Jan. 21, 1930. A. W. KOHL 1,744,641

AUTOMATIC DOOR

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Fig. 1.

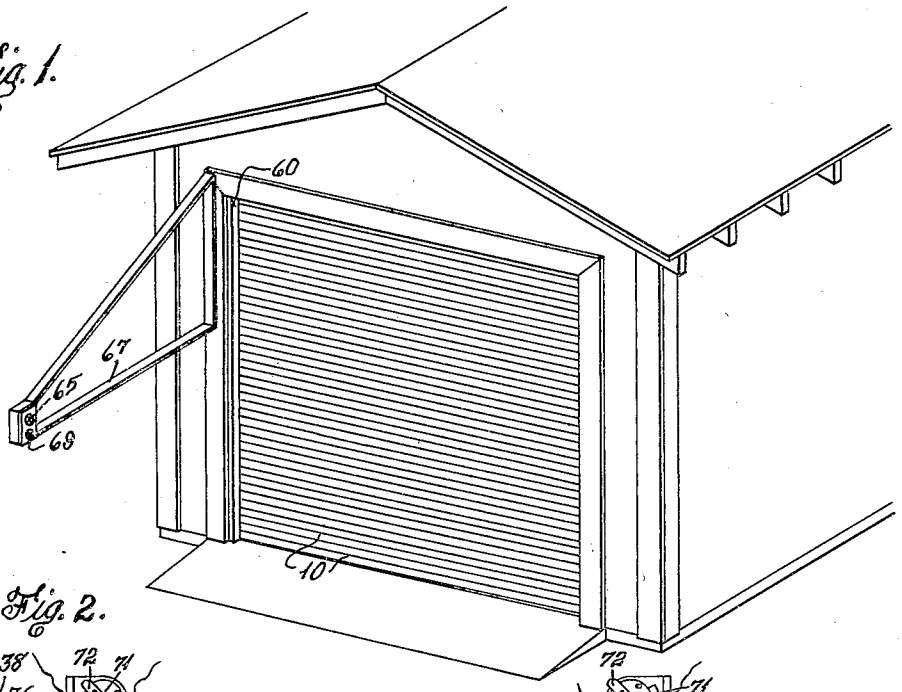
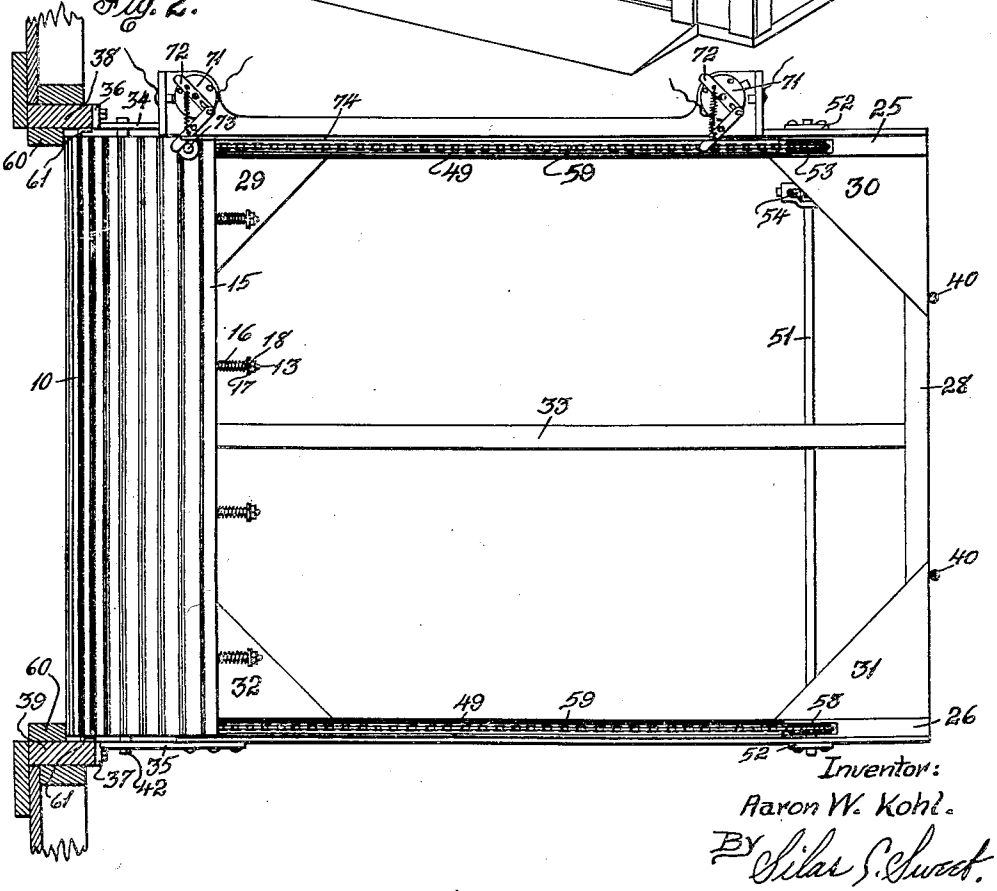


Fig. 2.



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Fig. 3.

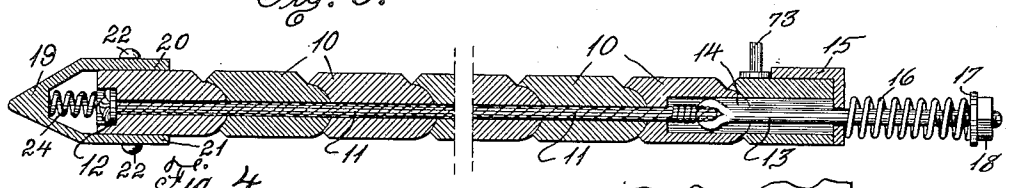


Fig. 4.

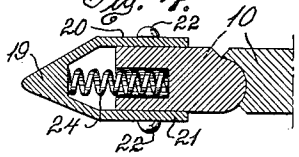


Fig. 5.

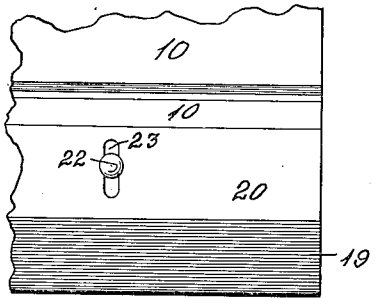


Fig. 6.

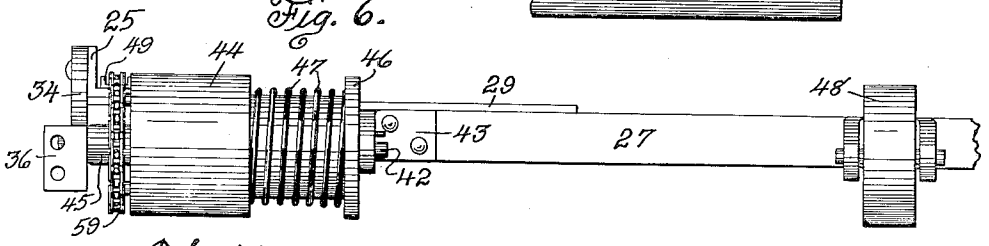


Fig. 7.

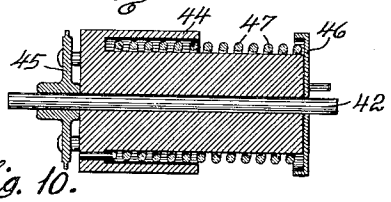


Fig. 8.

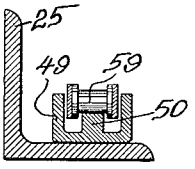


Fig. 10.

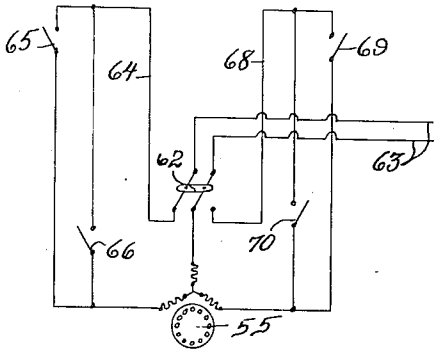
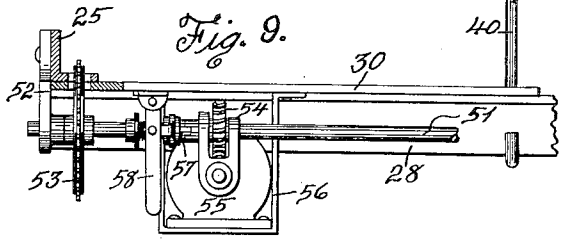


Fig. 9.



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Patented Jan. 21, 1930 1,744,641

UNITED STATES PATENT OFFICE

AARON W. KOHL, OF DENVER, COLORADO, ASSIGNOR OF ONE-HALF TO LAUREN D. BURT, OF DENVER, COLORADO

AUTOMATIC DOOR

Application filed December 6, 1926. Serial No. 152,890.

An object of this invention is to provide an improved construction of door adapted for use with large apertures such as are found in garages, warehouses and the like.

A further object of the invention is to provide an improved construction of flexible door.

A further object of the invention is to provide improved means whereby a flexible door may be opened and closed.

A further object of the invention is to provide improved means for limiting and arresting the movement of a flexible door.

A further object of the invention is to provide improved means for counterbalancing the weight of a flexible door.

A further object of the invention is to provide means for opening and closing a flexible door, which means serve to lock the door in a given position and prevent hand operation thereof.

A further object of the invention is to provide improved means for supporting a flexible door throughout its range of motion, whereby the friction of such motion is minimized through a rolling contact.

A further object of the invention is to provide means whereby a flexible door may be caused to automatically open or close from within or without the closure effected by said door.

A further object of the invention is to provide means for opening and closing a flexible door, said means being electrical and adapted for use with low voltage circuits.

My invention relates primarily to garage doors and more particularly to doors of private garages, and provides means for conveniently opening and closing said doors from within or without the garage and without the necessity of the operator leaving his seat when in a vehicle, and further provides operating means which may be connected with and operated from an electric light circuit, thus obviating the expense of installation of special power lines.

My invention consists in the construction, arrangement and combination of elements hereinafter set forth, pointed out in my claims and illustrated by the accompanying drawings, in which—

Figure 1 is an exterior view of a portion of a garage showing my improved door installed and in closed position. Figure 2 is a plan of the supporting and operating mechanism employed with my improved door, showing the method of installation. Figure 3 is a section, on an enlarged scale, longitudinally of the door. Figure 4 is a fragmentary detail section of a portion of the door, on the same scale as Figure 3. Figure 5 is a fragmentary detail elevation of one corner of the door, on the same scale as Figure 3. Figure 6 is a front end elevation of a portion of the supporting frame and operating mechanism, the door being removed. Figure 7 is a longitudinal section through one of the counterbalancing rollers employed in the apparatus. Figure 8 is a vertical section, on a much enlarged scale, through and at right angles to one of the side members of the frame. Figure 9 is a detail elevation, partly in section, of the driving mechanism employed in the apparatus. Figure 10 is a conventionalized wiring diagram of the control means employed in the apparatus.

In the construction of my improved apparatus as shown, a flexible door or curtain, of any suitable size, is formed of relatively long, narrow strips 10, preferable of wood, said strips, with the exception of the marginal strips, having each one concaved and one convexed edge whereby they may be articulated, one against the other, the marginal strips having each one plane edge, all of which is clearly shown in Figure 3. The strips 10 are each provided with a plurality of spaced, parallel bores intersecting their articulated edges, said bores being adapted to register with those in adjacent strips and thus provide continuous bores transversely of said strips and throughout the length of the assembled door. Flexible cables 11, having an enlarged head 12 on one end and a threaded eye-bolt 13 secured to the other end, are threaded through the longitudinal bores in the door, the head 12 being adapted to seat against the shoulder of a counterbore in the plane margin of the lowermost strip and the

eye-bolt 13 being received in an enlarged bore 14 in the strips adjacent the top of said door and having its threaded end extending beyond the top margin thereof. An angle, 15, is provided with apertures for the passage of the eye-bolts 13 and is fitted against the upper margin and face of the top strip of said door. Expansive coil springs 16 are loosely fitted around the projecting ends of the eye-bolts 13 and are confined between one leg of the angle 15 and a washer 17 positioned by a nut 18 threaded on each of said eye-bolts. The door being thus assembled, tension of the springs 16 exerts a pull on each of the cables 11, which, by virtue of the head 12, is transmitted to the strips 10 and serves to hold them in close marginal contact, while expansion and contraction of the material of which the strips are formed is absorbed by said springs. Variation of the tension of the cables 11 may be had through the adjusting nuts 18. The lower margin of the door is equipped with a shoe 19, wedge-shaped in section and having spaced, parallel flanges 20, 21, adapted to embrace and overlie the lowermost strip of said door, to which said shoe is secured in sliding relation by means of rivets, bolts or pins 22 passing through transverse slot 23 in the flanges 20 and 21. Expansive coil springs 24 are seated in recesses spaced along the plane margin of the lowermost strip 10, the other end of said springs bearing against the shoe 19 and tending to hold said shoe in its most extended position relative to said strip. Should the door, in closing, strike some obstruction such as a pebble, ice or rubbish before reaching the limit of its normal closure, the shoe 19 would be forced up, relative to the strip to which it is attached, against the pressure of the springs 24, and full action of the door would thus be permitted without damage thereto. A rectangular frame is formed of spaced, parallel angles 25, 26, connected at either end by spaced, parallel angles 27, 28 and braced at the corners by gusset plates 29, 30, 31 and 32, all rigidly riveted or bolted together. Said frame may be further braced by means of an angle 33 between the angles 25 and 26 and parallel therewith. The rectangular frame above described is adapted to be mounted in a horizontal plane within the building served by the door, slightly above the lintel of said door and spaced rearwardly somewhat from the door jamb and is positioned by means of brackets 34, 35 secured to the forward ends of the angles 25 and 26 respectively and curving forwardly and downwardly to terminate in flanges 36 and 37 apertured to receive bolts or screws whereby the ends of said brackets may be secured to inner margins of door jambs 38, 39, thus supporting the forward end of the frame; the rear end of said frame being adapted to be suspended from rafters or joists of the building by means of hooked hangers 40 engaged under the margin of the angle 28, said hangers being equipped with turnbuckles 41 whereby the rear end of the frame may be trued and levelled. Similar counterbalancing rollers are mounted at either forward corner of the rectangular frame between the angle 27 and the lintel of the door, each of said roller assemblies comprising a shaft 42 having one end journaled in a bearing in the bracket 34 or 35 and the other end journaled in a bearing in the projecting end of a bracket 43 secured to the face of the angle 27 and extending forwardly and downwardly therefrom; a two-diameter, cylindrical drum member 44, having its larger diameter portion undercut to form an annular cup and extending the length of the lesser diameter portion, mounted on said shaft; a chain sprocket 45 of substantially the same diameter as the larger portion of said drum spaced from and secured to said larger portion; a disc 46 formed with an annular flange, loosely mounted on said shaft adjacent the smaller end of said drum and secured to the bracket 43; and a helical spring 47, loosely coiled around the lesser portion of said drum and having one end seated in a bore in said drum and the other end seated in a bore intersecting the disc 46 and bracket 43. A simple roller 48, of the same diameter as the larger portion of the drum 44, may be mounted on the face of the angle 27 between and in axial alinement with the counterbalancing rollers and provide additional support when the width of the door is considerable. The angles 25 and 26 are mounted with one leg of each vertical and the horizontal legs extending toward one another and are spaced apart slightly more than the width of the door to be used. A track comprising a channel 49 formed or provided with an upwardly-extending rib 50 intermediate and spaced from its side flanges and extending the length of the channel, is mounted on the top face of the horizontal leg of each of the angles 25 and 26 and secured thereto in accurate parallel relation; the counterbalancing rollers being so mounted on the rectangular frame as to bring the chain sprockets 45 in alinement with the ribs 50 of the tracks 49, the orbit of the base of the teeth of said sprockets being tangent at its highest point to the plane of the top of the rib 50. The tracks 49 continue to the forward ends of the angles 25 and 26, but stop short of the rear ends of said angles and elongated slots are cut through said angles and the gusset plates 30 and 31 adjacent the rearward ends of said tracks. A horizontal shaft 51 is mounted transversely of and extends the entire width of the rectangular frame and is mounted for rotation in journals in the lower end of brackets 52 secured to the angles 25 and 26 and extending therebelow, said shaft being thus positioned below and spaced from the slotted portions of said

angles. Chain sprockets 53 are fixed to the shaft 51, adjacent either end thereof and in alinement with the rib 50 of the tracks 49, said sprockets having the orbit of the base of their teeth tangent at its highest point with the plane of the top of said rib. A worm gear 54 is loosely mounted on the shaft 51 and is engaged and adapted to be driven by a worm fixed to the end of the shaft of a motor 55, said motor being suspended from and below the rectangular frame by means of a yoke 56. A normally spring engaged jaw clutch 57, adapted for manual disengagement by means of a lever 58, is feathered to the shaft 51 and adapted to engage the worm gear 54 and lock said gear to said shaft, thus transmitting the power of the motor 55 to the shaft 51 and hence to the chain sprockets 53. Endless roller chains 59 connect each of the chain sprockets 53 with the corresponding sprocket 45, the rollers of said chains resting on the upper face of the ribs 50 as the chain travels along the tracks 49. The rectangular frame and its attached mechanism being assembled and positioned as above described, the door is mounted across the aperture with the strips 10 transversely thereof and the angle 15 at the top, the side margins of said door being received in sliding relation between stops 60, 61 secured to the door jambs. The door is preferably of a length greater than the heighth of the aperture and the upper end thereof is adapted to bear against the curved surfaces of the drums 44 and roller 48 and be supported thereby, the articulation of the strips 10 permitting the door to be bent around said drums and rollers so that the angle 15 may lie in a horizontal position transversely of the forward end of the rectangular frame and be received between the vertical legs of the angles 25 and 26, resting on the roller chains 59 to which said angle is firmly attached at either end. The tension of the helical springs 47 should be adjusted before attaching of the angle 15 to the chains 59 so that the weight of the door, when in closed position, is practically counterbalanced by said springs, upward motion of said door relieving said tension in proportion as the door is raised. The motor 55 is of a reversible type and is connected through a pole changer 62 to a source of electric current 63, thus providing two separate circuits, of opposite current direction, leading to said motor. With the pole changer in the position shown in Figure 10, the circuit 64 is available for operating of the motor in one direction, one side of said circuit containing two switches, 65, 66, connected in parallel, the closing of either switch completing the circuit and operating the motor. The switch 65 is preferably a key operated switch and is adapted to be mounted without the closure on a bracket 67, or post, within easy reach of an operator seated in a vehicle, the switch 66 being within the closure, thus permitting completion of the circuit 64 from within or without the building and from either side of the door. In like manner, one side of the circuit 68 is led through two switches 69, 70, connected in parallel, the switch 69 being preferably a key operated switch mounted on the bracket 67 without the closure and the switch 70 being within said closure, whereby, when the pole changer is in position to energize the circuit 68, said circuit may be completed from either side of the door. The pole changer 62 is shown on Figure 2 as comprising two separate units 71, one of said units being mounted near each limit of the range of movement of the angle 15 along the rectangular frame. Spring toggles 72 are mounted on each of the units 71, one arm of each of the toggles projecting across the track 49 of the angle 25 and into the path of a strike 73 carried by the door adjacent the end of the angle 15, the projecting arms of said toggles being interconnected by means of a pull rod 74. Thus, when the door reaches the limit of its forward movement along the tracks 49, the strike 73 engages the projecting arm of the toggle of the forward unit 71 and actuates said toggle, breaking the circuit of the rearward unit, while the circuit of the forward unit is established. As the door reaches its rearward limit of movement, the strike 73 engages the projecting toggle arm of the rearward unit 71, establishing a circuit there and breaking the circuit of the forward unit. Thus is provision made for automatically limiting movement of the door in either direction and automatically establishing the circuit for operating the door in the desired direction. If for any reason the operating mechanism should become inoperative, the clutch 57 may be manually disengaged by means of the lever 58 and the door be manually opened and closed; at all other times the worm drive acts as a lock, preventing manual actuation of said door.

In the practical operation of my apparatus, the door being in closed position, the pole changer is in position to energize the circuit 64 and the helical springs 47 are under tension; closing of the switch 65 completes the circuit 64 and the motor, assisted by the tension of the springs 47, raises said door and draws it rearwardly along the rectangular frame to the limit of its rearward movement, at which point the strike 73 reverses the pole changer, stopping the motor, and energizes the circuit 68, whereupon closing of the switch 70 completes the circuit 68 and closes the door, which, in closing, automatically retensions the springs 47 and reverses the pole changer as it reaches the limit of its forward movement. It is of course obvious that the sequence of events above recited would be the same were the switches 66 and 69 employed. That portion of the door in hori-

zontal position on the rectangular frame is supported by rolling contact of the rollers of the chains 59 with the top plane of the rib 50, friction being thus minimized.

I claim as my invention:—

1. An electrically-operated automatic door comprising a flexible closure member mounted for vertical reciprocation across an aperture, a horizontal frame spaced from, above and rearwardly of said aperture, rollers on the forward end of said frame adjacent said aperture and in engagement with the rear face of said closure member, reversible driving means carried by said frame, connections between said flexible member and driving means, a reversing switch on said frame and a strike on said flexible member adapted to engage said reversing switch at times and operate said switch at either limit of the range of movement of said flexible member.

2. In an apparatus of the character described having a horizontal frame and a flexible door adapted for travel along said frame, driving means carried by said frame for actuating said door, said means comprising a shaft transversely of and below the rear end of said frame, a worm gear loosely mounted on said shaft and engaging with a worm pinion on the shaft of an electric motor carried by said frame adjacent said shaft, chain sprockets on either end of said shaft extending through slots in the side members of said frame, rollers on the forward end of said frame, chain sprockets fixed to said rollers in alinement with the chain sprockets on said shaft and endless chains about and connecting each pair of chain sprockets, together with selective means whereby said motor may be caused to rotate in either of two directions.

3. In an apparatus of the character described, the combination of a flexible motor-driven door mounted for vertical reciprocation across an opening and horizontal reciprocation along a frame, of means for limiting and arresting the movement of said motor-actuated door along said frame, said means comprising switches on said frame adjacent the path of said door, arms on said switches extending across the path of one edge of said door and a strike carried by said door and adapted to engage said arms at times and open and close said switches automatically.

4. An electrically-operated automatic door comprising a flexible closure member adapted for vertical reciprocation across an aperture, a horizontal frame spaced from, above and rearwardly of said aperture, counterbalancing rollers mounted for rotation on axial shafts journaled in spaced brackets on the forward end of said frame, said rollers comprising each a two-diameter cylinder, a chain sprocket fixed to the larger end of said cylinder, a flanged disc concentric with said cylinder and fixed to one of said brackets adjacent the smaller end of said cylinder and a helical spring loosely wound about the lesser portion of said cylinder and having one end engaged in said cylinder and the other end engaged in said disc and bracket; together with reversible driving means carried by said frame and connections between said closure member, counterbalancing rollers and driving means whereby said closure member may be caused to move vertically across said aperture and horizontally along said frame.

5. An electrically-operated automatic door comprising a flexible closure member adapted for vertical reciprocation across an aperture, a horizontal frame spaced from, above and rearwardly of said aperture, longitudinal tracks on side members of said frame, said tracks comprising upwardly-opening channels having each a longitudinal rib between and spaced from its side flanges, endless roller chains secured to said closure member and adapted to travel along said tracks and driving means carried by said frame and engaging said chains whereby said closure member may be caused to move vertically across said aperture and horizontally along said frame.

Signed at Denver, in the county of Denver and State of Colorado, this 30th day of November, 1926.

AARON W. KOHL.