Nov. 3, 1942. C. NORTON ET AL 2,300,630

VERTICAL SLIDING DOOR CONSTRUCTION

Filed July 17, 1941 5 Sheets-Sheet 1

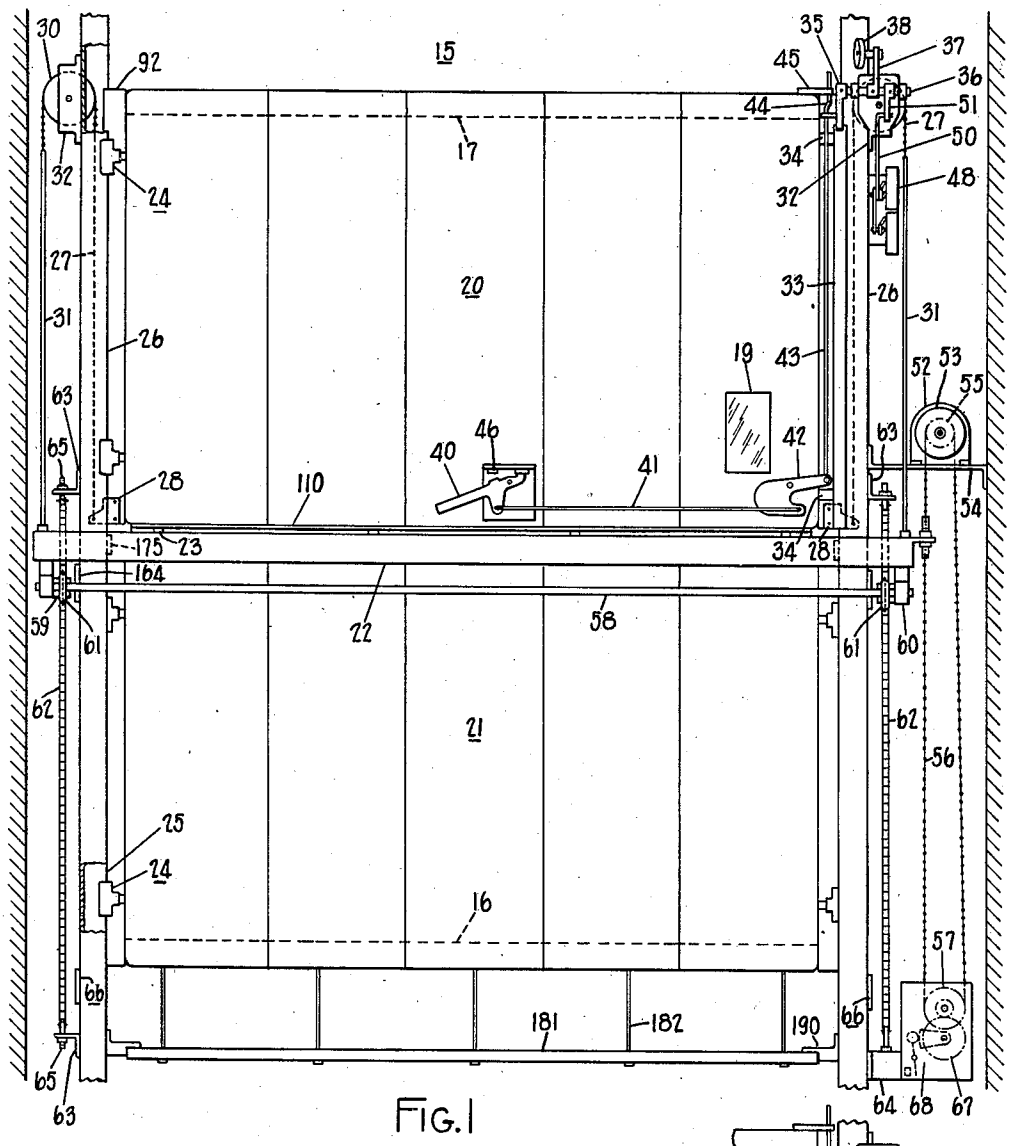


FIG. 1

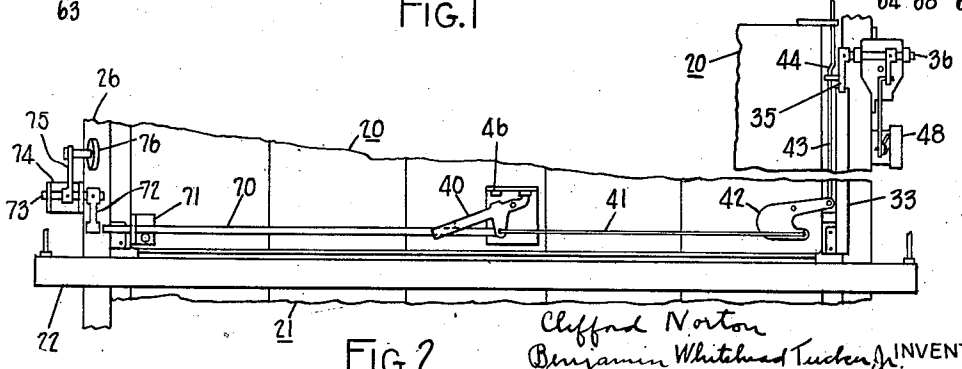


FIG. 2

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VERTICAL SLIDING DOOR CONSTRUCTION

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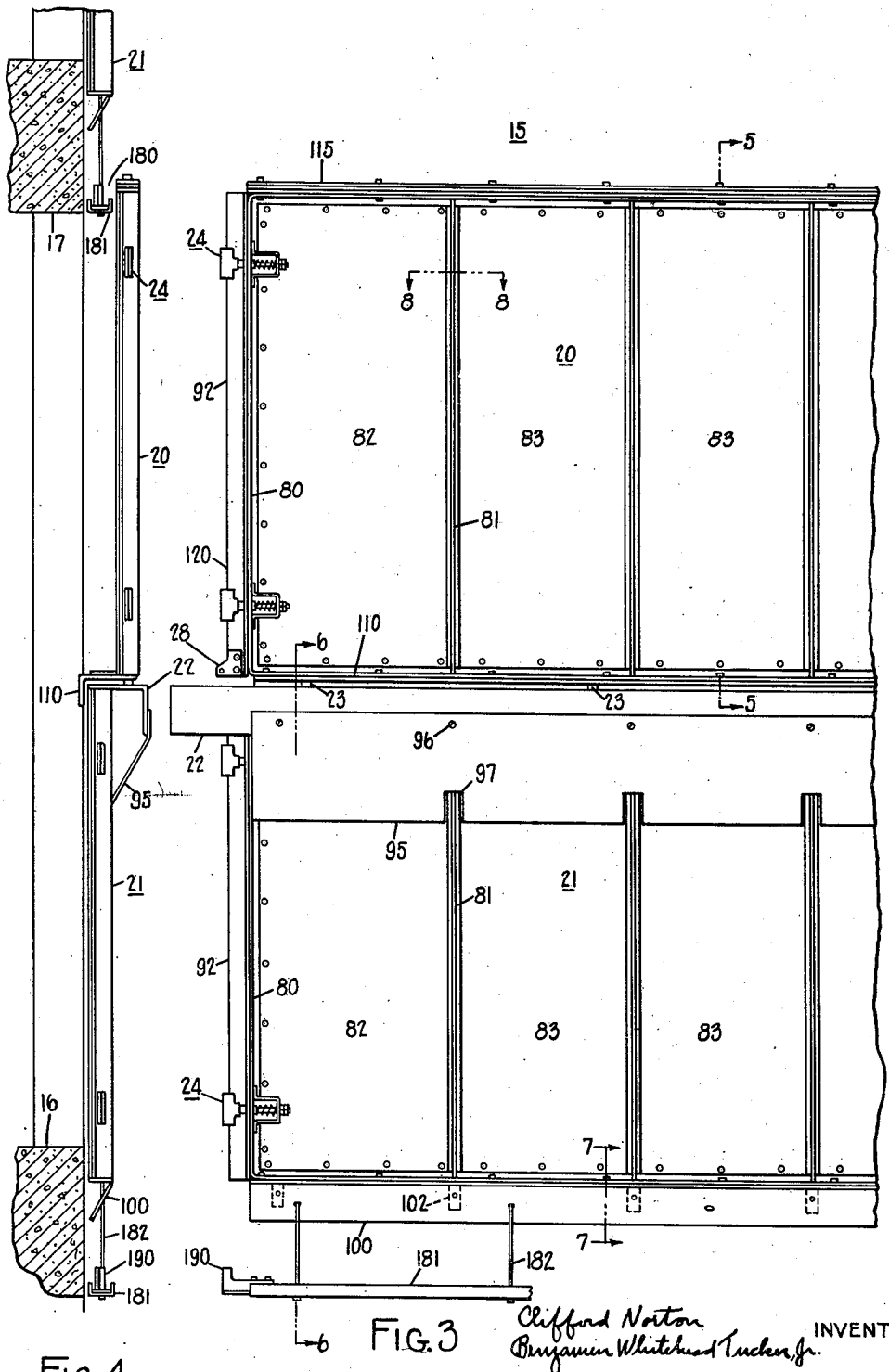


FIG. 4

FIG. 3

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VERTICAL SLIDING DOOR CONSTRUCTION

Filed July 17, 1941 5 Sheets-Sheet 3

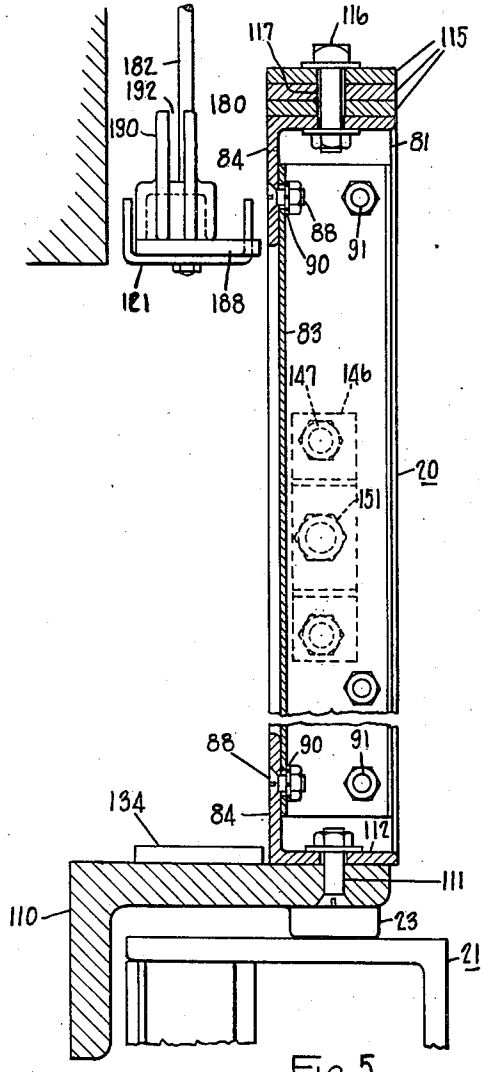


FIG. 5

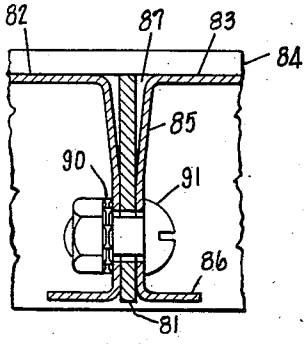


FIG. 8

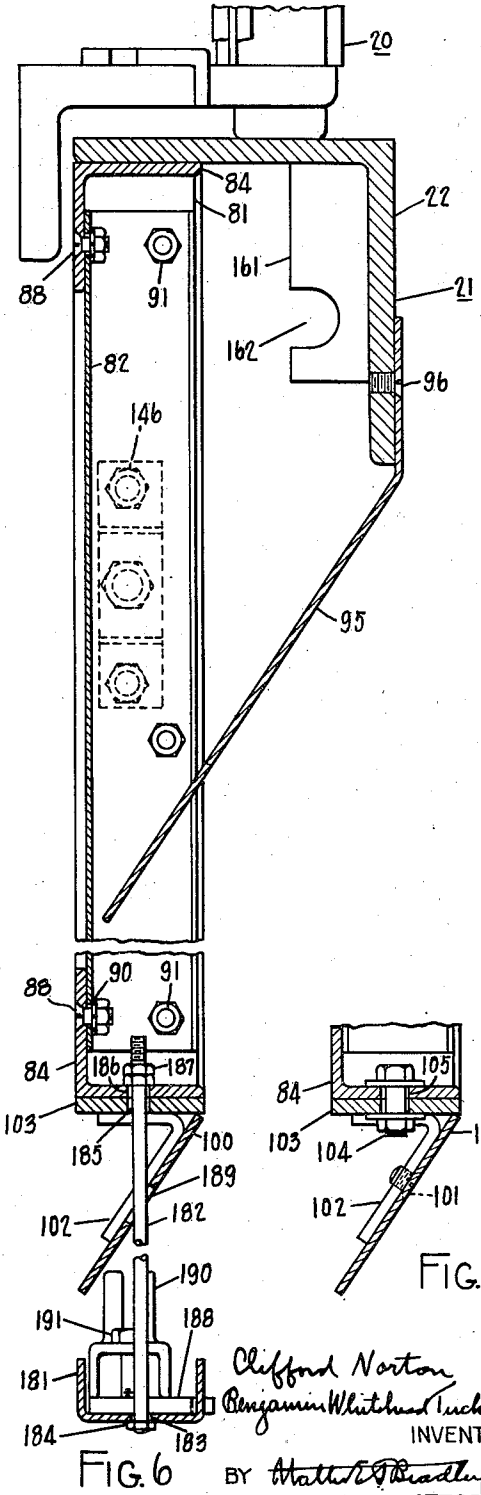


FIG. 6

FIG. 7

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Nov. 3, 1942. C. NORTON ET AL 2,300,630

VERTICAL SLIDING DOOR CONSTRUCTION

Filed July 17, 1941 5 Sheets-Sheet 4

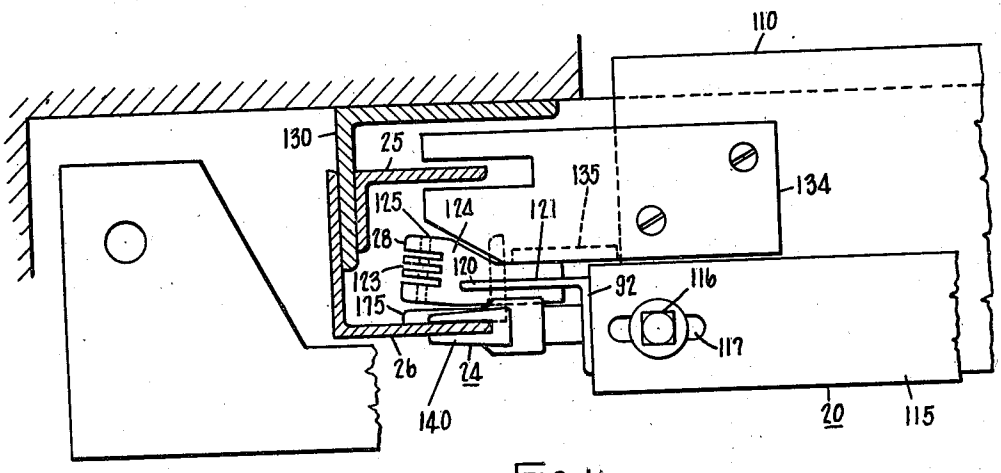


FIG. 9

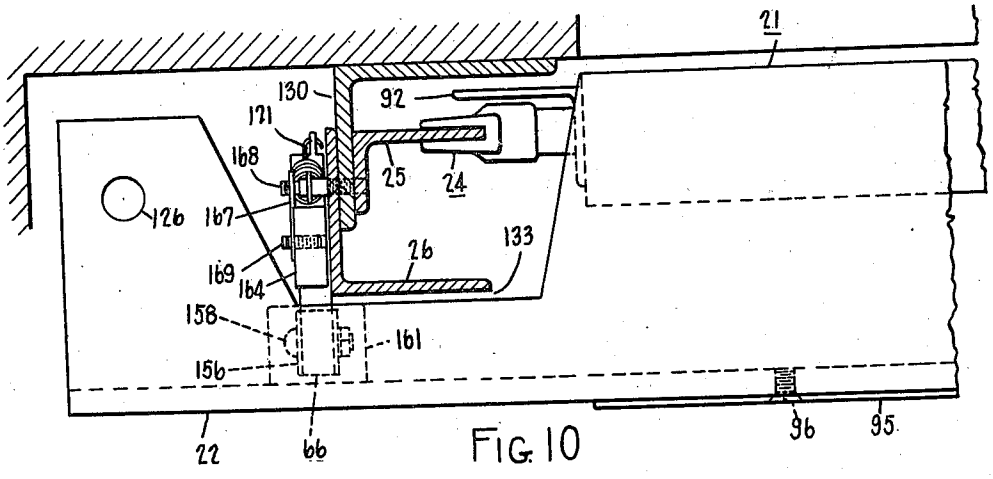


FIG. 10

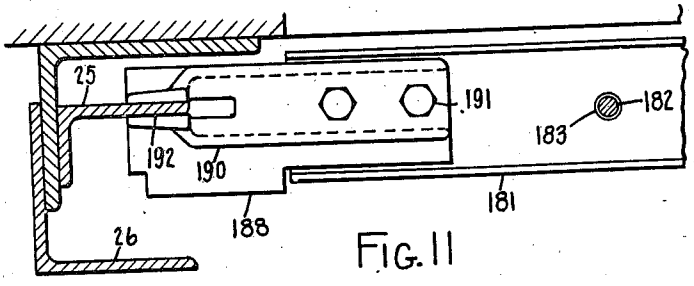


FIG. 11

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VERTICAL SLIDING DOOR CONSTRUCTION

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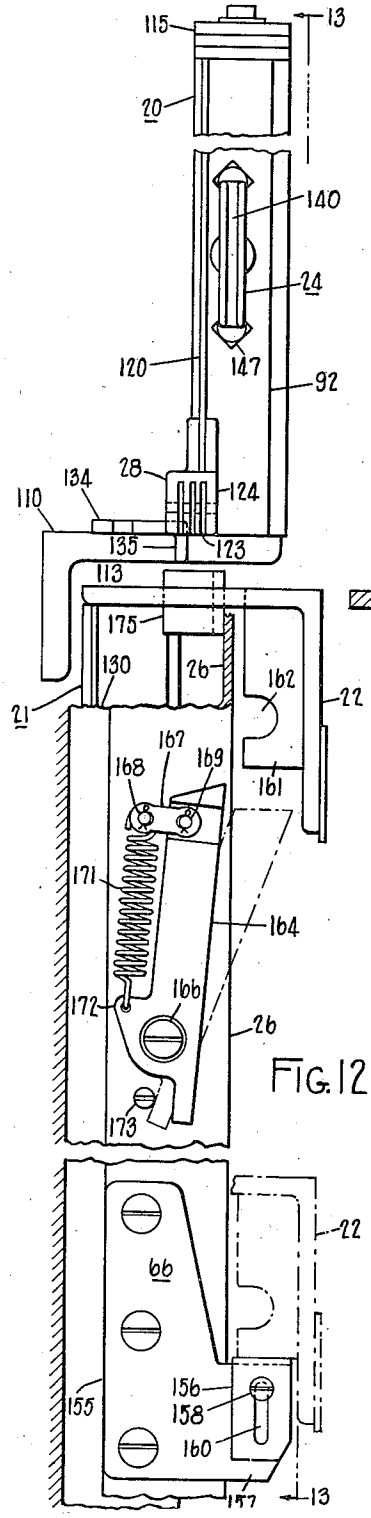


FIG. 12

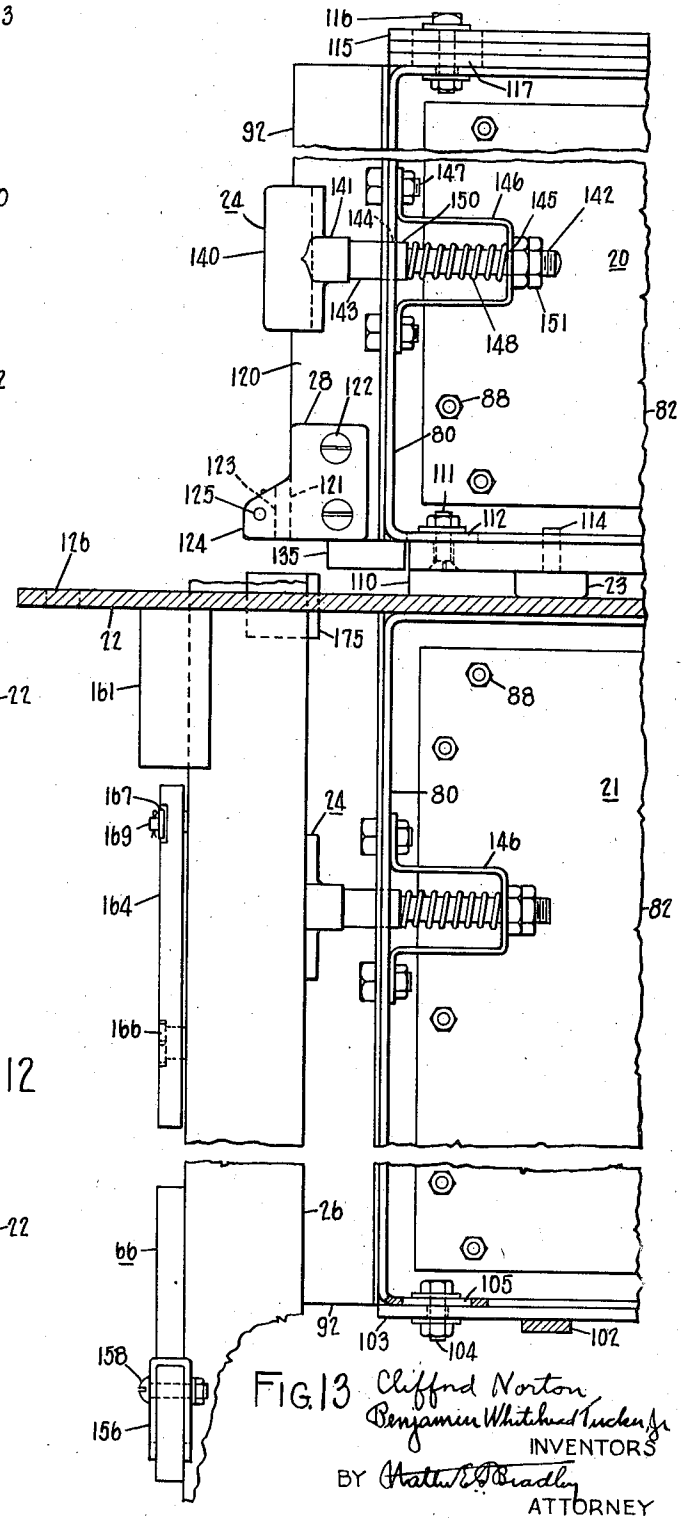


FIG. 13

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Patented Nov. 3, 1942 2,300,630

UNITED STATES PATENT OFFICE

2,300,630

VERTICAL SLIDING DOOR CONSTRUCTION

Clifford Norton, Summit, and Benjamin Whitehead Tucker, Jr., South Orange, N. J., assignor to Otis Elevator Company, New York, N. Y., a corporation of New Jersey

Application July 17, 1941, Serial No. 402,796

1 Claim. (Cl. 189—48)

The invention relates to doors, especially vertical bi-parting doors.

In freight elevator installations such as in factories and warehouses, many of the elevators are of large capacity and it is desirable in installations such as these that wide openings be provided at the floors to afford access to and from the cars. Vertically movable bi-parting doors are especially suitable for such installations inasmuch as with such doors, the door openings can be made as wide as the car. The door sections are guided on vertical guides and are connected together in counterbalancing relationship so that even though the doors are large and heavy, they are easy to operate. It is desirable that such doors be of sturdy construction and that they may readily be repaired as they are subject to hard usage. Also fire protection is an important factor in buildings of such character and it is desirable that the doors provide an effective seal of the hatchway openings against smoke and flame. Flame angles are provided to form a seal along the sides of the door sections while the joint between the abutting door sections when closed is sealed by an astragal secured to the bottom of the upper door section. The door sections overlap the top and bottom of the hatchway openings and in case the doors are of the pass type, the space between the top of the upper door section and the soffit of the hatchway opening is sealed by a lintel which is movable to enable the lower section of the door above to move to open position overlapping this upper section. It is desirable that the door be constructed so as to effectively retain these seals under the influence of heat and water. In insuring such buildings, special consideration is given hatchway doors of a construction which have passed certain fire tests provided by the Underwriters' Laboratories.

The object of the invention is to provide a vertical bi-parting door which is of sturdy construction, economical to manufacture and readily repaired and which is fireproof and provides an effective seal against fire and smoke.

In carrying out the invention according to the arrangement which will be described, each door section is made up of an angle iron frame provided with a plurality of spaced vertical stiffener bars and a plurality of vertical panels in the spaces formed by the bars. The panels are provided with flanged edges where they are joined to the bars, the flanges being formed so that an angle exists between them and the bars to allow for expansion in case of fire. These panels are secured to the frame and to the bars by bolts so as to be readily removable and replaced in case of damage. The door sections are provided with guide shoes biased to position for cooperating with the guide rails by springs to permit the expansion of the door sections in case of fire. Also these guide shoes facilitate the mounting of the door sections on the guide rails as the door sections may be mounted with the guide rails in place by compressing the springs. Fire latches are provided, one at each side of the lower door section near the top. These latches are pivotally mounted on the guide rails. Each latch is provided with a spring for moving it into position to lock underneath the truckable sill. A fusible link acts to hold the latch against the force of the spring, but in case of fire these links fuse and release the latches which move to locking position to support the door sections in case their connecting chains stretch or break. In the case of pass type doors, a movable lintel is carried by the lower door section of the door above so as to move therewith, being guided on the same guide rails as this lower section. The lintel is in the form of an elongated channel member and takes up the space between the top of the upper section of the door and the soffit of the door opening. The lintel is hung on rods depending from the lower section of the door above which slide into this section should the lintel upon the opening of the door above strike the astragal, as in cases of short floor heights. This construction provides an effective seal against flame and smoke and is not disturbed by fire pressure within the hatchway.

A general idea of the invention, the mode of carrying it out which is at present preferred, and the various features and advantages thereof will be gained from the above statements. Other features and advantages of the invention will be apparent from the following description and appended claims.

In the drawings:

Figure 1 is a schematic representation in rear elevation, with certain parts omitted, of a vertical by-parting counterbalanced pass type hatchway door embodying the invention, illustrating the application of both power operating mechanism and locking mechanism to the door;

Figure 2 is a fragmental view similar to Figure 1, in which the door is hand operated;

Figure 3 is an enlarged view in rear elevation of a portion of the vertical by-parting counterbalanced pass type hatchway door of Figure 1, illustrating details of construction;

Figure 4 is a side view of the same;

Figure 5 is an enlarged view in section taken along the line 5—5 of Figure 3;

Figure 6 is an enlarged view in section taken along the line 6—6 of Figure 3;

Figure 7 is an enlarged view in section taken along the line 7—7 of Figure 3;

Figure 8 is an enlarged view in section taken along the line 8—8 of Figure 3;

Figure 9 is an enlarged top view of one edge of the door and its guides taken from above the upper door section;

Figure 10 is a similar view taken from above the lower door section;

Figure 11 is a similar view taken from above the movable lintel;

Figure 12 is an enlarged end view of the door; and

Figure 13 is an enlarged rear view of one edge of the door taken along the line 13—13 of Figure 12.

Referring to Figure 1, the door 15 is illustrated as a vertical bi-parting door positioned for closing an elevator hatchway opening indicated by floor level 16 and soffit 17. The upper section of the door is designated 20, while the lower section is designated 21. The upper section is provided with a vision panel 19. The top of the lower section is provided with a truckable sill 22. The bottom of the upper section is provided with rubber bumpers 23 which rest on the top of the sill when the door is closed. Each section is provided with a plurality of guide shoes 24, two on each side thereof. The guide shoes for the lower section cooperate with guide rails 25, while those for the upper section cooperate with guide rails 26. The sections are connected together in counterbalancing relationship. This is effected on each side of the door by a chain 27 connected to a bracket 28 secured to the side of the upper door section at the bottom. From the bracket the chain extends upwardly and over a sheave 30 and is connected through a rod 31 to the end of sill 22. The supporting bracket 32 for sheave 30 is secured to the guide rail 26.

An elongated bar 33 is secured on the right hand side of the upper door section to angles 34 in turn secured to the door section. This bar serves as a lock bar, being engaged by the notched end of a latch lever 35 when the door is closed to lock the door sections against opening movement. This lever is secured to a pivot shaft 36 rotatably supported on bracket 32. Secured to shaft 36 is a lever 37 which carries an operating roller 38. This roller is adapted to be engaged by a retiring cam carried by the elevator car to move the latch lever into position to disengage the lock bar and unlock the door. This cam is retracted during operation of the car so as to clear the operating rollers for the door locks for the floors at which stops are not to be made.

The latch lever may also be operated manually through a bell crank lever 40 pivotally mounted on the inside of the upper door section near the bottom and central of the door. One arm of this lever serves as an operating handle and the other arm is connected by a rod 41 to a second bell crank lever 42 which is connected to a vertical rod 43. The lever 42 is weighted to counterbalance the weight of the rod. The rod 43 is bent inwardly near its upper end and then back to form a cam 44. The upper end of this rod extends through a guide aperture in a bracket 45 secured to the top of the door section. This cam when pulled downwardly engages a pin on latch lever 35 to unlock the door. This downward movement is effected by clockwise movement of operating lever 40, a stop 46 being provided to limit the movement of this lever. Continued pushing on operating lever 40 after it engages stop 46 moves the door to open position. The latch lever 35 is arranged to operate switching mechanism 48 when the door is unlocked, this being effected through a link 50 connecting the switching mechanism to a lever 51 on shaft 36.

Contacts of switching mechanism 48 control the operation of motor 53 which provides the power for moving the door sections to open and closed positions. This motor is mounted on a bracket 54 secured to the guide rail 26 at one side of the door, this bracket being also secured to the hatchway wall in certain instances to provide extra support. This motor drives a sprocket 55 through gear reduction 52, the sprocket in turn driving a sprocket chain 56. One end of this chain is secured to the sill 22 from which it extends upwardly over sprocket 55, thence downwardly and around another sprocket 57 and thence back to sill 22 to which the other end of the chain is secured. A shaft 58 extends across the lower door section beneath the sill being supported in bearings 60 depending from the sill. At each end of this shaft is secured a sprocket 61 which meshes with a stationary chain 62. These chains are secured to guide rails 26 through brackets 63 and 64, the connections being through eye bolts 65 in order that the chains may be adjusted and kept taut. These chains serve as racks upon which the sprockets move during operation of the door and prevent tilting of the door about an axis perpendicular to the plane of the door. Shoes 59 are provided for maintaining the sprockets in mesh with the chains. Stops 66 are secured to guide rails 26 in position to engage the ends of sill 22 when the door is open to support the lower section with the sill in line with the floor level 16. The sprocket 57 acts through gearing 67 to operate further control switching mechanism 68 for the motor, this switching mechanism being mounted on bracket 64.

In operation, as the car stops at the floor, the retiring cam is extended and engages roller 38 swinging lever 35 into position to disengage the lock bar 33, unlocking the door. Also, certain contacts of switching mechanism 48 are engaged causing the energization of motor 53 for rotative movement of sprocket 55 counterclockwise. This sprocket acts through chain 56 to pull down on the lower door section. At the same time the upper door is pulled upwardly through its connection to the lower door section by chain 27. Thus the two sections counterbalance each other minimizing the load on the motor. The door is brought to a stop upon the engagement of the truckable sill with stops 66. During the door opening operation motor 53 is controlled by switching mechanism 68 to be slowed down as the door nears open position. To close the door, the motor is energized for reverse rotative movement and acts through chain 56 to pull up on the lower door section. At the same time the upper section, being released by upward movement of the lower section, closes by its own weight. The sections are brought to a stop upon the engagement of the bumpers 23 with the truckable sill. During the closing movement, motor 53 is controlled by switching mechanism 68 to be slowed down as the door nears closed position. The operating mech-

anism above described is the subject matter of the copending application of Norton, Karmel and Tucker, Serial Number 368,424, filed December 4, 1940.

Referring to Figure 2 the construction is the same as Figure 1 except that no power operation is provided and the control of the lock is modified. A bar 70 is slidably supported in a bracket 71 secured to the upper door section and is connected to bell crank lever 40. The end of a lever 72 extends in the path of movement of the left hand end of this rod. This lever is mounted on a shaft 73 rotatably supported by a bracket 74 secured to the guide rail 26. Also secured to this shaft is a lever 75, the upper end of which carries an operating roller 76. This roller is adapted to be engaged by a stationary cam carried by the elevator car to move lever 72 into position out of the path of movement of bar 70 when the car is stopped at the floor. This enables clockwise movement of operating lever 40 to unlock and open the door by hand. However, when the car is away from the floor, the cam is disengaged from the roller so that lever 72 is in the path of movement of rod 70 preventing the unlocking of the door.

Referring now to Figures 3 and 4, the upper section 20 and the lower section 21 of the door each comprises a frame 80 having a plurality of spaced vertical stiffener bars 81 extending from top to bottom with the spaces formed by the bars filled in with panels 82 and 83. As may be more readily seen from Figures 5 and 6 the frame is made up from an angle 84 bent at right angles at the corners, the ends being joined together as by welding. The bars 81 extend the full height of the frame and are joined to the horizontal legs of the top and bottom frame angles as by welding. The width of these bars is substantially the same as that of the horizontal legs. The intermediate panels 83 between the vertical bars are in the form of troughs. They are formed from flat steel plates bent inwardly along the side edges to form flanges 85, the flanges being bent again at the edges to form lips 86 parallel with the plane of the panel, as shown in Figure 8. The flanges are the same width as the vertical bars but are shorter. The flanges are formed so that an angle 87 exists between the flange and the stiffener bar for a depth of about half the width of the bar. The end panels 82 are flanged only along their inner edges. At the outer edges of these panels the plates overlap the legs of the sides of the frame. Both ends of the panels 82 and 83 similarly overlap the legs of the top and bottom of the frame. The panels are secured to the frame by bolts 88 extending through apertures in the panels and the legs of the frame at points along where they overlap. Flat head bolts are employed which are countersunk into the legs of the frame, see Figures 5 and 6. Shakeproof lock washers 90 are provided between the nuts and the panels. The panels are similarly secured by bolts 91 extending through aligned apertures in the bars and abutting flanges. These apertures are near the lips 86 so as to be beyond the angle 87, see Figure 8. Shakeproof lock washers 90 are likewise provided between the nut and the adjacent flange. This construction enables the panels to be readily replaced individually in case of damage to one or more of them, as for example by being run into with a heavy truck. Flame angles 92 are secured as by welding to the sides of the frame.

The truckable sill 22 is secured as by plug welding to the top angle of the frame of the lower door section. This sill is in the form of an angle member, the vertical leg of which extends downwardly parallel to the plane of the door. This sill is longer than the door section is wide extending substantially the width of the hatchway. The purpose of this arrangement will be seen from further description. A toe guard 95 is secured to the vertical leg of the truckable sill by screws 96 arranged at spaced intervals. This toe guard extends well into the troughs formed by the panels being provided with slots 97 to clear the joints between the panels and the vertical bars 81. Another toe guard 100 is provided at the bottom of the lower section. This toe guard, as shown in Figure 7, is secured by screws 101 to angle brackets 102. These angle brackets are positioned at spaced intervals and are welded to a stiffener bar 103 in turn secured by bolts 104 to the bottom of the frame. The apertures 105 in the frame through which the bolts extend are elongated as shown in Figure 13 to allow for relative expansion between the bar and the frame in case of fire. The stiffener bar and the truckable sill minimize warping of the lower door section in case of fire upon the sudden cooling of the door.

An astragal 110 extends across the bottom of the upper door section and is secured to the frame by bolts 111 at spaced intervals. As in the case of bolts 104, the bolts 111 extend through elongated slots 112 in the frame, as shown in Figure 13, to allow for relative expansion between the astragal and the frame in case of fire. The astragal is in the form of an angle member the vertical leg of which extends downwardly to cover the space 113 between the door sections when the door is closed, see Figure 12, thereby providing a seal against smoke and flame. The rubber bumpers 23 are provided with stems 114, as shown in Figure 13, which extend into apertures in the astragal and frame to secure these bumpers to the door section. A plurality of steel bars 115 are provided on top of the upper door section, being secured to the frame by bolts 116 at spaced intervals. Elongated slots 117 are provided in the bars through which the bolts extend, as shown in Figure 13, to allow for relative expansion between the bars and the frame. These bars serve as stiffener bars and act to minimize bulging of the door section at the soffit in case of fire. They also add weight to the door section for counterbalancing the upper door section with the lower. Inasmuch as it is undesirable to have too many of these bars, the astragal is formed of heavy stock to assist in providing the counterbalance.

Referring also to Figure 9, the brackets 28 to which the chains 27, for connecting the door sections together are secured, are fastened to the sidewise extending legs 120 of the flame angles for the upper door section. Each bracket is provided wtih a slot 121 into which the leg 120 extends, screws 122 being provided for securing the bracket to the flame angle. A plurality of slots 123 are formed in a lug 124 extending from the bracket. These slots are for receiving the end of the chain 27. An aperture 125 extends through the lug for receiving a pin to secure the end of the chain to the bracket. Apertures 126 are provided in the ends of the truckable sill into which the rods 31 extend for connecting the other ends of the chains 27 to the lower door section. The locations of apertures 126 and of slots 123 are substantially in the vertical planes

through the centers of gravity of the door sections, thereby causing the sections to slide on their guide rails with a minimum of friction.

Reference may now be had to Figures 9, 10, 12 and 13 which illustrate the construction of the guides and guide rails. The guide rails 25 and 26 are shown as in the form of angle members and are secured to an angle member 130 on each side of the door opening, angle members 130 in turn being secured to the structural framework of the hatchway. The guide rails are secured to the angle members 130 as by welding. The dimensions of the guide rails and flame angles are such that these members overlap. Also, the truckable sill is cut away at each end at 133 to clear the guide rails, as shown in Figure 10. A plate 134 provided with a projection 135 and slotted to span the guide rail is secured to the top of the astragal to form a flame seal partially to close this opening.

The guide shoes 24 are alike. Each comprises a slotted shoe 140 into which the guide leg of the guide rail extends. The shoe is formed with a hub 141 from which extends a stem 142 having an enlarged cylindrical portion 143. An aperture 144 is provided in the flame angle and door frame into which the enlarged portion 143 slidably extends. The end of the stem is threaded and extends through an aperture 145 in the yoke portion of a chair bracket 146. This bracket is secured by bolts 147 to the door frame. A compression spring 148 is provided on the stem between the shoulder 150 formed by enlarged portion 143 and the yoke portion of the bracket. This spring acts to maintain the guide shoe extended into position for cooperating with the guide rail. Nuts 151 are provided on the threaded end of the stem for adjusting the position of the guide shoe with respect to the guide rail and for locking it in adjusted position. In case of fire the expansion of the door sections causes the springs to compress, so that the door expands without straining either the door frames or the guide rails. Also, with this construction the door sections may be mounted with the guide shoes thereon and with the guide rails in place by compressing the springs 148 sufficiently to place the guide shoes on the rails.

The stops 66, upon which the truckable sill rests when the door is open, each comprises a bracket 155 secured to guide rail 26. A clip 156 in the form of an inverted U is provided on the horizontal extending arm 157 of the bracket. The clip is secured to the bracket by a bolt 158 extending through the clip and bracket. Each leg of the clip is provided with a vertical slot 160 through which the bolt extends for adjustably positioning the clip on the bracket. In adjusting the clip, shims are placed between the top of the clip and the bracket, thereby providing a solid foundation for supporting the sill in adjusted position. Stop members 161 are secured as by welding to the underside of the truckable sill for engaging stops 66 when the door is open. Slots 162 are provided in the stop members for clearances for cross-shaft 58.

The stop members 161 also serve to engage the fire latch levers 164 in case of fire upon the stretching or breaking of chains 27. The fire latch levers are mounted on guide rails 26 on each side of the hatchway. Each lever is pivotally mounted on the rail as by a shoulder screw 166. The lever is held in retracted position by a fusible link 167 extending between a pin 168 secured to the guide rail and a pin 169 secured to the upper end of the lever. This link is in the form of two overlapping halves held together by metal which fuses say around 160 degrees Fahrenheit. A tension spring 171 extends between the pin 168 and an ear 172 formed on the lever tending to move the lever to latching position. A stop 173 is provided to be engaged by the lower end of the lever when released to limit the outward movement of the lever to a position immediately beneath stop member 161. Thus, with this arrangement the latch lever is held in retracted position by the link during normal operation. However, in case of fire the link releases the lever and the spring acts to move it into position beneath the stop member, as indicated in dot-dash lines. Thus, upon the stretching or breaking of chains 27 the stop members come down upon the ends of the levers which stops further downward movement of the door. The upper section is preferably provided with stops 175 secured to guide rails 26 to limit its downward movement. In case these stops are not provided the upper section follows the lower section downwardly as the chains stretch until brought to a stop by the engagement of stop members 161 with the ends of the fire latch levers, the upper section being supported on top of the lower section.

In the case of pass type doors, the construction illustrated, a space 180 exists between the top of the upper door section and the hatchway wall at the soffit 17. To seal this space against flame and smoke a movable lintel is provided. Referring to Figures 1, 3, 5, 6 and 11, this lintel is in the form of a channel member 181 extending in space 180 across the door opening. This lintel is supported by a plurality of rods 182 extending at spaced intervals downwardly from the lower section of the door above. These rods extend through apertures 183 provided in the channel member and the lower ends are threaded to receive nuts 184 upon which the channel member is supported. These rods extend upwardly through apertures 189 in toe guard 100. The upper ends of these rods extend through apertures 185 and 186 in the stiffener bar 103 and the door frame respectively of the lower section of the door above. The apertures 186 are elongated to permit relative expansion between the bar and the frame. The upper ends of the rods are threaded to receive adjusting and lock nuts 187 which support the rods to position the channel members in line with the top of the door opening. A plate 188 may be secured to the channel at each end thereof to form a flame seal, each plate being provided with a slot to span the guide rail. On top of the plate is secured a guide shoe 190, the plate and guide shoe being secured to the channel by bolts 191. The guide shoes 190 slide on the same guide rails 25 as the lower door sections, each shoe being provided with a slot 192 into which the guide leg of the guide rail extends.

With this construction the movable lintel is raised and lowered with the door section to which it is secured and when the door is closed forms a dependable and effective seal for the opening 180. The construction is very sturdy and is not disturbed by fire pressure within the hatchway. In certain installations due to the relationship of floor heights and door sizes it may be that in opening the door the lintel will strike on the astragal of the door below before full opening is reached. In such cases the rods 182 are pushed upwardly into the lower door section

until this section reaches full open position. When the door is closed the door frame moves up into position engaging the nuts **187** thereby picking up the rods and thus the lintel to move it back into sealing position as the door is closed.

While a certain construction of door operating and locking mechanism has been described for the door, it is to be understood that operating and locking mechanisms of other constructions may be employed. Also, in some installations certain of the features of the invention may be omitted. Where the door sections are "in line," the movable lintel is omitted from the lower section of the door above. Other features of the invention are applicable to the "in line" doors as well as to the pass type. In the case of "in line" type doors, the upper and lower door sections would be guided on the same guide rails in which event the fire latches would be mounted on these rails in proper positions to prevent the falling of the door sections. Certain features of the invention are applicable to single section doors. Also the invention is applicable to doors used for closing openings other than elevator hatchway openings, such as warehouse doors. Many variations in the construction of the door may be made. For example, the construction of the truckable sill may be varied in accordance with the load to which the lower sections are subjected when open. Also, where code requires that the difference in temperature between the inside and outside of the door be within certain limits, the panels may be filled with heat insulating material and covered with metal sheets secured to the lips **86**.

Therefore, as many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

In a vertical bi-parting elevator hatchway door installation in which the door sections are connected together in counterbalanced relationship by flexible means at each side of the door, in which the lower door section has a truckable sill at the top thereof which is provided with a pair of depending stop members, one at each side of the door, for engaging stops secured to the guide rails for supporting the lower door section in open position with said sill level with the floor landing, and in which guide rails are provided at the sides of the door, a pair of fire latches, one for each side of said door, each latch comprising a latch lever pivotally mounted on the guide rail for the side of the door for which the latch is provided below said sill and in alignment with said stop member for that side of the door, a fusible link connected between the upper end of said lever and a pin on such rail for retaining said lever in retracted position, and a coil spring connected in tension between said pin and said lever for moving said lever about its pivot upon being released by said link to place its upper end beneath said stop member, said lever having a lug thereon to which the lower end of said spring is connected which positions the spring parallel with said lever, said links fusing in case of fire upon the temperature reaching a certain value permitting said springs to move the upper ends of said levers beneath said stop members so that in the event of stretching or breaking of said flexible means said stop members engage said levers to support said door substantially in closed position.

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