Sept. 20, 1960. E. P. JONES 2,953,368

WINDOW AND OPERATOR THEREFOR

Filed March 16, 1955

5 Sheets-Sheet 1

FIG. 1

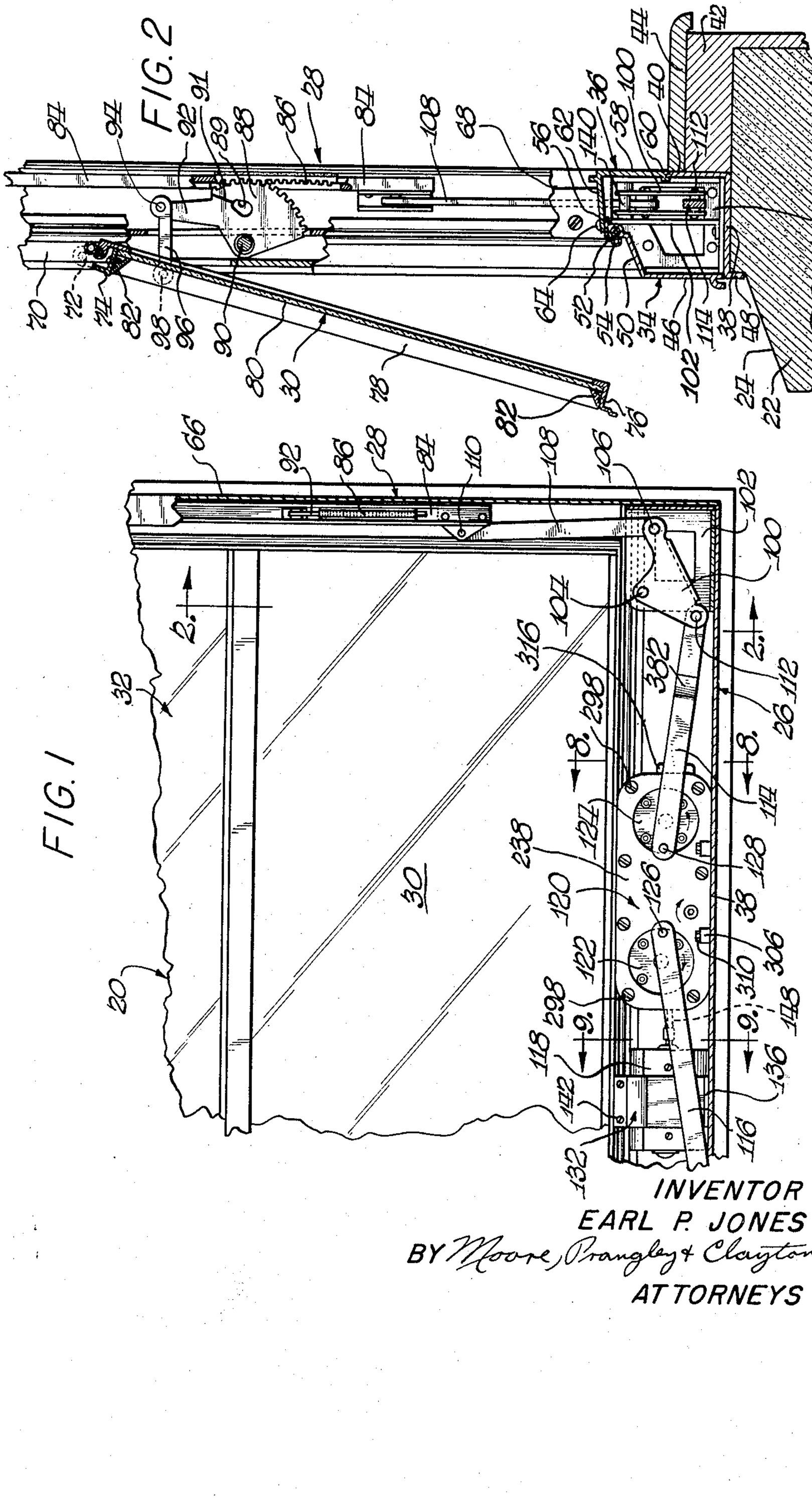


FIG. 2

INVENTOR
EARL P. JONES
BY Moore, Prangley & Clayton
ATTORNEYS

Sept. 20, 1960 E. P. JONES 2,953,368

WINDOW AND OPERATOR THEREFOR

Filed March 16, 1955 5 Sheets-Sheet 2

FIG. 3

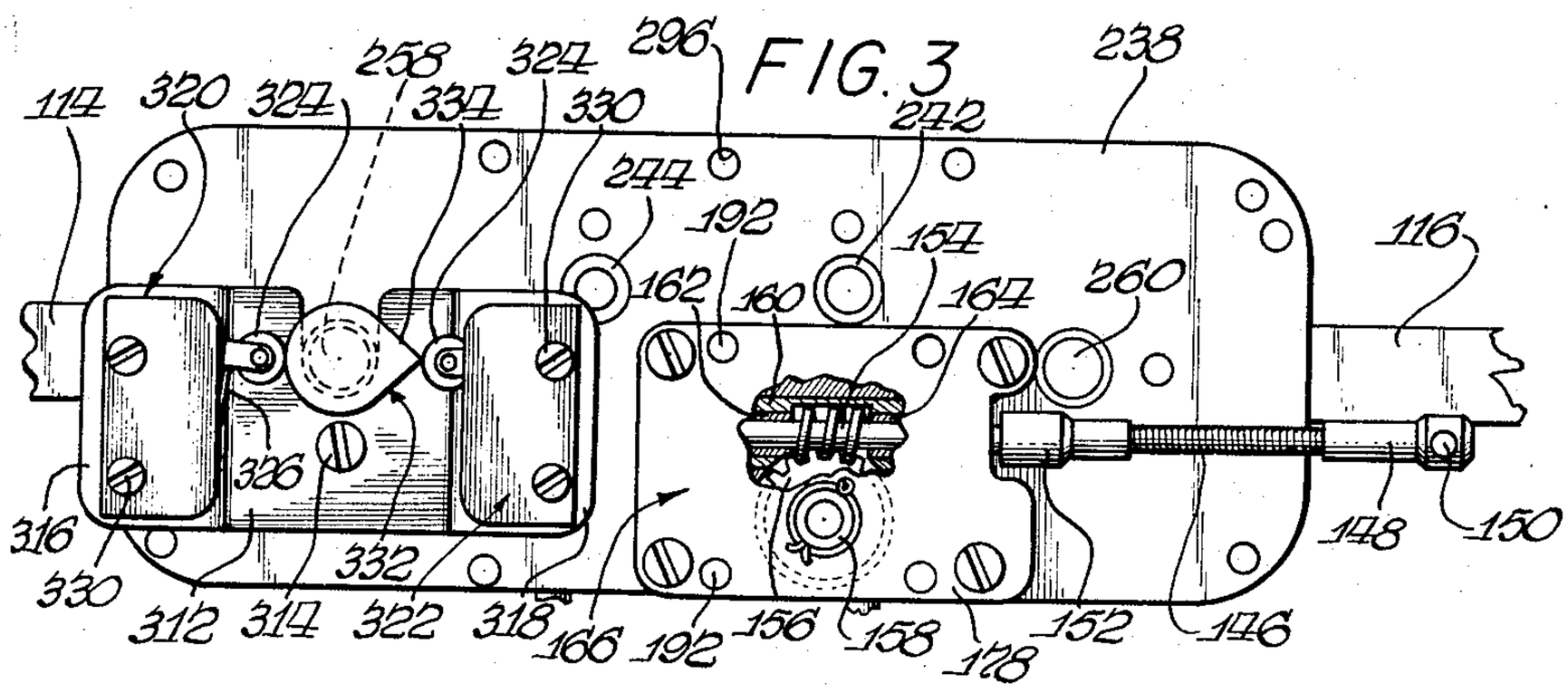


FIG. 4

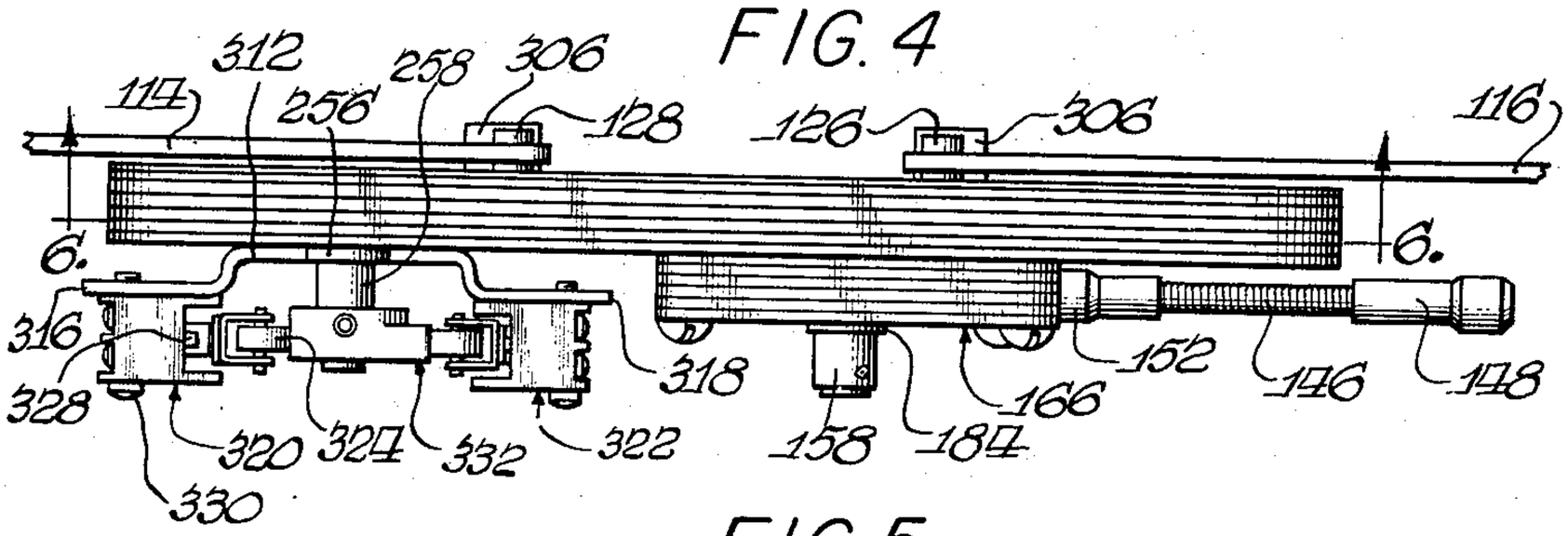
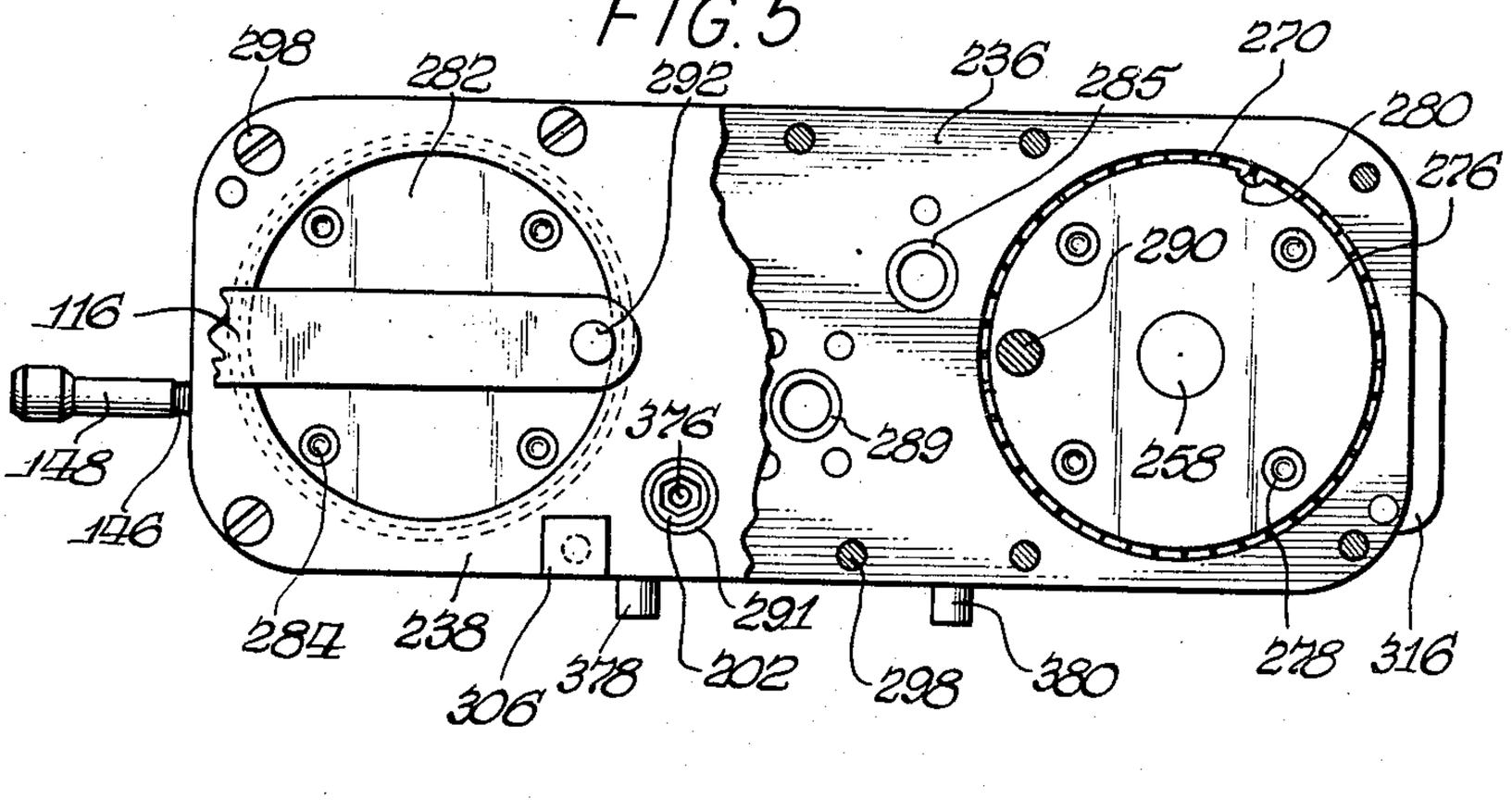


FIG. 5



INVENTOR
EARL P. JONES
BY Moore, Prangley & Clayton
ATTORNEYS

Sept. 20, 1960 E. P. JONES 2,953,368

WINDOW AND OPERATOR THEREFOR

Filed March 16, 1955 5 Sheets-Sheet 3

FIG. 6

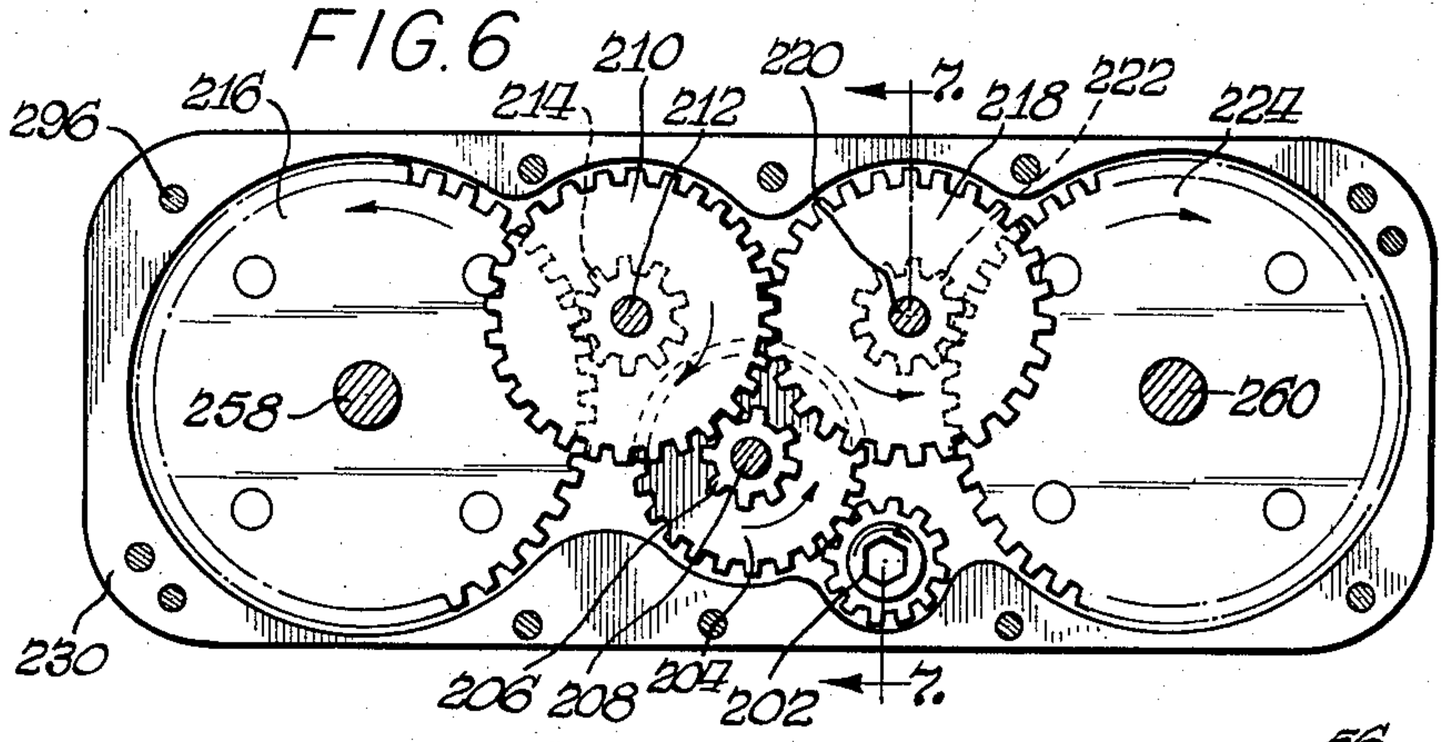


FIG. 8

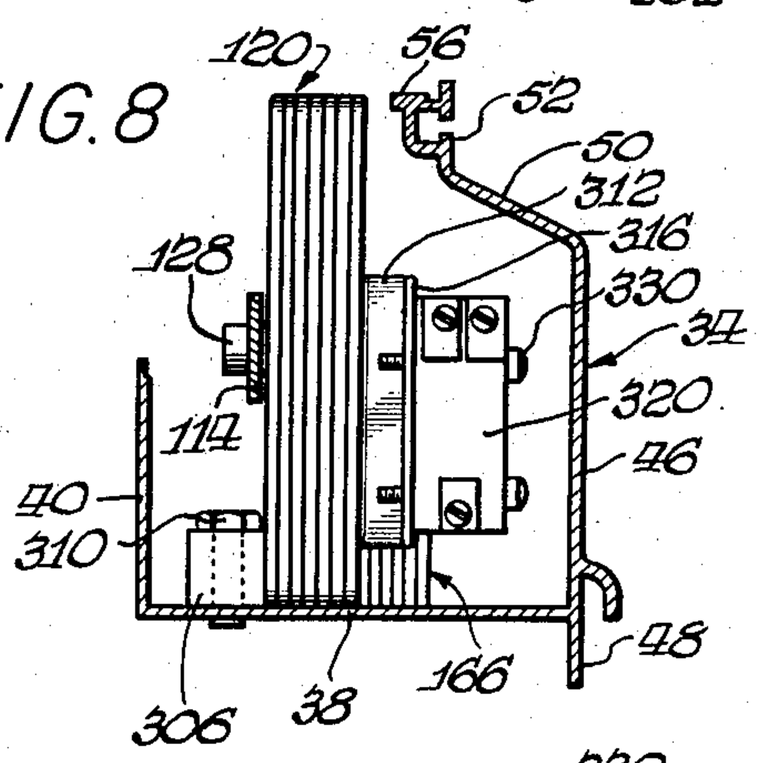


FIG. 9

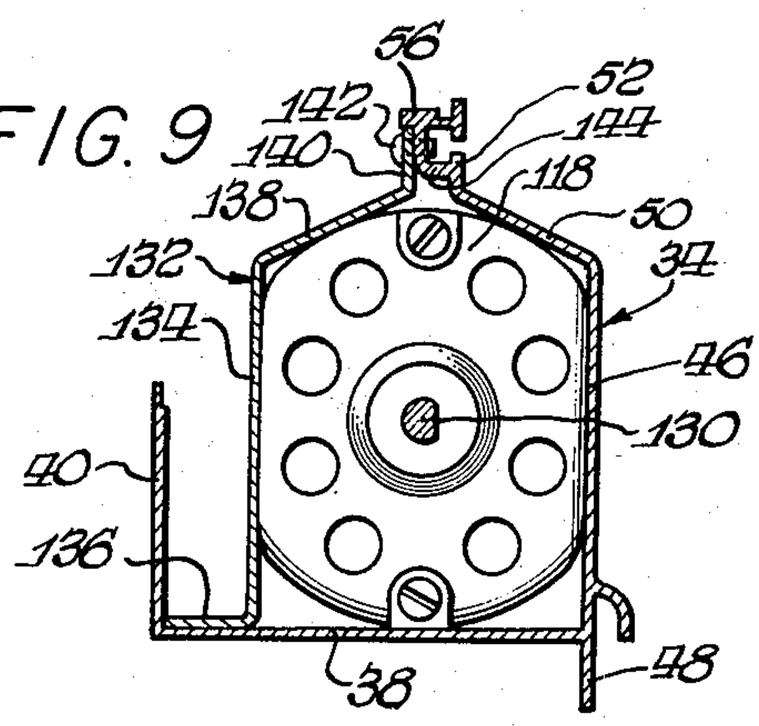


FIG. 7

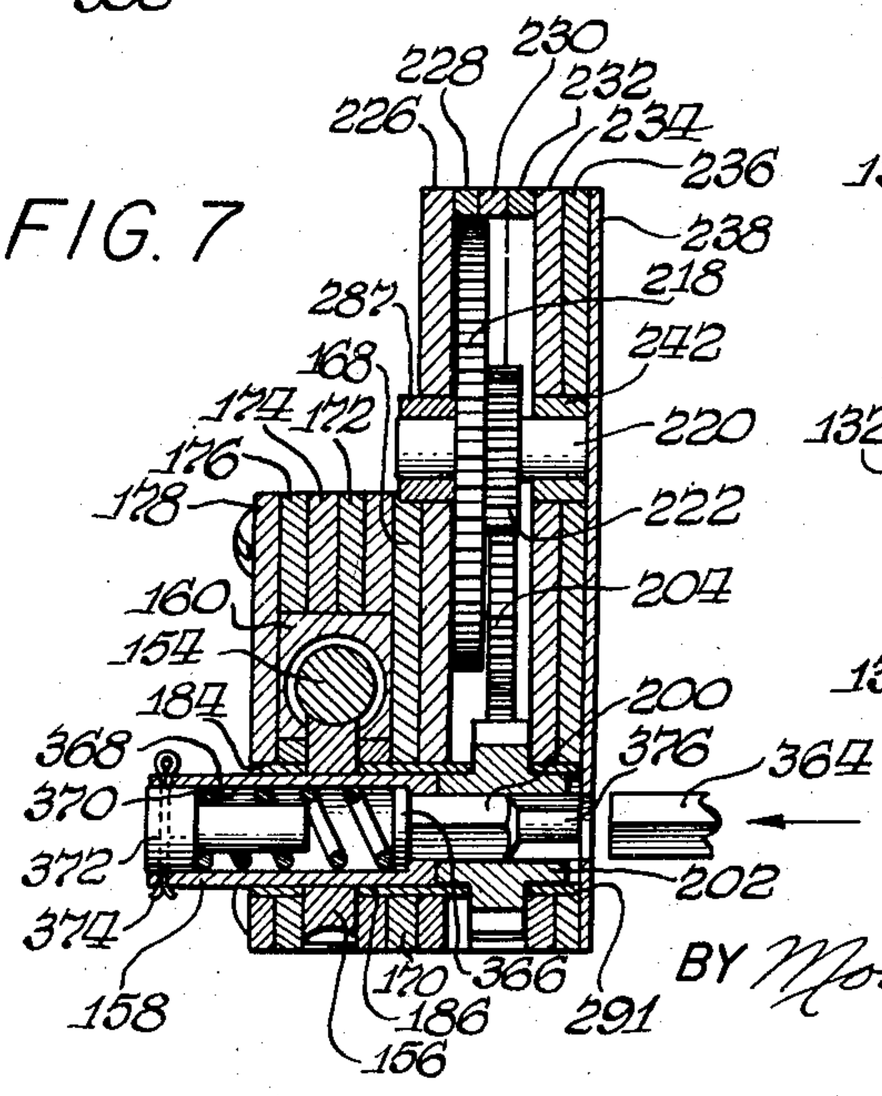
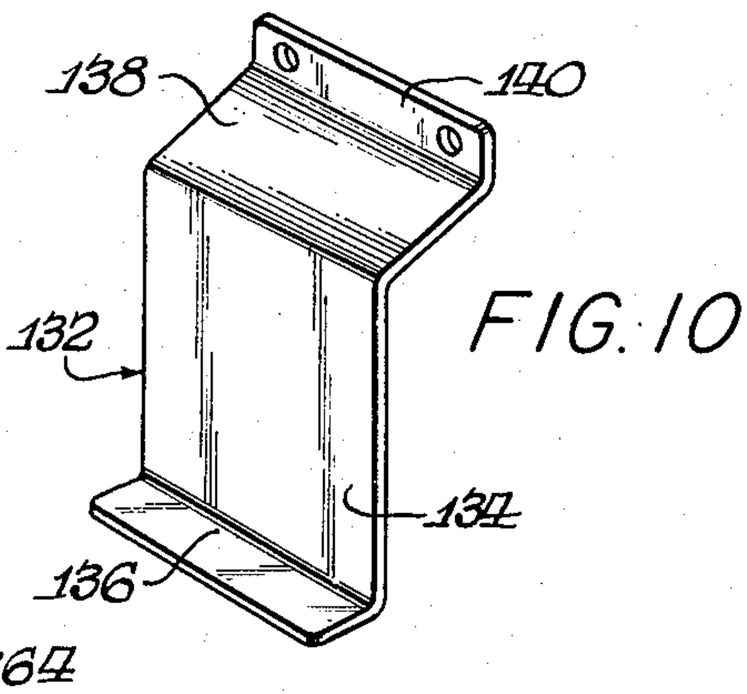


FIG. 10



INVENTOR
EARL P. JONES
BY Moore, Prangley & Clayton
ATTORNEYS

Sept. 20, 1960 E. P. JONES 2,953,368

WINDOW AND OPERATOR THEREFOR

Filed March 16, 1955 5 Sheets-Sheet 4

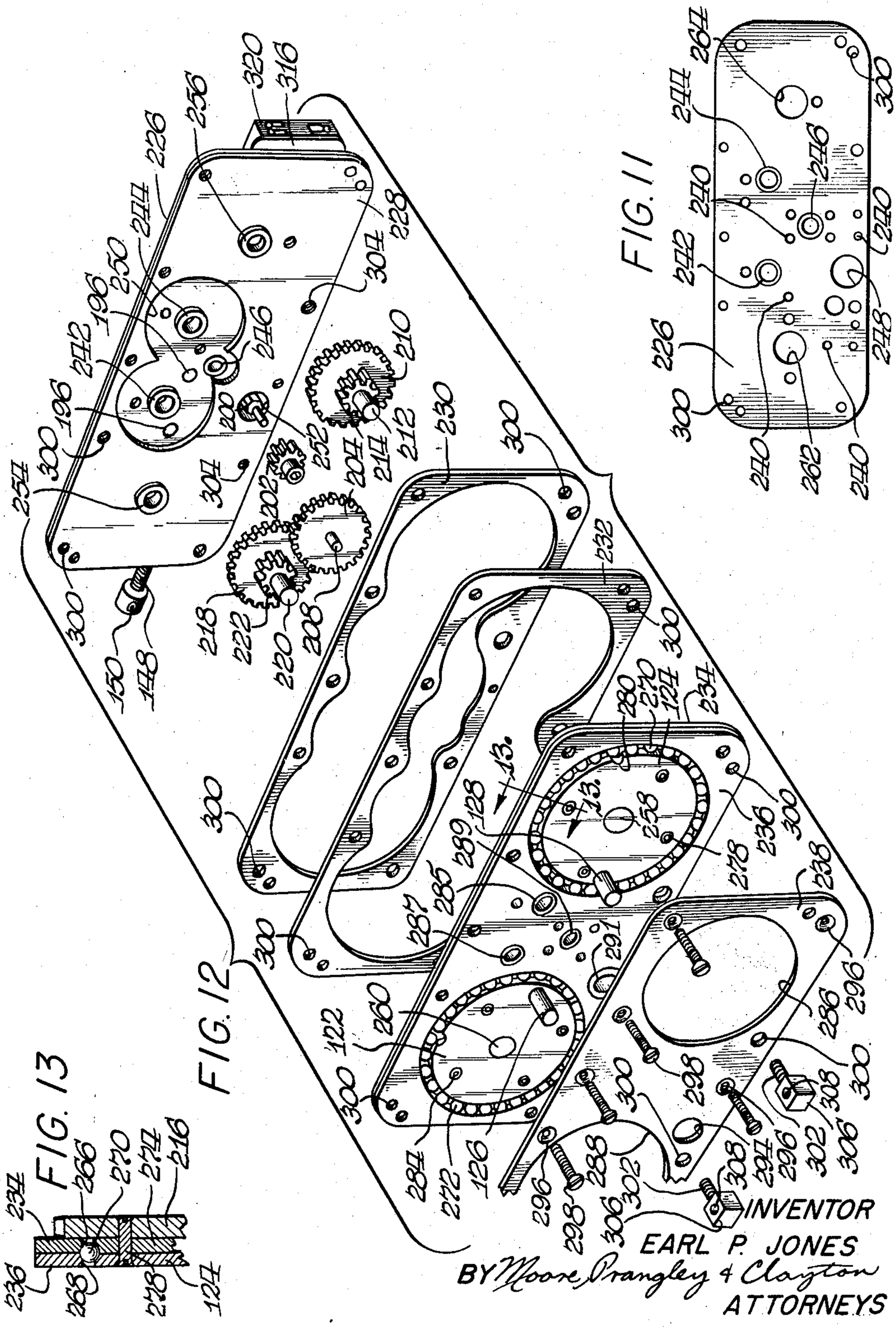


FIG. 11

FIG. 12

FIG. 13

INVENTOR
EARL P. JONES
BY Moore, Prangley & Clayton
ATTORNEYS

Sept. 20, 1960 E. P. JONES 2,953,368

WINDOW AND OPERATOR THEREFOR

Filed March 16, 1955 5 Sheets-Sheet 5

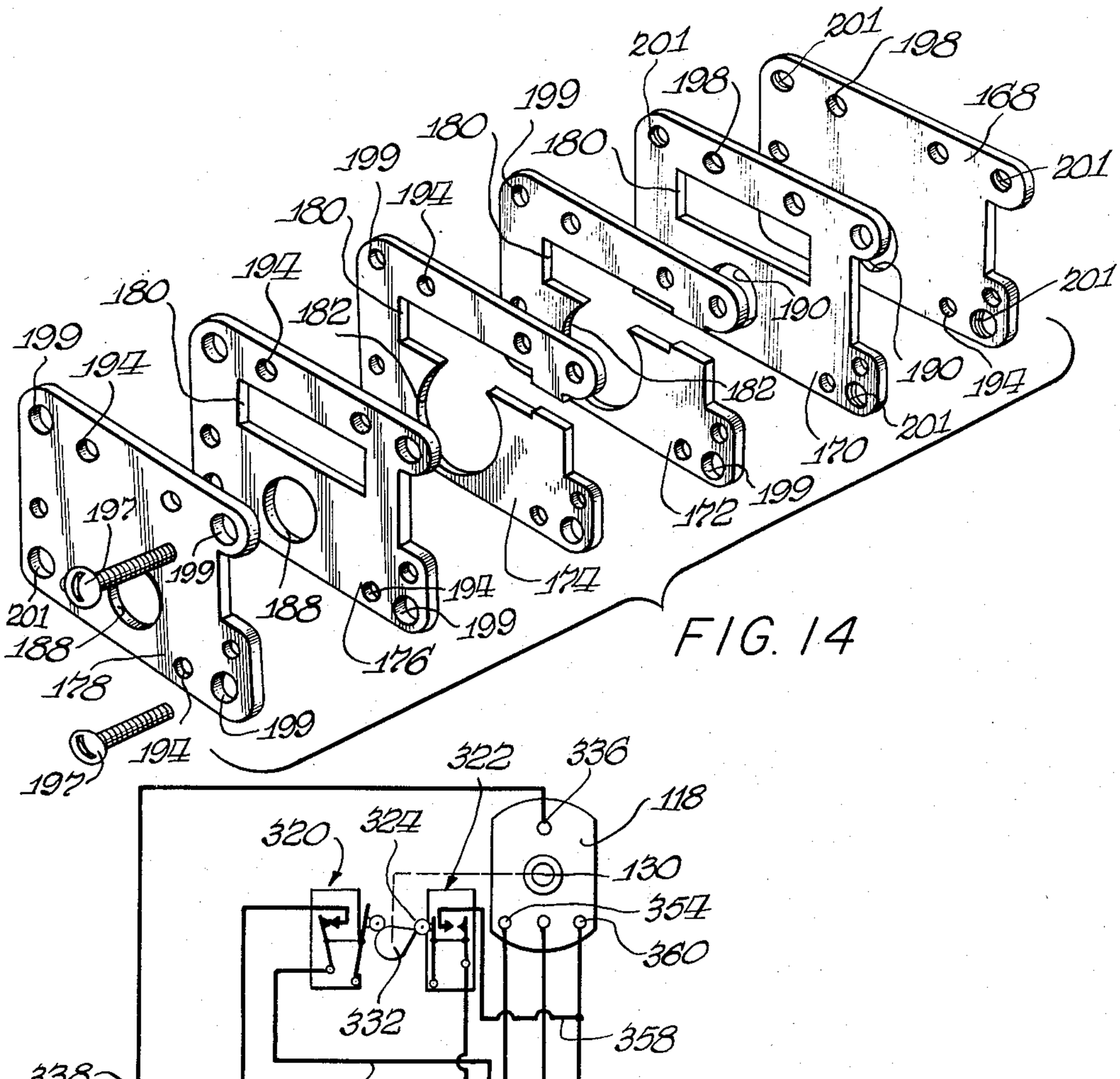


FIG. 14

FIG. 15

INVENTOR
EARL P. JONES
BY Moore, Prangley & Clayton
ATTORNEYS

United States Patent Office

2,953,368

Patented Sept. 20, 1960

2,953,368

WINDOW AND OPERATOR THEREFOR

Earl P. Jones, Fort Lauderdale, Fla., assignor to Gate City Sash and Door Company, Fort Lauderdale, Fla., a corporation of Florida

Filed Mar. 16, 1955, Ser. No. 494,678

7 Claims. (Cl. 268—106)

This invention relates to windows and window operating mechanism and particularly to motor operated mechanisms for opening and closing awning type windows.

The operating mechanism of the present invention is of general utility but it is particularly suited for use with windows of the type including a substantially rectangular frame within which and on which are hung two or more window sashes. The sashes in windows of this type are pivoted about a horizontal axis near the upper edge thereof. Link mechanism is provided along the sides of the frame and the sashes to pivot the sashes outwardly about the upper pivot whereby the upper edges of the sashes will swing outwardly and upwardly about the pivot point adjacent the upper edges of the sashes. Such a window and link mechanism is shown in my copending U.S. patent application, Serial No. 432,269 filed May 25, 1954, for "Awning Window," now Patent 2,819,065 granted January 7, 1958.

The present invention is particularly adapted for use in the window of this copending application and will be described in connection therewith. In the window illustrated in the copending application, a hollow sill is provided having a removable cover. The drive mechanism for the links operating the window sashes is located within the hollow sill and access thereto can be gained by removing the cover from the sill. One of the preferred forms of drive mechanism illustrated in that copending application is a manually operated crank mechanism which can be serviced and bodily removed from the hollow sill upon removal of the sill cover.

The present invention provides an automatic electrical drive mechanism for operating the window sashes which can be readily installed upon removal of the crank operated drive mechanism from the hollow sill. In such electrical drive mechanisms it is desirable that switch means be incorporated therein to limit the maximum open and closed positions of the sashes. These switch means preferably take the form of micro- switches which must occasionally be replaced because of the hard wear which the switches undergo in use. It further is desirable when the electrical drive mechanism is inoperative to be able to drive the sash operating mechanism manually by means of a crank while the electrical drive mechanism is disconnected.

Accordingly, it is an important object of the present invention to provide an improved electrical drive mechanism for windows of the type set forth; more specifically, it is an object of the present invention to provide such an electrical drive mechanism which can be installed in a hollow sill window simply by removing the cover therefrom and without removing the sill or other window parts from the building aperture.

Another object of the invention is to provide means to facilitate installing of electrical drive mechanisms for window sashes in a hollow sill and particularly to provide means facilitating accurate positioning of the drive mechanism within the hollow sill.

Still another object of the invention is to provide an electrical drive mechanism for window sashes which has the gears and bearings thereof positioned within a housing formed of aluminum sheet metal stampings.

Yet another object of the invention is to provide in electrical sash operating mechanisms of the type set forth a spring release clutch which automatically disconnects the electrical drive from the remaining portions of the sash operating mechanism when a manual handle is inserted therein for manual operation of the window sashes and which further ejects the handle when the electrical drive is connected to the sash operating mechanism.

A further object of the invention is to provide an electrical sash operating mechanism having limit switches to limit the extreme open and closed positions of the sashes in which the limit switches can be readily removed when required without readjusting the other parts of the operating mechanism.

These and other objects and advantages of the invention will be better understood from a consideration of the following description when taken in conjunction with the accompanying drawings. In the drawings wherein like reference numerals have been utilized to designate like parts throughout:

Figure 1 is a partial view of a window having a hollow sill with the electrical sash operating mechanism of the present invention installed therein and operatively connected to the window sashes;

Figure 2 is a partial view in vertical section with certain parts broken away of the window frame and sash operating mechanism illustrated in Figure 1 substantially as seen in the direction of the arrows along the line **2—2** of Figure 1;

Figure 3 is a rear view of the gear box of the present invention with certain portions thereof broken away;

Figure 4 is a plan view of the gear box shown in Figure 3;

Figure 5 is a front view with certain portions broken away of the gear box illustrated in Figure 3;

Figure 6 is a view in vertical section through the gear box of Figure 4 substantially as seen in the direction of the arrows along the line **6—6** of Figure 4;

Figure 7 is a view in vertical section on a slightly enlarged scale of the gear box shown in Figure 3 substantially as seen in the direction of the arrows along the line **7—7** of Figure 6;

Figure 8 is a view in vertical section through a hollow sill having the sash operating mechanism of the present invention incorporated therein substantially as seen in the direction of the arrows along the line **8—8** of Figure 1;

Figure 9 is a view in vertical section similar to Figure 8 substantially as seen in the direction of the arrows along the line **9—9** of Figure 1;

Figure 10 is a perspective view of the retainer plate utilized to hold the electric motor forming a part of the sash operating mechanism of the present invention in operative position within the hollow window sill;

Figure 11 is a view of the first or master plate forming a part of the gear box housing illustrated in Figure 3;

Figure 12 is an exploded perspective view of the gear box including the housing and gears therein of the present invention;

Figure 13 is a partial cross sectional view of one of the ball bearing races of the present invention substantially as seen in the direction of the arrows along the line **13—13** of Figure 12;

Figure 14 is an exploded perspective view of the plates forming the worm gear housing of the present invention; and

Figure 15 is a schematic electrical diagram showing

the electrical connections within the sash operating mechanism of the present invention.

Although the sash operating mechanism of the present invention has general utility, it is particularly adapted to be used with a type of awning window having a covered hollow sill. Such an awning window is fully described in the copending patent application, Serial No. 432,269 identified above. Referring to Figures 1 and 2 of the present application, there is shown a window of the type set forth in the copending application and illustrating the sash operating mechanism of the present invention installed therein.

The window generally designated by the numeral **20** is illustrated mounted in a precast cement frame **22** which is in turn supported by a building wall defining a window receiving aperture. The frame **22** is bevelled downwardly and to the right as at **24**, the frame of window **20** completely filling and interfitting with the cement frame **22**.

The frame of window **20** comprises generally a hollow horizontally disposed sill **26**, a horizontally disposed head (not shown), and a pair of vertically extending jambs **28**, only one of which is illustrated in the drawings. The assembled frame is adapted to receive and support a plurality of sashes such as the sashes **30** and **32** illustrated.

As is best seen from Figure 2, the hollow sill **26** comprises two elongated continuous aluminum extrusions providing a front piece **34** and a removable cover **36**. The front piece **34** has a normally horizontally disposed bottom **38** upon which is formed a rear or inwardly disposed upstanding wall **40**. Wall **40** is positioned inwardly toward the associated room and is normally substantially concealed and surrounded by a masonry piece **42** which is provided with an inwardly directed finishing sill piece **44**. The forwardly or outwardly facing edge of bottom **38** joins a forward upstanding wall **46** intermediate the ends thereof so that a downwardly extending flange **48** is provided to overlie and cover a portion of frame **22**. Front wall **46** extends substantially parallel to rear wall **40** and is substantially higher than rear wall **40**. The upper edge of front wall **46** is formed integral with a rearwardly slanting wall **50** having an upstanding terminating flange **52**.

Flange **52** is preferably provided with means to receive a weather stripping **54** and is also provided with an inwardly directed flange **56** adapted to support the forward edge of cover **36**. Cover **36** has a vertical wall **58** having an overlapping connection as at **60** with the upper edge of wall **40** and a forwardly and downwardly extending top wall **62**. The forward edge of wall **62** is adapted to cooperate with flange **56** on the front piece **34** and receives therethrough a fastener **64** which interconnects cover **36** and the front piece **34**. Piece **34** together with cover **36** forms a completely enclosed rigid hollow window sill **26** within which a major portion of the sash operating mechanism is mounted and concealed.

The jamb **28** is formed hollow and includes a main body **66** having a removable cover **68** mounted thereon. Attached to the forward wall of the main jamb body **66** is a channel **70** which has pivotally affixed thereto a hinge member **72** which carries and supports the sashes **30**, **32** and the like. Each sash such as sash **30** has a plurality of sash frame members including upper frame member **74**, a lower frame member **76**, and vertical frame members **78** which support a glazing such as a piece of glass **80**. Glass **80** is held in position on the sash frame by means of glazing strips **82**.

Outward movement of sashes such as sash **30** is accomplished by means of an operating mechanism which includes a vertically movable channel **84** which carries a plurality of toothed racks **86**. A channel **84** is provided for each side of the window sashes so that positive drive is given to both sides of the sashes during opening and closing movement thereof.

Each toothed rack **86** engages a toothed sector **88** which is pivoted to jamb **28** at point **90** for pivoting movement thereabout. Extending outwardly from one side of sector **88** is an operating arm **92** pivotally connected as at **94** to a link **96** pivotally attached to one side of sash **30** as at **98**. Toothed sectors **88** are of the yieldable type described fully in the above identified application. Such yieldable sectors operate to close any normally operating sashes **30—32** completely even though one of the sashes is jammed in a partially opened position. More specifically, the sector **88** is provided with an aperture **89** in the center thereof positioned toward arm **92** and the teeth on sector **88**. A shear slit **91** is formed in the material of sector **88** between the teeth of the sector and arm **92** and communicating with aperture **89**. Normally the edges of the slit **91** abut each other so that there is no relative movement therebetween and any tendency to cause noise by chattering is eliminated. If the associated window sash is jammed in the open position whereby normally to prevent downward movement of rack **86**, sector **88** can yield opening slit **91** and permit movement of rack **86** and the corresponding racks of the other sashes to the closed position whereby fully to close any window sash which is not jammed.

By means of the above described linkage, window **30** can be moved from the vertical closed position to the slanted open position by vertical movement of channel **84** and racks **86**. Movement of channels **84** upwardly from the position shown in Figure 2 further opens sash **30** while downward movement thereof will pivot sash **30** toward the closed position.

In order to achieve the desired movement of channels **84** and the accompanying opening or closing movement of the sashes such as sash **30**, further linkage is provided including a bell crank **100** positioned in hollow sill **26** on a bracket **102**. Bell crank **100** is pivotally connected to bracket **102** as at **104** for pivotal movement thereabout. One arm of bell crank **100** is pivotally connected as at point **106** to one end of a link **108** that is pivotally attached at point **110** to the bottom end of channel **84**. The other arm of bell crank **100** has pivotally attached thereto as at point **112** a link **114** which is operatively connected to the drive mechanism to be described hereinafter. When bell crank **100** is turned in a counterclockwise direction as viewed in Figure 1, channel **84** and the associated racks **86** are moved upwardly to open the various sashes and clockwise movement thereof drives channels **84** downwardly to close the sashes.

A link **116** similar in structure and operation to link **114** is provided to operate a sash mechanism for the other side of the sashes similar to that described above with respect to Figures 1 and 2. The sash operating mechanism for the other side of the sashes is identical with the one which includes racks **86**, bell crank **100** and links **108** and **114**. Accordingly, a detailed description of the other side of the sash operating mechanism will not be given, it being understood that the construction thereof is identical with the one described heretofore.

According to the present invention, opening and closing movement of the links **114—116** is obtained from an electric motor generally designated by the numeral **118** which is operatively connected with gears positioned in gear box **120**. The output of gear box **120** appears on two oppositely rotating plates **122** and **124** carrying pins **126** and **128**, respectively, which are in turn pivotally received by the inner ends of links **116** and **114**, respectively. A 180° revolution of plates **122** and **124** from the position shown in Figure 1 gives a full opening movement for each of the attached sashes. Reverse rotation of plates **122—124** in the same amount serves fully to close each of the sashes.

The motor **118** is preferably a reversible electrical motor which can be powered from a 115 volt A.C. line. The output from motor **118** appears on a shaft **130**

which is operatively connected to the gear box **120**. The direction of rotation of shaft **130** can be reversed so that both opening and closing movement of the window sashes can be obtained from the same motor. Referring to Figure 9, it will be seen that the dimensions of motor **118** are so chosen that it can be inserted within the hollow channel member **34** of the hollow sill when the cover is removed therefrom. Suitable positioning of motor **118** with respect to the hollow sill is achieved by means of a bracket generally designated by the numeral **132**. Bracket **132** includes a body **134** which engages one of the flattened sides of motor **118** and which carries on one end a right angularly disposed flange **136** and on the other end a second flange **138**. The length of flange **136** is such that when the free edge thereof abuts wall **40** of the sill, body **134** supports motor **118** against front wall **46** of the sill. Flange **138** carries on the upper end thereof an attachment flange **140** provided with holes receiving a pair of self-tapping metal screws **142** which screw into apertures in a channel **144** which receives and supports the weather stripping **54** (see Figure 2). The free edge of flange **140** fits beneath the rearwardly directed upper flange **56** on front wall **46**. Bracket **132** thereby serves to hold motor **118** in the desired adjusted position.

Output shaft **130** on motor **118** is operatively connected to a flexible shaft **146** having a coupling **148** provided with a set screw **150** thereon (see Figures 3 and 4). Shaft **130** is received within coupling **148** and is fixedly attached thereto by engagement with set screw **150**. The other end of flexible shaft **146** is received by another coupling **152** which connects it with a worm **154**. Worm **154** operatively engages a worm gear **156** fixedly mounted on a shaft **158** and retained thereon by a press fit. Worm **154** is housed within a metal block **160** suitably apertured and recessed to receive the worm and a pair of cylindrical bearing members **162** and **164** which rotatably support the ends of the worm. Block **160** is preferably formed of aluminum and the bearing members **162—164** are preferably formed of brass or some similar good bearing material.

Block **160** and shaft **158** are mounted and enclosed within a subhousing generally designated by the numeral **166** which is made from a plurality of interconnected aluminum stampings. The shape and configuration of the various stampings comprising housing **166** is best seen in Figure 14 of the drawings. More specifically six stampings designated by numerals **168, 170, 172, 174, 176** and **178** are provided. Block **160** is received within rectangular apertures **180** formed in plates **170, 172, 174** and **176**. Worm gear **156** is similarly received within a circular aperture **182** formed in plates **172** and **174** while the ends of shaft **158** are received in bushings **184** and **186** (see Figure 7) which are supported by certain of the subhousing plates. More specifically, bushing **184** is supported by apertures **188** in plates **176** and **178** and bushing **186** is supported by circular apertures **190** in plates **168** and **170**. Plates **172** through **178** are permanently secured together by four flat headed rivets **192** which extend through apertures **194** formed in the various plates. Similarly plates **168** and **170** are secured to each other and also to one of the plates of the main gear housing by four flat headed rivets such as rivets **196** (see Figure 12) which pass through aligned apertures **198** in plates **168** and **170** (see Figure 14). The assembly of plates **172—178** is secured to plates **168—170** by a plurality of bolts **197** passing through apertures **199** in plates **172** through **178** and threadedly engaging threaded apertures **201** in plates **168** and **170**.

The driving connection is made from shaft **158** by means of a hexagonal pin **200** which passes through a hexagonal opening in the inner end of shaft **158** and into a hexagonal opening in a small gear **202**. Gear **202** drivingly meshes with a gear **204** (see Figure 6) which has permanently affixed thereto a small gear **206** and is

mounted upon a shaft **208**. Gear **206** in turn meshes with an intermediate gear **210** mounted on a support shaft **212**. Gear **210** has permanently affixed thereto a smaller gear **214** which meshes with a large gear **216**. Gear **210** also meshes with a second intermediate gear **218** carried by a shaft **220** and having fixedly attached thereto a small gear **222**. Gear **222** is in driving mesh with a large gear **224**.

Large gear **216** is fixedly attached to plate **124** (see Figure 1) and gear **224** is similarly fixedly attached to plate **122**. Consequently, when gear **202** is rotated clockwise as viewed in Figure 1 (counterclockwise as viewed in Figure 6) plate **122** is rotated in a clockwise direction and plate **124** is rotated in a counterclockwise direction through the gear train described above to move the window sashes toward the open position. Reverse rotation of gear **202** causes the gear train and plates **122—124** to rotate in opposite directions whereby to move the window sashes toward the closed position.

Referring now to Figures 3 through 8 and 11 through 13, the construction of gear housing **120** and the manner of mounting the gears and other working parts therein will be described in detail. Gear box **120** is made from seven aluminum sheet metal stampings which are suitably apertured and arranged to receive and support the various gears and gear shafts described above. Referring to Figure 12, it will be seen that the seven plates are numbered **226, 228, 230, 232, 234, 236**, and **238**. The construction of plate **226** is shown in Figure 11 wherein it is seen that the plate is generally rectangular in shape with the corners rounded and with suitable apertures formed therein. It is to this plate that subhousing plates **168** and **170** are attached by rivets **196** passing through apertures **240**. Also mounted on plate **226** are bronze bearing bushings **242, 244** and **246** which receive and rotatably support shafts **212, 220** and **208**, respectively. Bushing **186** also extends through an aperture **248** therein.

Plate **228** is provided with a pair of openings **250** which form housings for gears **210** and **218** as well as the gear **204**. Another opening **252** is provided to receive bushing **186** therethrough. Mounted on plate **228** are two bushings **254** and **256** that receive shafts **258** and **260**, respectively, which support gears **216** and **224**, respectively (see Figure 6). Bushings **254** and **256** also extend into apertures **262** and **264** formed in plate **226**.

The plates **230** and **232** are also generally rectangular in shape and have an outer configuration like plates **226** and **228**. An enlarged aperture is formed in the center of each of these plates to receive therein another of the various gears which are contained within and supported by gear box **120**.

Plates **234** and **236** are shaped similar in external outline to plates **226, 228, 230** and **232** and have two large circular apertures formed therein such as apertures **266** and **268** formed in plates **234** and **236**, respectively (see Figure 13). The inwardly facing portions of plates **234** and **236** adjacent apertures **266** and **268** are cut away to form a part-circular groove which is to receive a set of ball bearings **270** or **272** and serve as an outer race therefor. The inner race for ball bearings **270** is formed by two plates **274** and **124** (mentioned above) which are circular in shape and are permanently secured together and to gear **216** by four flat-headed rivets **278**. The outer circumferences of plates **124** and **276** have a part-circular depression formed therein which provides an inner race for the ball bearings **270**. Plate **124** is provided with a part-circular cut out **280** through which ball bearings **270** can be introduced before plate **238** is assembled on plates **234** and **236**. After plates **234, 236** and **238** have been assembled with the ball bearings **270** in position, the ball bearings are held in position by the plates and by the inner race formed on plates **274—124**.

Ball bearings **272** are also held in position by a pair

of plates **122** identical in construction with plates **274—124** described above. Four flat-headed rivets **284** hold plates **122** in assembled relationship with each other and with gear **224**.

Assembled plates **234** and **236** also carry bronze bearing bushings **285** and **287** to support one end of shafts **212** and **220**, respectively, a bushing **289** to support one end of shaft **208** and a bushing **291** to support one end of gear **202**.

Plate **238** serves as a cover plate and has enlarged circular apertures **286** and **288** formed therein through which project pins **126** and **128** fixedly attached to and extending outwardly from plates **122** and **124**, respectively. Pins **126** and **128** actually extend through and connect with the gears **224** and **216**, respectively, described above. An aperture **294** is also provided in plate **238** to provide access to the hexagonal opening in gear **202** (see Figure 7).

Formed around the periphery of plate **238** and each of plates **230**, **232**, **234** and **236** is a plurality of aligned apertures **296** which receive bolts **298** that hold the plates and the enclosed parts firmly assembled. Preferably the apertures **296** in plates **236** and **238** are countersunk so that flat-headed bolts **298** can be used therein.

Another pair of larger apertures **300** extend through each of plates **226**, **228**, **230**, **232**, **234**, **236** and **238** to receive threaded bolts **302**, the outer ends of which are threadedly received in threaded apertures **304** in plates **226** and **228**. The heads of bolts **302** are formed as cubes and are designated by the numeral **306**. Each of the heads **306** has an aperture **308** therein extending perpendicular to the axis of the threaded bolt **302**. When the housing **120** is assembled and placed within the hollow sill **26**, the apertures **308** are positioned vertically and receive self-tapping metal screws **310** that thread into the bottom **38** of hollow sill **26** and thereby firmly position and attach housing **120** within the hollow sill **26**.

Means is provided to deenergize drive motor **118** when the window sashes arrive at the maximum open position and when the window sashes arrive at the maximum closed position. To this end a bracket **312** is secured to plates **226** and **228** by means of a threaded bolt **314** received by threaded apertures in plates **226** and **228**. Bracket **312** has two support arms **316** and **318** each of which support a micro-switch generally designated by the numerals **320** and **322**, respectively. Each micro-switch includes a contacting roller **324** mounted upon a movable arm **326** which is normally urged outwardly to the position illustrated by switch **320** in Figure 4 by a spring (not shown). Positioned beneath arm **326** is a plunger **328** which serves to open switch **320** when arm **326** is pressed thereagainst. A plurality of threaded bolts **330** suitably secure switches **320** and **322** to their respective support arms **316** and **318**.

Actuation of switches **320** and **322** at the proper time is accomplished by a cam **332** adjustably mounted on an extension of shaft **258**. Cam **332** has a pair of cam surfaces **334** which are adapted to contact rollers **324** as is illustrated by the contact with the roller of switch **322** in Figures 3 and 4. Switch **322** is the limit switch operable to deenergize motor **118** when the sashes reach the fully closed position. The window parts are in the position shown in Figures 1, 3 and 4 when the sashes are so closed. As the window opening mechanism is operated to open the sashes, cam **332** rotates in a counterclockwise direction as viewed in Figure 3 until it engages the rotating wheel **324** of switch **320**. Switch **320** is positioned to cooperate with cam **332** so that switch **320** is actuated when the sashes reach the fully opened position. At this time switch **320** opens the circuit to motor **118** stopping operation of the actuating mechanism.

The electrical connections which control the above operation are shown schematically in Figure 15 of the drawings. Motor **118** has a terminal **336** connected by a line **338** to one side of a suitable source of driving

potential such as a 115 volt A.C. line. The other side of this 115 volt A.C. line is connected by a line **340** to a terminal of a control switch generally designated by the numeral **342**. Switch **342** is mounted in any convenient position such as adjacent the window. Switch **342** is a double pole double throw neutral return type switch and includes a pair of contacts **344** which when contacted by the switch blades **346** cause motor **118** to operate in a sash opening direction. Another set of contacts **348** is provided on switch **342** which when contacted by the switch blades **346** cause the motor to operate in a sash closing direction.

It further will be seen that the open limit switch **320** is in series with the contact **344** on switch **342** whereby to limit the opening movement of the window sashes. More specifically, it will be seen that the lower contact **344** is connected through a line **350** to one of the contacts within switch **320** and that the other contact within switch **320** is connected by a line **352** to contact **354** on motor **118**. Switch **320** is a micro-switch that is normally closed and is opened when cam **332** contacts roller **324**.

The limit switch **322** is in series with contacts **348** on switch **342** which when contacted cause motor **118** to operate in a reverse direction. More specifically, the lower contact **348** is connected by a line **356** to one contact of switch **322** and the other contact of switch **322** is connected through a line **358** to terminal **360** on motor **118**. Switch **322** is also a micro-switch which is normally closed and is opened when the roller **324** thereof is contacted by cam **322**.

The operation of the circuit of Figure 15 is as follows. The parts as illustrated are in the closed position with the switch blades **346** in the neutral or non-contacting position. To open the window sashes, switch blades **346** are moved into contact with contacts **344** by moving the switch handle **362** which is connected to switch blades **346**. When the switch blades **346** are moved against contacts **344**, a connection is made from the lower line of the potential source through line **340**, switch blade **346**, the lower contact **344** and line **350** to limit switch **320**. Limit switch **320** has the other end thereof connected through line **352** to contact **354** of motor **118**. As long as switch blades **346** are held against contacts **344** motor **118** will be operated in a sash opening direction. The operator can stop the movement of the sashes at any desired point or can hold switch **342** in the open position until cam **332** opens limit switch **320**. As has been explained above limit switch **320** is opened by cam **332** when the sashes arrive at the full open position. Opening of switch **320** interrupts the circuit to motor **118** and stops movement of the sashes.

Meanwhile cam **332** has moved away from roller **324** on limit switch **322**. Accordingly if the switch blades **346** are moved against contacts **348**, motor **118** will be connected across the potential source and will run in a sash closing direction. When the sashes arrive at the fully closed position, cam **332** will have rotated into contact with wheel **324** of switch **322** whereby to open switch **322** and stop operation of drive motor **118**.

An important advantage of utilizing limit switches **320** and **322** in controlling the operation of the sashes lies in the fact that these switches can be quickly replaced without adjusting the setting of cam **332**. This is important since switches **320** and **322** are subjected to a large amount of wear and in general are a portion of the window mechanism which most rapidly wear in use.

In the event that the drive for the windows from motor **118** becomes inoperative because of failure of switch **320** or **322** or for any other reason, it is desirable that means be provided to operate the sash opening mechanism manually. To this end the hexagonal opening in gear **202** positioned toward plate **238** (see Figure 7 particularly) can be engaged by the hexagonal end of a hand crank generally designated by the numeral **364**. Since

the motor is connected to gear **202** through a non-reversing worm and worm gear connection by the hexagonal pin **200**, it is necessary to remove this connection before gear **202** can be moved by crank **364**. In order to make this possible shaft **158** is formed hollow to receive pin **200** therein whereby to disconnect pin **200** from gear **202**. It is necessary however to insure engagement between pin **200** and gear **202** when the motor is used to open and close the sashes and it further is desirable to make the disconnection of pin **200** responsive to insertion of crank **364** into gear **202**. Accordingly pin **200** is formed with a substantially circular head **366** received in a circular opening **368** formed in shaft **158**. Normally pin **200** is urged into engagement with gear **202** by a spring **370** held in position by a pin **372** held in place by a cotter pin **374**. Head **366** is restrained in movement to the right as viewed in Figure 7 by a shoulder formed on shaft **158**. Pin **200** has a plunger **376** formed on the other end thereof adapted to engage crank **364** so that insertion of crank **364** in the hexagonal opening within gear **202** moves the hexagonal portion of pin **200** to the left as viewed in Figure 7 against the action of spring **370** a sufficient distance to disengage pin **200** from gear **202**. After this disengagement crank **364** acting through gear **202** is operative to drive the sash actuating mechanism in either the opening or the closing direction.

An important feature of the present invention resides in the fact that the motor **118** and the gear box **120** together with the necessary interconnecting parts can be readily installed within the hollow sill **26** by simply removing cover **36** therefrom and without further dismantling the sill or any other portions of the window. More specifically, the motor **118** and gear box **120** can be inserted in place of the crank actuating mechanism illustrated in the co-pending patent application, Serial No. 432,269 identified above by simply removing cover **36** and taking out the gear box and linkages up to but not including the bell cranks **100**. The gear box **120** of the present invention can then be inserted through the opening left by the removal of cover **36** and positioned within hollow sill **26**. In order to insure proper positioning of gear box **120**, bottom wall **38** of the sill is preferably provided with a pair of spaced apertures which are provided therein before final assembly of the sill with the other window parts in anticipation of eventual conversion of the sash operating mechanism from manual to automatic operation. A pair of removable pins **378** and **380** (see Figure 5) are provided in suitable apertures in the bottom of gear box **120**, these pins being insertable into the apertures in bottom wall **38** of sill **26** whereby properly to position gear box **120** within the sill. After gear box **120** has been properly positioned by means of pins **378** and **380**, self-tapping screws **310** can then be put in position whereby fixedly to attach gear box **120** to the hollow sill **26**.

Motor **118** can then be slipped through the opening provided by cover **36** and into the hollow sill **26** after which the shaft thereof is connected with coupling member **148**. With motor **118** properly coupled, retaining bracket **132** is placed in position and secured to the hollow sill by means of the self-tapping screws **142**. Links **114** and **116** are then connected to the crank arms **100** and pins **128** and **126**, respectively. It is to be noted that links **114** and **116** are bent intermediate their ends as at point **382** on link **114** (see Figure 1). The bends **382** properly align the ends of links **114** and **116** disposed toward the bell cranks and yet provide clearance for motor **118** and gear box **120**.

Motor **118** has been previously wired to the limit switches **320** and **322** and is then wired to the control switch **342**. This completes the installation of the automatic actuating mechanism within window sill **26**. It will be seen that the removal of the manual actuating mechanism and its replacement with an automatic actuating mechanism has been accomplished without disassembling the window with the exception of removing the sill cover **36**. The various parts of the automatic actuating mechanism can likewise be removed for repair or replacement without disassembling the window.

It will be seen that there has been provided a window actuating mechanism which fulfills all the objects and advantages set forth above. Although a preferred embodiment of the invention has been shown for purposes of illustration, it is to be understood that various changes and modifications can be made therein without departing from the spirit and scope thereof. Accordingly, the invention is to be limited only as set forth in the following claims.

I claim:

1. An awning type window comprising a frame including a hollow sill with a readily removable cover and hollow side jambs, a sash hingedly mounted on said frame for swinging movement with respect thereto, sash operating mechanism positioned within said hollow sill and said hollow jambs, electrical motor means mounted within said hollow sill for operating said sash operating mechanism, said electrical motor means being readily installed on removal of the sill covers in said hollow sill and removed therefrom and a connecting unit readily installed on removal of said cover in said hollow sill and removed therefrom and having means for connecting said motor means to said sash operating mechanism.

2. An awning window comprising a metal frame including opposite hollow metal jambs, an elongated hollow metal sill between the lower ends of said jambs, and a head member between the upper ends of said jambs, said jambs and sill being in open communication internally with each other and having detachable cover plates extending substantially the entire length thereof on the room side of said frame, a sash hingedly mounted on said frame for swinging movement with respect thereto, a sash operating mechanism mounted inside said hollow jambs and said hollow sill, an electrical motor unit insertable into the hollow sill when the sill cover plate is removed, an elongated speed reducing unit insertable into the hollow sill when the sill cover plate is removed and having input and output connections connectible to said sash operating mechanism and said motor through the aperture covered by said sill cover plate, and manual operating means engageable through an opening in said sill with said speed reducing unit to operate said sash operating mechanism, said speed reducing unit including means operable to disconnect said electrical motor unit from said sash operating mechanism while the manual operating means is being used.

3. An awning window comprising a metal frame including opposite hollow metal jambs, a hollow metal sill between the lower ends of said jambs and a head member between the upper ends of said jambs, said jambs and sill being in open communication internally with each other and having detachable cover plates extending substantially the entire length thereof on the room side of said frame, a sash hingedly mounted on said frame for swinging movement with respect thereto, sash operating links operatively connected to said sash and positioned in said jambs and extending downwardly into said hollow sill, a gear box insertable into the hollow sill when the sill cover plate is removed, connecting links interconnecting said gear box and said sash operating links, an electric motor insertable into said hollow sill when said sill cover plate is removed and operatively connected to drive said gear box, and means for detachably securing said gear box and said electric motor within said hollow sill for removal when said sill cover plate is removed.

4. An awning window comprising a metal frame including opposite hollow metal jambs, a hollow metal sill between the lower ends of said jambs and a head member between the upper ends of said jambs, said jambs and sill being in open communication internally with each

other and having detachable cover plates extending substantially the entire length thereof on the room side of said frame, a sash hingedly mounted on said frame for swinging movement with respect thereto, sash operating links operatively connected to said sash and positioned in said jambs and extending downwardly into said hollow sill, a gear box insertable into the hollow sill when the sill cover plate is removed, connecting links interconnecting said gear box and said sash operating links, an electric motor insertable into said hollow sill when said sill cover plate is removed and operatively connected to drive said gear box, and limit means detachably mounted within said hollow sill and detachably connected to said gear box and said motor for removal and replacement when the sill cover plate is removed and operative to deenergize said electric motor when the sash reaches the fully opened position and when the sash reaches the fully closed position.

5. An awning window comprising a metal frame including opposite hollow metal jambs, an elongated hollow metal sill between the lower ends of said jambs and a head member between the upper ends of said jambs, said jambs and sill being in open communication internally with each other and having detachable cover plates extending substantially the entire length thereof on the room side of said frame, a sash hingedly mounted on said frame for swinging movement with respect thereto, sash operating links operatively connected to said sash and positioned in said jambs and extending downwardly into said hollow sill, an elongated gear box insertable into the hollow sill when the sill cover plate is removed, connecting links interconnecting said gear box and said sash operating links, a thin electric motor insertable into said hollow sill when said sill cover plate is removed and operatively connected to drive said gear box and detachably secured to said sill, a pair of limit switch means including microswitches detachably mounted within said hollow sill for removal and replacement when the cover plate is removed, and a cam driven from said gear box and engaging said micro-switches, said micro-switches being connected in circuit with said electric motor, one of said micro-switches deenergizing said motor when said sash reaches the fully opened position and the other of said micro-switches deenergizing said motor when said sash reaches the fully closed position.

6. An awning window comprising a metal frame including opposite hollow metal jambs, a hollow metal sill between the lower ends of said jambs and a head member between the upper ends of said jambs, said jambs and sill being in open communication internally with each other and having detachable cover plates extending substantially the entire length thereof on the room side of said frame, a sash hingedly mounted on said frame for swinging movement with respect thereto, sash operating links operatively connected to said sash and positioned in said jambs and extending downwardly into said hollow sill, a

gear box insertable into the hollow sill when the sill cover plate is removed, connecting links interconnecting said gear box and said sash operating links, an electric motor insertable into said hollow sill when said sill cover plate is removed and operatively connected to drive said gear box, a bracket mounted on said gear box, a pair of micro-switches detachably mounted upon said bracket for removal and replacement when the sill cover plate is removed, and a cam driven by said gear box and engaging said micro-switches, said micro-switches being connected in circuit with said electric motor, one of said micro-switches deenergizing said motor when the sash reaches the fully opened position and the other micro-switch deenergizing said motor when said sash reaches the fully closed position.

7. An awning window comprising a metal frame including opposite hollow metal jambs, an elongated hollow metal sill between the lower ends of said jambs and a head member between the upper ends of said jambs, said jambs and sill being in open communication internally with each other and having detachable cover plates extending substantially the entire length thereof on the room side of said frame, a sash hingedly mounted on said frame for swinging movement with respect thereto, sash operating links operatively connected to said sash and positioned in said jambs and extending downwardly into said hollow sill, an elongated plate-like gear box unit insertable into the hollow sill when the sill cover plate is removed and having input and output connections, connecting links detachably interconnecting the output of said gear box and said sash operating links, a thin electric motor insertable into said hollow sill when said sill cover plate is removed and detachably connected to the input of said gear box, bracket means for detachably securing the motor in the sill, said sill having gear box positioning apertures, and pins engageable at one end in said apertures in said hollow sill and at their other ends in said gear box accurately to position said gear box within said sill for connection of the input and output to the motor and the sash operating links when the sill cover plate is removed.

References Cited in the file of this patent

UNITED STATES PATENTS

2,108,328	Carnahan	Feb. 15, 1938
2,345,594	Gardner	Apr. 4, 1944
2,516,090	Korff	July 18, 1950
2,539,585	Maier	Jan. 30, 1951
2,635,485	Gravenstine et al.	Apr. 21, 1953
2,637,547	Schottenberg	May 5, 1953
2,665,904	Lehmann	Jan. 12, 1954
2,690,336	Belmont	Sept. 28, 1954
2,758,834	Sanford et al.	Aug. 14, 1956
2,772,578	Kling	Dec. 4, 1956
2,819,065	Jones	Jan. 7, 1958