tubular member which has an exterior screw thread 38 extending from the forward end thereof to a point adjacent to but spaced from the rear end thereof, the rear end being provided with a projection, or stop, 39 to engage the internal thread of the outer member 49 and limit the forward movement of the inner member 37 when the rear end of the exterior thread of said inner member has moved beyond the rear end of the interior thread of the outer member. The first inner member 37 is also provided at its forward end with a relatively short internal screw thread 40 which meshes with an exterior screw thread 41 on a second inner member 42, this second inner member also having at its rear end a stop 43 spaced from the rear end of the exterior thread thereon. The second inner member has at its forward end a relatively short internal screw thread 44 which engages an exterior screw thread 45 on a third inner member 46 similar to the preceding inner members and having at its inner end a relatively short internal screw thread 47 which engages the exterior thread 48 on the innermost member 49 of the extensible device. This innermost member may be of any suitable character, but it is here shown as a solid shaft.

the end of which, when the extensible device is in its contracted position, extends slightly beyond the forward end of the several tubular members and this projecting end is provided with means for securing the same to the sash. In the present instance the member 49 is pivotally connected with a bracket 50 which is adapted to be secured to the lower sash rail 51, as by screws 52.

It will be apparent that the rotation of the outermost tubular member 19 will impart longitudinal movement to the first inner member 37 and when said first inner member has moved the limit of its forward movement and the stop 39 has engaged the inner end of the internal thread 36 of the outer member 19, the two members are connected one with the other for rotation in unison and the first inner member imparts longitudinal movement to the next succeeding, or second, inner member 42. When the second inner member 42 has reached the limit of its forward movement it is connected with the first inner member 37 for rotation therewith and thus imparts longitudinal movement to the third inner member 46. When the third inner member reaches the forward limit of its movement with relation to the second inner member it rotates with the preceding tubular members and imparts longitudinal movement to the inner, or shaft, 43. When the telescoping members move freely with relation one to the other and there is no binding of the threads, the several members will be projected in the order above described. However, if movement of one member with relation to the others is resisted, as by a binding of the threads, the movement of that member will be retarded and the succeeding members may move forwardly in advance thereof. This is not important because the order in which the telescoping members are projected one beyond the other does not materially affect the operation of the device. When the outermost member 19 is rotated in a reverse direction the several inner members will be retracted to their initial positions. Usually the innermost member will be first retracted and then the other member successively retracted, but as in the case of the forwardly projecting movement of the members, they may not always be retracted in the same order.

Means are provided for positively limiting the movement of the inner members. In the present instance a washer 53 is mounted in an annular recess in the first inner member 37 and is retained in engagement therewith by a pin 54 which extends through the radially projecting rear portion 39 at the rear end of the member 37, the washer being of such radial width that it extends into the path of the rearward movement of the second inner member 42. A smaller diameter washer 55 is supported in the paths of a third inner member 46 and the innermost member 49 and is retained in position by a pin 55 extending through the rear portion of the second inner member 42.

The extensible member 16 may be extended to any desired length within the range of movement thereof and thus the window sash may be moved to the limit of its outward movement or to any position between that outward limit and the closed position of the sash. When, as in the present instance, the actuating device is an electric motor, its operation is controlled by a manually operated switch 57, which may be supported in any suitable position and is connected with the
motor through a cable 58 and a junction box 59, which includes switches and the like. The connections between the switch 51 and the motor are such that when the actuating member 52 of the switch is in its intermediate or neutral position, the motor will be de-energized. The movement of the actuating member in one direction from its neutral position will energize the motor for operation in a direction to project the extensible device, and the movement of the actuating device in the other direction from its neutral position will energize the motor for operation in a direction to retract the extensible device. Means are also provided to positively de-energize the motor when the extensible device has reached the limit of its movement in either direction and thus prevent damage to the motor.

For this purpose a limit switch 60 is mounted on the transverse member of the window frame and provided with a movable member 61 arranged to be engaged and actuated by the sash when the latter arrives at its closed position and thus de-energize the motor. A similar limit switch 62 is mounted on one of the side frame members and has a movable part 63 arranged to be engaged and actuated by the upper portion of the sash when the latter is moved to its fully opened position, thus deenergizing the motor.

While I have shown and described one embodiment of my invention, I wish it understood that I do not desire to be limited to the details thereof as many modifications may occur to a persons skilled in the art.

Having now fully shown and described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An operator for a window of the type including a frame having an apertured shield extending along one margin thereof and a sash supported by said frame for movement from a closed position to an inclined open position, said operator comprising a plurality of telescoping members, each inner telescoping member having an exterior screw thread extending from the forward end thereof to a point adjacent the rear end thereof, each outer telescoping member having at its forward end a relatively short internal screw thread engaging the exterior screw thread on the adjacent inner member, a tubular supporting structure adapted to be mounted on the window frame, said supporting structure including a plurality of telescoping members, each inner telescoping member being mounted within the shield so as to conceal the pivotal means, and a grommet mounted between the tubular supporting structure and the shield providing a seal, means for preventing the axial movement of said outermost member, the innermost of said members having means whereby it may be operatively connected with the sash to be operated, and means for rotating said outermost member.

2. An operator for a window of the type including a frame having an apertured shield extending along one margin thereof and a sash supported by said frame for movement from a closed position to an inclined open position, said operator comprising a plurality of telescoping members, each inner telescoping member having an exterior screw thread extending from the forward end thereof to a point adjacent the rear end thereof, each outer telescoping member having at its forward end a relatively short internal screw thread engaging the exterior screw thread on the adjacent inner member, a tubular supporting structure adapted to be mounted on the window frame, said supporting structure including a plurality of telescoping members, each inner telescoping member being mounted within the shield so as to conceal the pivotal means, and a grommet mounted between the tubular supporting structure and the shield providing a seal, means for preventing the axial movement of said outermost member, the innermost of said members having means whereby it may be operatively connected with the sash to be operated, and means for rotating said outermost member.
the aperture in the shield, and resilient means for sealing the juncture between the supporting structure projecting through the aperture and the margins of the aperture of the shield, means for rotatably supporting the rear end portion of the outermost of said telescoping members on said supporting structure and for preventing axial movement of said outermost member with relation to said supporting structure, and means for rotating said outermost member, the innermost of said telescoping members having at its forward end means whereby it may be connected with the sash to be operated, and means including parts carried respectively by said frame and said sash for interrupting the rotation of said outermost member when said sash has been moved in either direction to a predetermined position.

5. An operator for a window of the type including a frame and a sash supported by said frame for movement from a closed position to an inclined open position, said operator comprising a plurality of telescoping members, each inner telescoping member having an exterior screw thread extending from the forward end thereof to a point adjacent the rear end thereof, each outer telescoping member having at its forward end a relatively short internal screw thread engaging the exterior screw thread on the adjacent inner member, a tubular supporting structure, means for mounting the tubular supporting structure upon the window frame, said means including an apertured shield through which aperture the tubular supporting structure projects, and a resilient grommet member sealing the tubular supporting structure to the shield, said tubular supporting structure rotatably supporting the rear end portion of the outermost of said telescoping members, said tubular supporting structure terminating at its rear end in a reduced cylindrical portion, means for preventing the axial movement of said outermost member in said telescoping members, the innermost of said telescoping members having means whereby it may be operatively connected with the sash to be operated, and a motor driving mechanism including a gear casing having a forwardly directed reduced cylindrical extension seated in the reduced cylindrical portion of the supporting structure so that the motor driving mechanism is supported by said supporting structure and drivenly connected with said outermost member.

6. An operator for a window of the type including a frame and a sash supported by said frame for movement from a closed position to an inclined open position, said operator comprising a plurality of telescoping members, each inner telescoping member having an exterior screw thread extending from the forward end thereof to a point adjacent the rear end thereof, each outer telescoping member having at its forward end a relatively short internal screw thread engaging the exterior screw thread on the adjacent inner member, a supporting structure for said telescoping members, pivot mounting means for mounting said supporting structure on said window frame for movement about a substantially horizontal axis, said means including an apertured shield and a flexible sealing member sealing the juncture between the shield and the supporting structure projecting through the aperture in the shield, means for rotatably supporting the outermost of said telescoping members on said supporting structure and for preventing the axial movement thereof, a bracket carried by the cylindrical extension of said supporting structure, a motor mounted on the bracket, and means for drivingly connecting said motor with said outermost member.

7. An operator for a window of the type including a frame having an apertured shield extending along one margin thereof and a sash supported by said frame for movement from a closed position to an inclined open position, said operator comprising a tubular supporting member mounted in the aperture in the shield, a flexible member having a marginal groove receiving the peripheral margin of the shield surrounding said aperture, said flexible member sealing the juncture between the tubular supporting member and the shield, means for mounting said supporting member on a window frame, said last mentioned means including a pivot mounting concealed by the shield, a member mounted in said supporting member for rotation about the axis thereof and held against axial movement with relation thereto, an outer elongate tubular member extending into said supporting member and rigidly secured to said rotatable member, said outer member extending forwardly beyond said supporting member and having at the forward end portion thereof a relatively short internal screw thread, a tubular member movably supported in said outer member and having an external screw thread extending for substantially the full length thereof and engaging the internal thread of said outer member, means for connecting said inner member with said sash, and means for rotating said rotatable member.

8. An operator for a window of the type including a frame having an apertured shield extending along one margin thereof and a sash supported by said frame for movement from a closed position to an inclined open position, said operator comprising a tubular supporting member mounted in the aperture in the shield, a flexible member having a marginal groove receiving the peripheral margin of the shield surrounding said aperture, said flexible member extending along the juncture between the tubular supporting member and the shield, means for mounting said supporting member on said window frame, said last mentioned means including a pivot mounting concealed by the shield, a member mounted in said supporting member for rotation about the axis thereof, said supporting member and said rotatable member having opposed circumferential grooves, bearing balls in said grooves rotatably supporting said rotatable member and preventing axial movement thereof, an outer elongate tubular member extending into said supporting member and rigidly secured to said rotatable member, said outer member extending forwardly beyond said supporting member and having at the forward end portion thereof a relatively short internal screw thread, a tubular member movably supported in said outer member and having an external screw thread extending for substantially the full length thereof and engaging the internal thread of said outer member, means for connecting said inner member with said sash, and means for rotating said rotatable member.

9. An operator for a window of the type including a frame having an apertured shield extending along one margin thereof and a sash supported by said frame for movement from a closed position to an inclined open position, said operator comprising a tubular supporting member mounted in the aperture in the shield, a flexible
member having a marginal groove receiving the peripheral margin of the shield surrounding said aperture, said flexible member sealing the juncture between the tubular supporting member and the shield, means for mounting said supporting member on a window frame for movement about a transverse axis, said last mentioned means including a pivotal mounting concealed by the shield, a member mounted in said supporting member for rotation about the axis thereof and held against axial movement with relation thereto, an outer elongate tubular member extending into said supporting member and rigidly secured to said rotatable member, said outer member extending forwardly beyond said supporting member having in the forward end thereof a relatively short internal screw thread, an inner tubular member movably supported in said outer member and having an exterior screw thread extending for substantially the full length thereof and engaging the internal thread in said outer member, means for connecting said inner member with said sash, a motor supported on said supporting member for movement therewith, and means for drivingly connecting said motor with said rotatable member.

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