Jan. 17, 1950 L. S. LONGENECKER 2,494,713

FURNACE DOOR OPERATING MECHANISM

Filed April 2, 1946 6 Sheets-Sheet 1

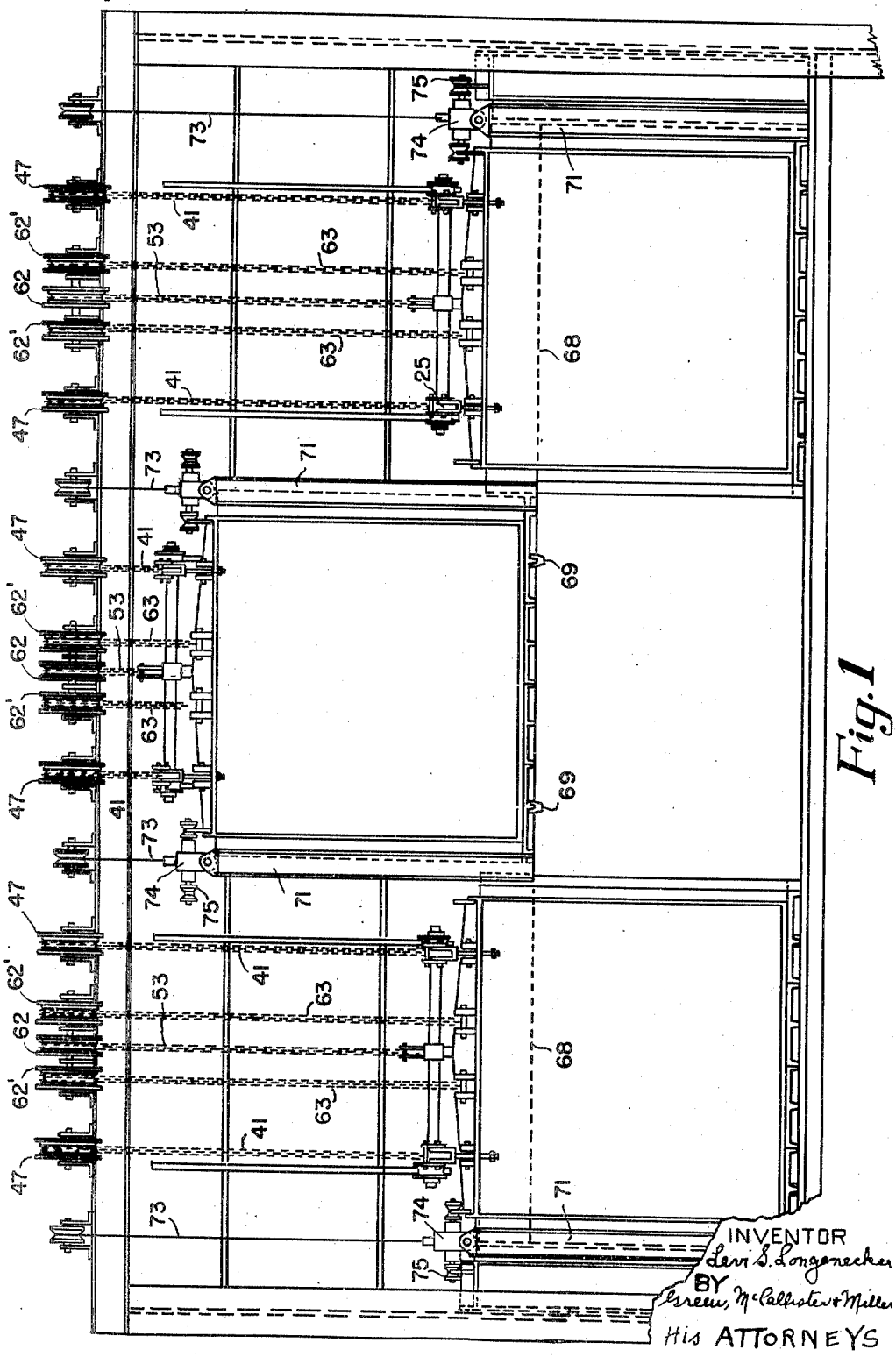


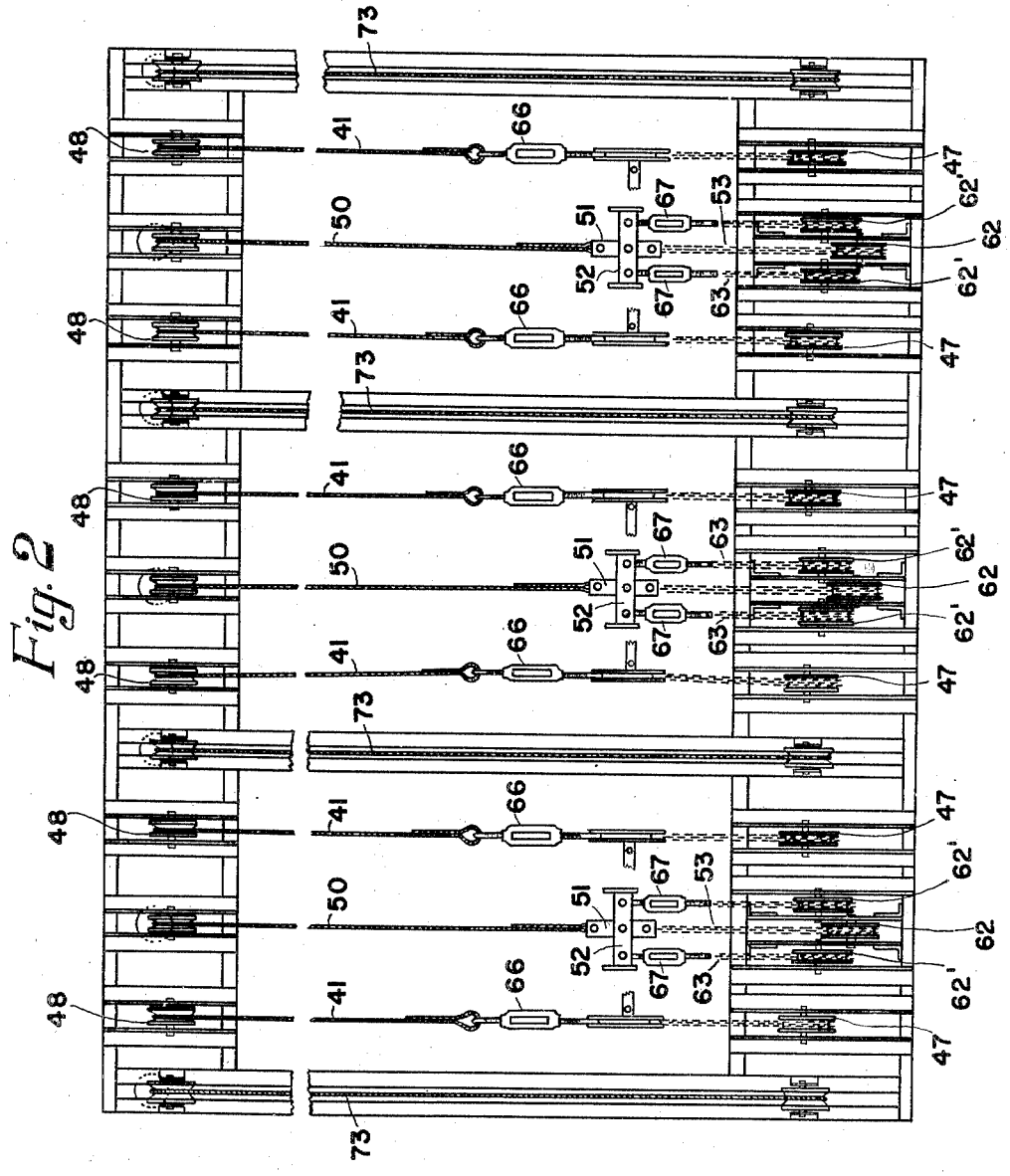
Fig. 1

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FURNACE DOOR OPERATING MECHANISM

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Fig. 2



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His ATTORNEYS

Jan. 17, 1950 L. S. LONGENECKER 2,494,713

FURNACE DOOR OPERATING MECHANISM

Filed April 2, 1946 6 Sheets-Sheet 3

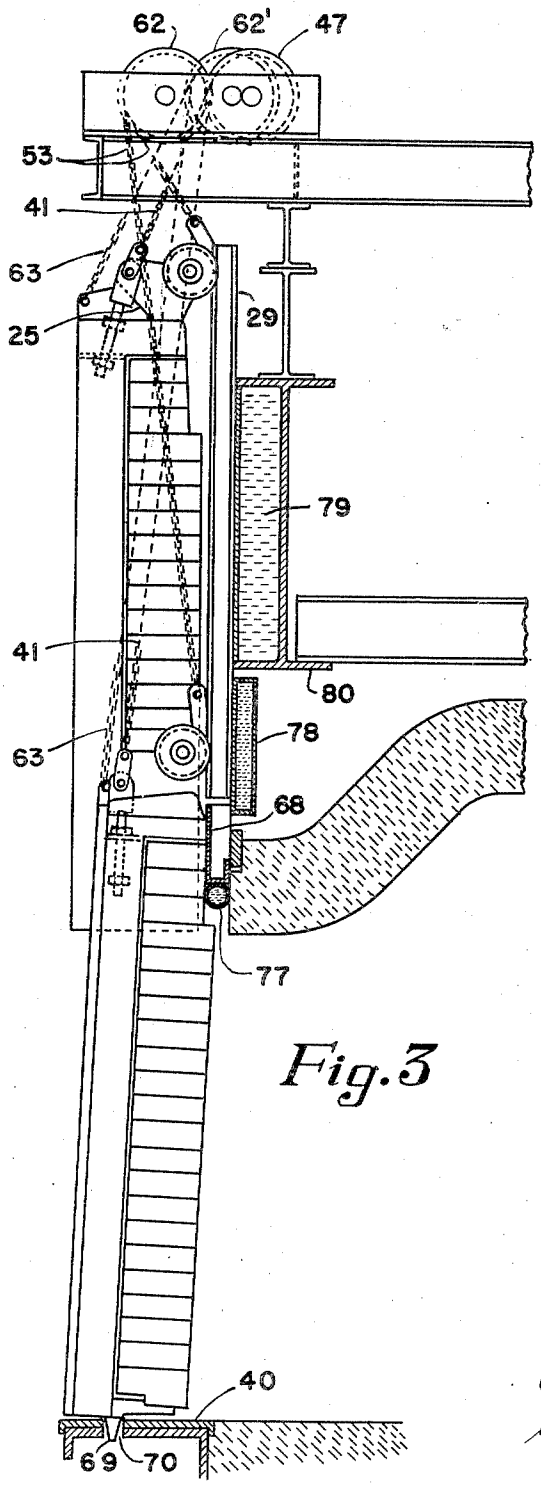


Fig. 3

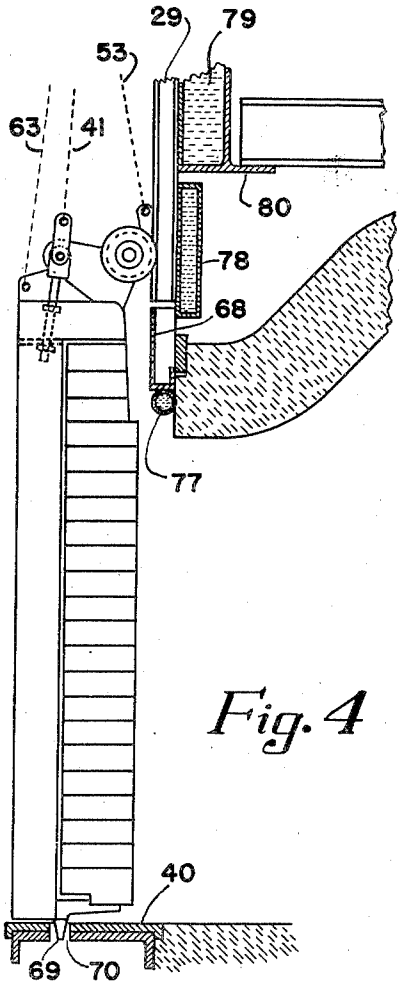


Fig. 4

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Jan. 17, 1950 L. S. LONGENECKER 2,494,713

FURNACE DOOR OPERATING MECHANISM

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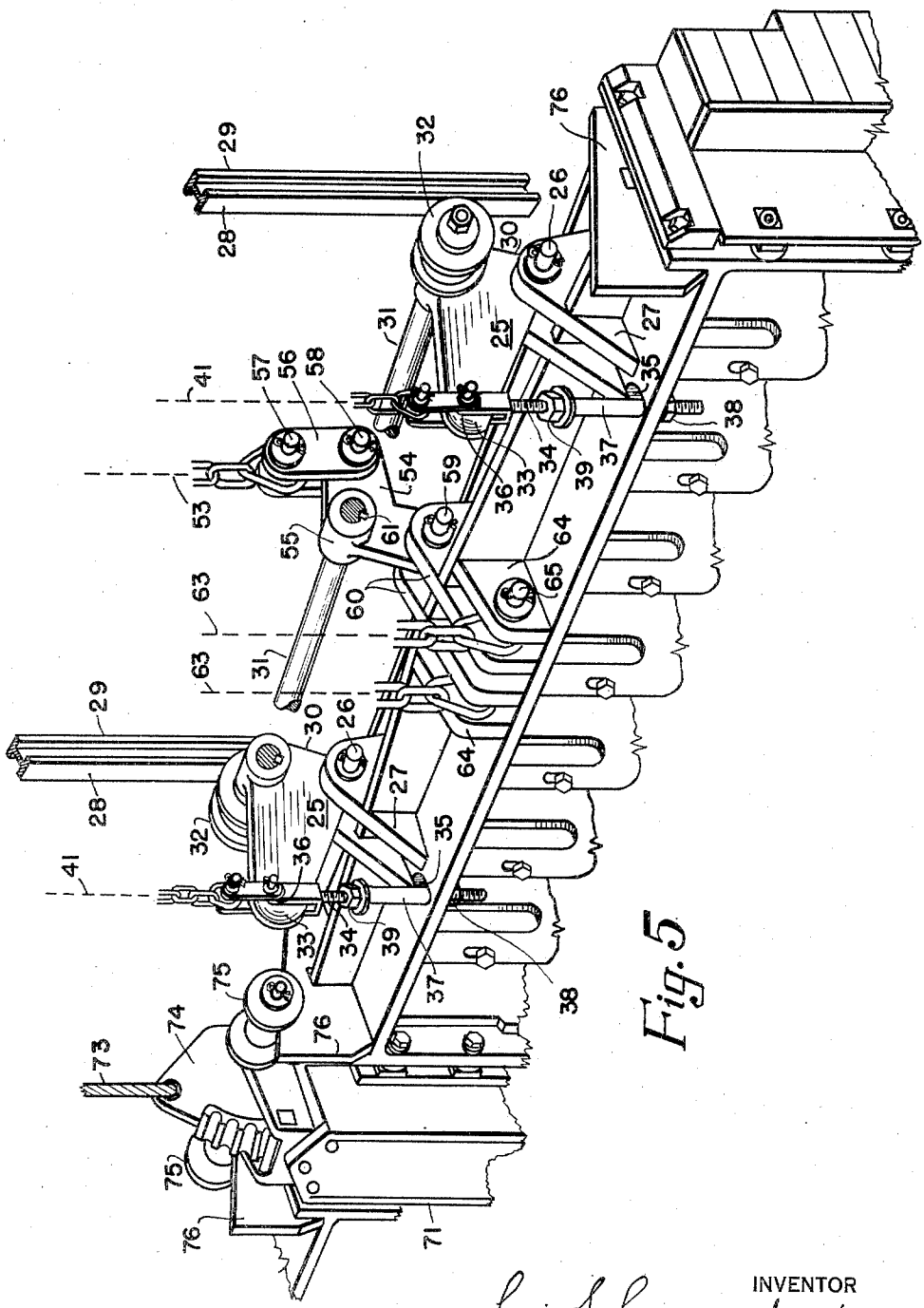


Fig. 5

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Jan. 17, 1950 L. S. LONGENECKER 2,494,713

FURNACE DOOR OPERATING MECHANISM

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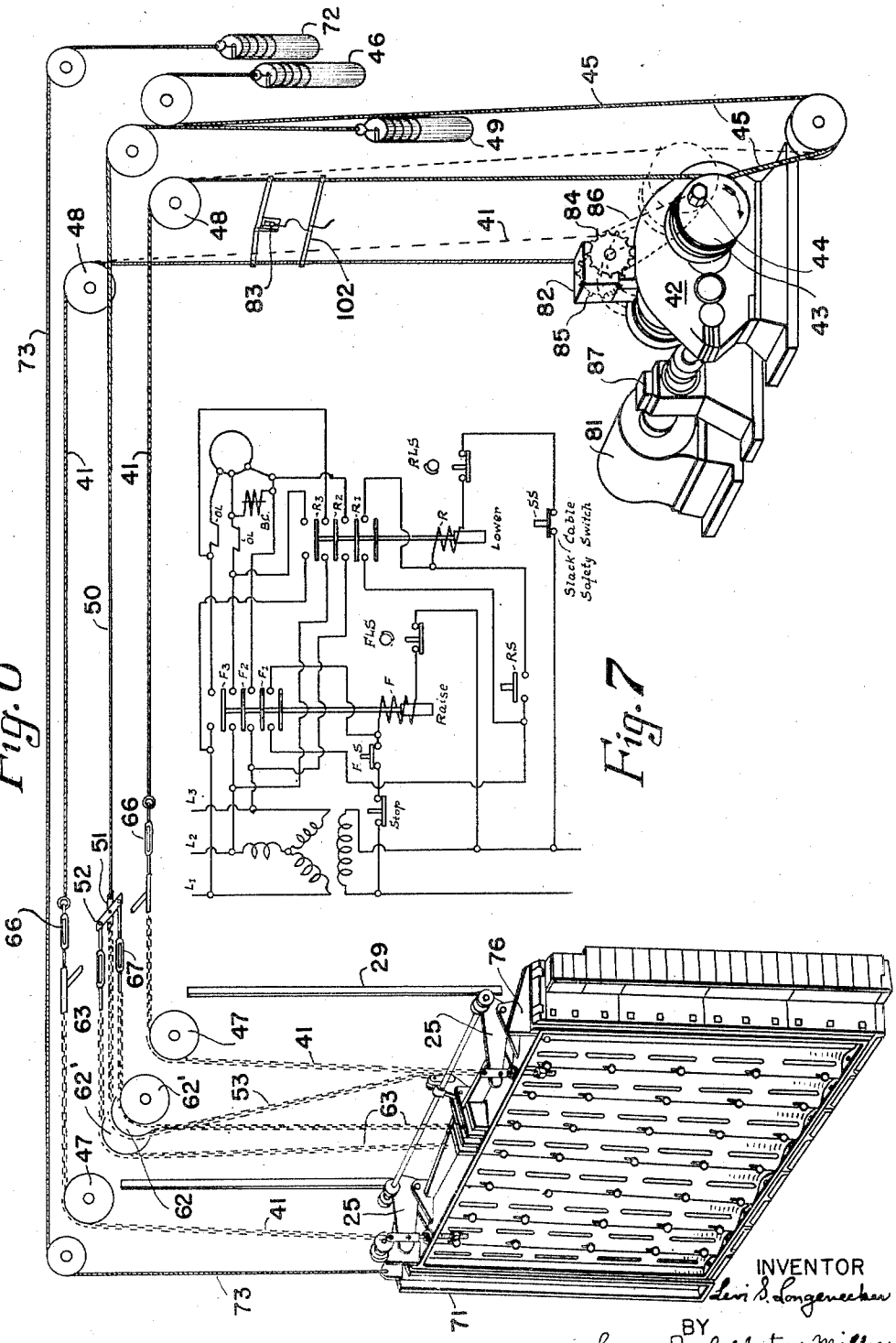


Fig. 6

Fig. 7

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FURNACE DOOR OPERATING MECHANISM

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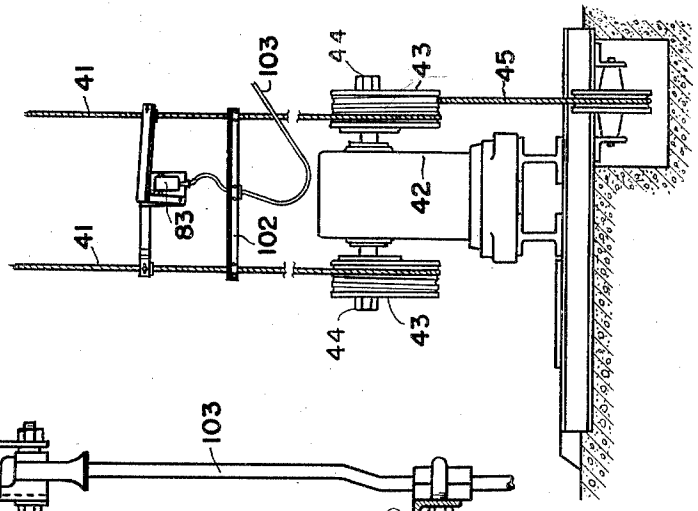


Fig. 11

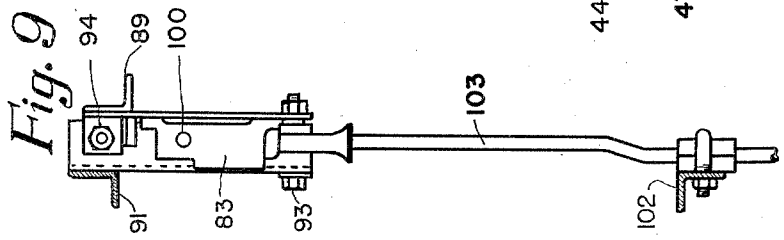


Fig. 9

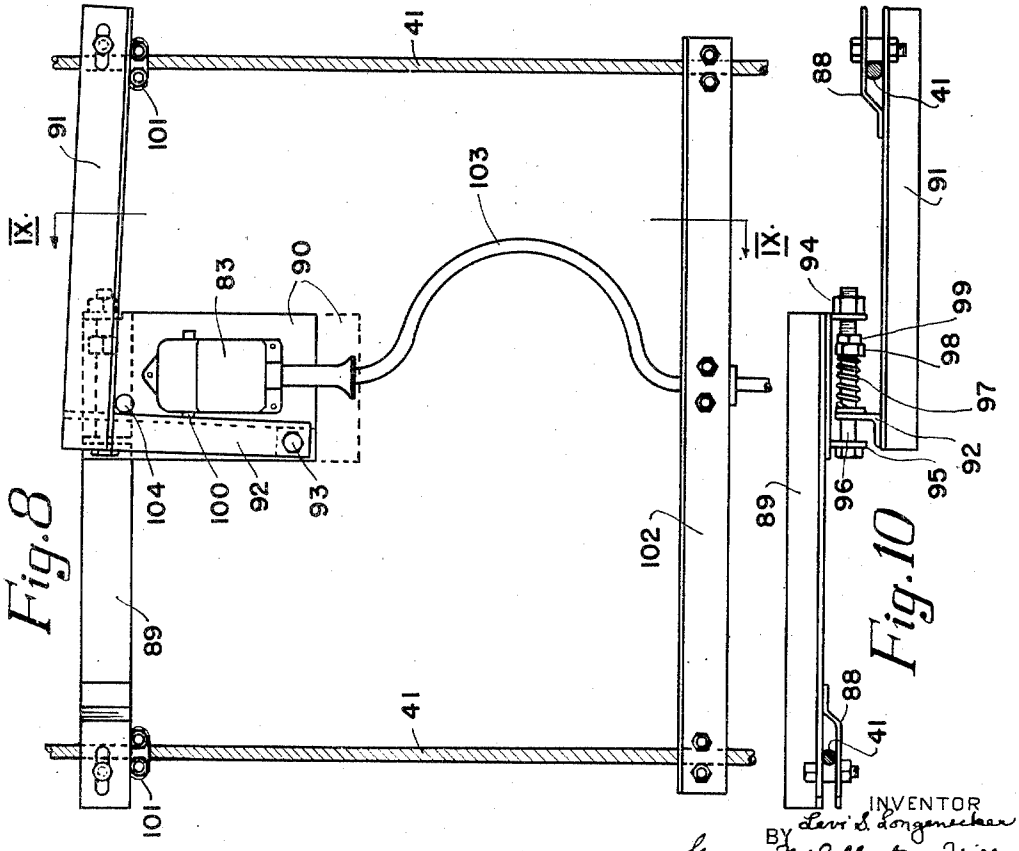


Fig. 8

Fig. 10

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Patented Jan. 17, 1950

2,494,713

UNITED STATES PATENT OFFICE

2,494,713

FURNACE DOOR OPERATING MECHANISM

Levi S. Longenecker, Mount Lebanon, Pa.

Application April 2, 1946, Serial No. 659,014

11 Claims. (Cl. 110—176)

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This invention relates to furnaces equipped with what are known as tilt-lift doors and more particularly to the mechanism for operating such doors. In United States Patent 2,045,662, issued to me on June 30, 1936, I disclose tilt-lift furnace doors and several forms of mechanisms for operating such doors.

In said patent, the tilt-lift doors are disclosed in connection with an all-door front wall furnace in which the furnace front or charging opening, which may extend throughout substantially the full length of the furnace is closed by a series of tilt-lift doors arranged in side by side, slightly spaced, relation, with each such space sealed by a counterweighted sealing member that is carried by one or another of the adjacent doors and by the end doors of the series.

In said patent, each door of the series is provided with its own operating mechanism and the construction of each door and its operating mechanism is such that when the door is in closed position, it is supported on the sill in inclined position and rests against the lintel above the charging opening, and before being raised, must be righted or tilted back to substantially vertical position in order to clear the lintel and have its furnace face spaced from the furnace. The doors of said patent are so constructed that when they reach the sill, on their downward travel, and the hoisting chains or cables are slackened, they will tilt into position so that they lean against the lintel.

Each door is provided with spaced wheels that engage and run on a track that extends vertically above the door opening.

One object of this invention is to produce improved mechanism for operating tilt-lift doors for open hearth, heating or other furnaces.

Another object is to produce improved mechanisms for operating the tilt-lift doors of a series of doors disposed in side by side relation and arranged to control the charging opening of a furnace such as an open hearth, heating or other furnace.

A further object is to produce improved hoisting mechanism for operating a vertically movable tilt lift door for open hearth heating or other metallurgical furnaces.

A further object is to produce mechanism for so raising and lowering a tilt-lift furnace door that said door is not only prevented from swinging laterally from its path of travel, but from swinging toward and from the furnace as well.

A still further object is to produce improved means or mechanism for so raising and lowering each door of a series of doors disposed in side by

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side relation for controlling a single furnace opening as to prevent each such door during its travel toward and from the door sill from swinging laterally toward the adjacent doors as well as toward and away from the furnace.

These and other objects, which will be apparent to those skilled in this particular art, I attain by means of the structures described in the specification and illustrated in the drawings accompanying and forming part of this application which is filed as a continuation in part of an application filed by me on May 15, 1942, and Serially Numbered 442,874, which application has now become abandoned.

In the drawings:

Figure 1 is a view in front elevation of a furnace equipped with three doors arranged side by side in slightly spaced relation, each equipped with a door operating mechanism of this invention, with sealing means closing the spaces between adjacent doors and between said doors and jambs.

Fig. 2 is a top plan view of the superstructure of the furnace of Fig. 1 and illustrates the hoisting lines of the door operating mechanisms and the sheaves for supporting such lines;

Fig. 3 is a fragmentary view partially in section and partially in elevation of the furnace of Fig. 1 and superstructure of Fig. 2, and illustrates two of the furnace doors, one in closed position and the other in raised or open position.

Fig. 4 is a fragmentary view partially in section and partially in elevation and illustrates one of the doors of the furnace of Fig. 1 supported on the sill and moved to substantially vertical position by the operating mechanism, just prior to being raised or just prior to being tilted into contact with the lintel;

Fig. 5 is a view in perspective illustrating the top of one of the doors and the pilot truck for such door. This view discloses the tracks upon which the door runs, the hoisting lines and one of the seals supported in position on the door;

Fig. 6 is a schematic perspective view illustrating one of the furnace doors of the series disclosed in Fig. 1 and the operating mechanism for such door. This view also shows the main or dead counterweight for counterbalancing a portion of the weight of the door, the door being shown as it appears when in closed position as it rests against the lintel;

Fig. 7 is a simplified schematic wiring diagram for the motor, brake, limit switch, slack cable switch and the manual controls for operating and controlling the operation of the door hoisting mechanism;

Fig. 8 is a more or less diagrammatic view of a slack cable safety switch which is secured to and carried by parallel runs of the hoisting cables for one of the doors;

Fig. 9 is a sectional view taken on line IX—IX of Fig. 8;

Fig. 10 is a fragmentary top plan view of the support for the slack cable safety switch; and

Fig. 11 is a more or less diagrammatic view of the device of Fig. 8 showing the winding drums for operating the cables.

In the furnace chosen for the purpose of disclosing this invention and its application to tilt-lift doors, I show a furnace employing a series of three such doors with the spaces between adjacent doors of the series and between the end doors and the door jambs, sealed by sealing members such as broadly disclosed in my said patent.

Each door of the series is equipped with a pilot truck forming part of this invention, and each pilot truck is operated by its own hoisting unit, and its own hoisting lines and is under the control of its own electrical circuit, and since these are identical for all doors of the series, it is believed that a description of but one will suffice.

It is to be understood that in the specification and claims where the term "hoisting line or lines" is employed, it is merely for the purpose of convenience and such terms are intended to include lines, chains and/or cables.

In connection with this invention, I preferably employ doors as disclosed in Patent 2,387,594, issued to me on October 23, 1945, and I show such doors in connection with Figs. 3, 4, 5 and 6 of the drawings.

The pilot trucks

Since the pilot truck for each door forms an important part of this invention, I will first consider one such truck.

The truck as disclosed in Fig. 5 includes two levers **25** equally spaced from the longitudinal center of the door top and pivotally connected to such top by means of pivot pins **26** which pass through spaced ears **27** formed as part of the door frame casting which includes the door top.

The common axis of pivot pins **26** is located on the furnace side of the longitudinal center line of the door top and parallels such line, so that levers **25** swing in parallel planes perpendicular to such center line and therefore perpendicular to the plane which includes the outer surfaces **28** of track rails **29** that extend vertically above the furnace charging opening controlled by the tilt-lift doors.

The short arms **30** of levers **25**, which extend from such common axis toward the furnace, are rigidly connected by a rod or bar **31** which passes through such short arms, is keyed thereto and extends beyond such arms toward the ends of the door top.

Track contact elements, in the form of flanged wheels **32** mounted for rotation on the extended ends of bar or rod **31**, are arranged to engage said track rails **29**.

The long arm **33** of each lever **25**, which extends from such common axis toward the off furnace side of the door top, has a lost motion connection with the door top for limiting the up and down swing of such lever. Each lost motion connection (there being one for each lever) comprises a threaded bolt-like member **34** which passes through an elongated opening **35** in the door top, has its upper end pivotally connected to long arm **33**, as at **36**, has its threaded central portion surrounded by a tubular sleeve **37**, has its upward movement limited by a nut **38** threaded to the bolt below the door top and below sleeve **37** and has its downward movement limited by a nut **39** threaded to the bolt above the door top and above sleeve **37**.

The furnace door is raised from and lowered to its sill by two hoisting lines **41—41**, operated by a hoisting unit **42** (Figs. 7 and 11).

The hoisting lines are connected to long arms **33** of levers **25** directly over the sliding bolts, before referred to as lost motion connections.

Hoisting unit **42** comprises two winding drums **43—43**, to which the hoisting lines are attached. These drums are eccentrically mounted on opposite ends of the low speed shaft **44** of a combined speed reduction and hoisting unit **42**.

By adjusting the hoisting lines so as to make them of equal length, the door can be operated, that is, raised and lowered in a level position. The flanged truck wheels by engaging the track, guide the door up and down in the same plane at all times and prevent the door from walking sidewise, in which case it would foul the adjacent doors or the adjacent end jamb as the case may be.

One of the winding drums **43**, as shown in Figs. 6 and 11, has attached thereto a counterweight line **45** carrying a counterweight **46**. This line **45** wraps around the drum adjacent its outer flange, while the hoisting lines **41** wrap around the drums adjacent their inner flanges. Counterweight line **45** leads off from its drum in the opposite direction from the hoisting lines. This means that the counterweight line is unwound from the drum as hoisting lines **41** are being reeled in and vice versa, so that counterweight **46** counterbalances part of the weight or load through the hoisting unit.

The eccentrically mounted hoisting drums are so arranged with relation to the travel of the door that when the door, in its downward travel, reaches the sill, the hoisting lines are tangent to the drum surface at the point where such surface is nearest shaft **44** upon which the drums are mounted. Because of this arrangement, the door, in closing, slows down so that it contacts the sill without any jolting or jarring. When the door reaches its open position, the hoisting lines are again tangent to the drums at the same point, that is, where the drum surface is nearest mounting shaft **44**. Complete travel of the drums is about 420°, since about 60° of over-travel is necessary to provide sufficient slack in the hoisting lines, so that the pilot truck can be operated by the main counterweight to tilt the door to closed position against the door lintel as will be later described.

Hoisting lines **41** pass over aligned sheaves **47** carried by the furnace superstructure above the door at the front of the furnace and substantially in line vertically above the hoisting line connections to levers **25**, as disclosed in Figs. 1, 3 and 6. These lines then extend horizontally above the top of the furnace superstructure and pass down over sheaves **48** at the back of the furnace superstructure and thence to hoisting unit **42**.

A counterweight **49** (Fig. 6) which I term the main counterweight, has its line **50** connected to one end of a bar **51**, (Figs. 2 and 6) and a spreader **52**, at its center is pivotally connected to this bar. A chain **53** having one end connected to the opposite end of bar **51**, has its opposite end connected to the pilot truck on the furnace side of the common axis of levers **25**. This connection

comprises a bell crank lever 54 having a hub 55 through which shaft 31 passes. This lever has one arm thereof connected to chain 53 by spaced links 56 and upper and lower pins 57 and 58. The other arm of this lever is connected by a pivot pin 59 to spaced ears 60—60 which form part of the door top casting and are located on opposite sides of the longitudinal center of the door top. Hub 55 of lever 54 is shown rigidly connected to shaft 31 by a key 61, although it need not be secured to shaft 31 but will function to swing levers 25 as lever 54 is swung, as long as it surrounds shaft 31.

Chain 53 passes over a sheave 62 carried by the furnace superstructure between sheaves 47—47 but located considerably forward of the plane of travel of the furnace face of the door as shown in Figs. 2 and 3, while chains 63—63 pass over sheaves 62'—62' which are located between sheaves 47—47 and but slightly forward of such sheaves and the plane of travel of the furnace face of the door.

Spreader 52 has two chains 63—63 attached thereto adjacent its ends (Figs. 2 and 6). These chains are secured to the door top on opposite sides of its longitudinal center and adjacent the off furnace side thereof. The means by which these chains are secured to the door top comprises two ears 64—64, ears 60 and a pin 65, which passes through ears 60 and 64.

Hoisting cables 41—41 and chains 63—63 are provided with turnbuckles numbered 66—66 and 67—67 respectively for adjusting the length of such cables and/or chains.

The three chains, 53 and 63—63, located adjacent the longitudinal center of the door top, and assembled beyond the overhead sheaves 62 and 62'—62', by means of spreader bar 52, which is connected to the main counterweight cable 50, not only stabilize the door but hold it against swinging toward and away from the furnace during raising and lowering. This arrangement also insures placement of the doors on a definite sill line so that all three doors and two end jambs will be in true alignment when the doors are being raised and lowered.

When a door reaches the sill, slack in its hoisting lines 41—41 is provided by the overrun of drums 43 of its hoisting unit. Slacking of counterweight chain 53 occurs simultaneously with the slacking of the hoisting lines because lever 54 is caused to swing as levers 25 swing. When slack occurs in counterweight chain 53, the counterweight through chains 63 pull the door tightly against door lintel 68 (Figs. 3 and 4) and hold it tight until the door is again righted by operation of levers 25 and track contact wheels 32 by the hoisting lines.

Sheaves 62' are offset toward the furnace from a vertical plane which includes the major axis of pin 65 when the door is in closed position resting against the furnace. This offset is sufficient to cause main counterweight 49 to exert a component of force on pin 65 which, when counterweight chain 52 is slackened, tilts the door to and holds it in closed position against the furnace.

The bottom of the door adjacent its ends is provided with downwardly extending pins 69 located on the door tilt line (Figs. 1, 3 and 4). These pins, when the doors are in true alignment with the end jambs, register with openings or holes 70 formed for their reception (when the door is in closed position) in door sill 40. The bottom of the door frame slopes upwardly from these pins toward its furnace side, and since the center of mass of the door is on the furnace side of these pins, the door (upon slacking of the hoisting lines) tends to move from near vertical position as shown in Fig. 4 to closed position as shown in the lower portion of Fig. 3, in which position the top of the door and the upper part of its refractory lining rests in contact with lintel 68.

Each door is counterweighted in an amount equal to about three fourths of the total weight of the door. This counterweighting is divided between main counterweight 49 and hoisting unit counterweight 46. This split system of counterweighting not only reduces the bulk size of each counterweight but better balances the operation of the door truck.

In a number of installations employing the invention of this application, each furnace door weighs approximately 8500 pounds and I have found that a main counterweight of 4500 pounds and a hoist counterweight of 2500 pounds are satisfactory and that with such counterweights, motor 81 can be relatively small, for example a 750 R. P. M. five horse power motor.

A clearance space of about two inches is maintained between adjacent doors and also between the end doors and the jambs, and these spaces are closed by means of refractory lined sealing members 71 such as broadly disclosed in my said patent. Each of these sealing members is counterbalanced by a counterweight 72 and the counterweight line 73 connects with a rockable member 74 pivoted to the top of the sealing member and comprising a pair of wheels 75 which ride on inclined supports 76 secured to the end members of the door top as disclosed in Fig. 5. The sealing member counterweights are sufficient to prevent the sealing members from falling to the floor in case one becomes disengaged from its supporting door during operation of such door.

The three upper courses of the refractory blocks of the door lining, as shown in Figs. 3, 4 and 6, are thinner than the blocks forming the major part of such lining, so that when the door is in closed position, such thinner upper courses bear against lintel 68, while the thicker courses extend inwardly under the lintel.

The lower end of lintel 68 is provided with a water cooling tube 77. An intermediate water cooler 78 and a water chamber 79 formed on the overhead support girder 80 both serve as shields to protect the adjacent steel superstructure from the white hot door lining when the doors are raised to open position.

The combination speed reduction and hoisting unit 42 is driven by an electric motor 81 under the automatic control (so far as stopping when the door reaches the upper and lower limits of its travel is concerned) of a limit switch 82 and under the manual control of manually operated switches or control buttons, by which the motor is started, when it is desired to open and close the door operated thereby, and for stopping the motor when it is necessary or desirable.

A slack cable safety switch 83 (Figs. 6, 7, 8, 9, and 11) located in the door lowering circuit, is arranged to de-energize the motor, if the door, while being lowered, is prevented from reaching the sill.

A limit switch which has been found suitable is Cutler Hammer rotating cam limit switch 14975 B-1-2 circuits. This is driven from the low speed shaft of the combination reduction gear and hoisting unit 42 by a chain and sprocket de-

vice, which includes sprockets 84 and 85, and a chain 86.

A spring applied brake 87 is utilized to stop the motor and therefore the winding drums, and such brake is so constructed and arranged that it is released as the motor is started in either direction, and is applied as the motor is stopped by the limit switch, the slack cable safety switch, or when it is stopped by manual operation of the stop switch or control button. A brake that has been found satisfactory for the purpose is a Cutler Hammer brake S–7 as described in Cutler Hammer Bulletin 511. This brake is applied by a spring and released by a solenoid designated B. C. in the schematic wiring diagram (Fig. 7). In this diagram, FLS and RLS respectively designate the forward and reverse portions of the limit switch 82, and these portions of said switch are mounted on the same shaft. The switch or control button for starting the motor in forward direction is marked FS while that for starting the motor in reverse direction is marked RS. The slack cable safety switch is marked SS and the switch or control button for stopping the motor independently of the limit switch is marked "Stop."

Slack cable safety switch

Not infrequently a furnace door, while on its downward travel, is prevented from reaching the sill because of an obstruction in its path such as a charging peel or slab. While the stop switch or button is provided for stopping motor 81, the operator is generally too busy or else is not quick enough to operate the switch or button in time to avoid trouble. I have found that if the motor is not stopped, the hoisting lines unwind from their drums and loop on the floor in such a way that when the motor is reversed, for the purpose of raising the door, such lines will often miss the drums and become badly tangled. This of course is serious since it has a tendency to throw the limit switch out of step with the hoisting mechanism. It is also serious, since if only one line misses the drum, the door is pulled askew and becomes jammed between the adjacent doors. It is also a difficult job to straighten out the tangled lines.

In order to stop the motor the instant the door is stopped in its downward travel by any obstruction, I make use of the slack cable safety switch 83 and carry this switch by substantially vertical parallel runs of the hoisting lines. I arrange the mounting means for the switch so that any slack in either or both such lines will open the switch, thus stopping the motor and applying the brake. This switch is connected into the "down" or door lowering control circuit, allowing the door to be relifted if and when the switch is open. I find that a normally open stop switch such as Allen Bradley type L–400–L serves the purpose admirably. The special mounting causes the switch to open the instant the lines become slack. When the lines are again tightened, the switch is forced to closed position and is therefore only open when the lines are slack.

Attached to one of lines 41 by means of a clamping device 88 is an angle support arm 89 which carries a plate-like panel 90 to which switch 83 is secured. A similar angle support 91 clamped to the other lines 41, has rigidly attached thereto a depending angle arm 92 which is pivotally connected to panel 90 by a pivot bolt 93.

Support member 89 has secured thereto a bracket member having spaced ears 94 and 95 located on opposite sides of angle 92 and provided with aligned openings for receiving a bolt 96. Angle 92 is provided with an opening through which bolt 96 passes freely. A helical spring 97 surrounding bolt 96, at one end bears against angle 92 and at the opposite end against an adjustment nut 98 which is threaded to said bolt (Fig. 10).

Adjustment nut 98, while lines 41 are taut, is adjusted and locked in position by a lock nut 99 until spring 97 is compressed as shown in Fig. 10. When lines 41 are taut, depending angle 92, which as before said, is rigidly attached to support 91, bears against button 100 of switch 83 thereby holding such switch in closed position as shown in the wiring diagram of Fig. 7.

As soon as slack occurs in either or both of lines 41, spring 97 increases the overlapping of supports 89 and 91 thereby moving depending angle 92 out of contact with button 100 of the switch and permits the switch to move to open position so that the down control circuit is broken, motor 81 instantly deenergized and brake 87 applied, thus stopping the winding drums 43—43.

In order to make sure that angles 89 and 91 do not slip on lines 41, supports 101 are bolted to said lines immediately below said angles, in fact said angles are clamped in position above and in contact with said supports.

To prevent the weight of the switch and its supporting structure from affecting winding of lines 41 on drums 43, I provide a spacer bar 102 which is securely clamped to both lines 41 and holds the same in proper spaced relation. This spacer bar is located well above the winding drums with the door at the upper limit of its travel, and this causes any slack that occurs in the lines to occur between it (the spacer bar) and sheaves 48 carried by the superstructure at the rear of the furnace (Figs. 2 and 6).

The wires to switch 83 are enclosed in a cable 103 which, as shown in Figs. 8 and 11, is looped and secured to spacer bar 102.

When slack occurs in lines 41, switch mounting panel 90 moves down to the dotted line position of Fig. 8 and movement of angle 92 toward the switch is limited by a stop pin 104 carried by angle 29.

The controls

The control panel employed (not shown) preferably includes all the controls for all the doors of the series (in this case 3) so that they can be operated one at a time, two at a time or all together, depending upon the size of the article or material to be charged into or removed from the furnace.

If we assume the doors are closed, in which position they rest against the lintel, then the operating mechanism for each door will be in the condition of that shown in connection with the door of Fig. 6. In this figure, the winding drums, in closing the door, have moved in the direction of the arrow about 420° or enough more than one complete revolution to slacken the hoisting lines sufficiently to permit the door to tilt to closed position due to the position of its center of mass, its inclined bottom and the load of counterweight 49 exerted through chains 63 to the off furnace side of the door top.

The current to motor 81 has been cut off by limit switch 82, and brake 87 has been applied so that not only was the motor stopped, but the hoisting unit counterweight 46 which was raised slightly by the overrunning of the winding drum, was locked in this slightly raised position.

Tilting of the door to closed position, the position shown in the lower part of Fig. 3 and in Fig. 7 caused the long arms of levers **25** of the pilot truck to swing down toward the top of the door and track wheels **32** to swing up and forward in an amount necessary to permit the door to bear tightly against the lintel.

In order to right and then open the door, the switch or control button for such door, marked FS, is closed. This energizes coil F which closes switches F_3, F_2 and F_1 and causes the motor to drive the winding drums in the opposite direction to that indicated by the arrow. Rotation of the winding drums in this direction first tightens the hoisting lines, thus raising the long arms of levers **25** until the lost motion connection between such levers and the door top is taken up and as these long arms swing up, track engaging wheels **32**, by means of the short arms **30**, are swung down toward the furnace, and being in contact with track rails **29**, pry the top of the door out until the same, supported on the sill, is in near vertical position—the position shown in Fig. 4.

Movement of the hoisting lines occasioned by the winding drums during this door righting operation is relatively slow. As the winding drums proceed on their opening movement, the speed of the hoisting lines increases until full speed is reached. Shortly before the door reaches the upper limit of its travel, this speed slows down.

When the door reaches the upper limit of its travel, the forward movement portion of limit switch **82**, corresponding to the portion marked FLS in Fig. 7 cuts off current to the motor and brake **87**. The brake is applied by its spring as soon as the current is cut off. The motor and winding drums are thus stopped and the door is held in raised or open position until the door closing switch or control button, marked RS is closed.

When it is desired to close the door, switch or control button RS is closed. This places the hoisting mechanism under the control of the closing movement portion of limit switch **82** (that portion marked RLS in Fig. 7).

It will be apparent that, by means of the switch or control button marked "Stop," the hoisting mechanism may be stopped at any position during opening or closing movement of the door and that after being stopped, the hoisting mechanism may be started in either direction and placed under the control of limit switch **82** by closing either of the switches or control buttons FS or RS, depending upon the direction of door travel desired.

When the slack cable safety switch stops the door in its downward travel, the up-circuit is still operative and the door can be raised for removal of the obstruction. The hoisting lines will be held in proper mesh on the drums, since they cannot unreel without some door load to close the switch. This safety feature is also an insurance against the door dropping from any appreciable height against the slack lines, should the obstruction which caused the door to stop be removed without reversing the hoisting mechanism.

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

1. In a furnace having a charging opening, a track extending vertically above such opening, a door controlling such opening and which when closed rests against the furnace in inclined position, spaced lever devices connected to the door top for swinging movement about a common axis that parallels the longitudinal center line of the door top, each such lever device including an arm which extends away from such axis toward the off furnace side of the door and a track contact element located on the furnace side of such axis, means limiting the upswing of such arms, an agent located on the furnace side of such axis rigidly connecting such lever devices, hoisting lines secured to such lever devices, means for operating such lines to raise and lower the door, a counterweight for counterbalancing a substantial part of the weight of the door, flexible means connecting such counterweight to the door top adjacent its off furnace side and to such agent adjacent the furnace side of the door top, and sheave means mounted above the furnace for supporting such flexible means and being offset toward the furnace from the vertical plane which, when the door is resting against the furnace in closed position, includes the point at which the counterweight makes connection with the off furnace side of the door top; the construction and arrangement being such that when the door reaches down position and the hoisting lines are slackened, the counterweight exerts a component of force on the door top that tilts the door to and holds it in closed position against the furnace.

2. A structure as defined in claim 1, in which the agent rigidly connecting said lever devices comprises a shaft that extends through and beyond said lever devices and on the extended ends of which said track contact elements are mounted.

3. A structure as defined in claim 1 in which that portion of the weight of the door which is not counterbalanced by the counterweight is supported during the raising of the door by the two hoisting lines which are secured to the arms of the lever devices adjacent their free ends on the off furnace side of the common axis.

4. A structure as defined in claim 1, in which the means limiting the upswing of the lever arms which extend toward the off furnace side of the door, comprises two bolt-like members, one connected to each such arm adjacent its off furnace end and which extends down through an opening in the door top and has its movements limited by adjustable stops which are secured to such bolt-like members above and below such door top.

5. A structure as defined in claim 1, in which the operative connection between said counterweight and the door top on the off furnace side of said common axis comprises two lines equally spaced from the longitudinal center of the door top, the operative connection between said counterweight and said agent comprises one line, a spreader above the furnace to which such three lines are connected, a single line extending from such spreader to said counterweight, and three sheaves above the furnace and between such spreader and the door and over which such three lines pass, whereby swinging of the door toward and from the furnace is minimized.

6. A structure as defined in claim 1, in which the counterweight has operative connection with said agent at the longitudinal center of the door top.

7. A structure as defined in claim 1, in which said agent adjacent its longitudinal center passes through a bell crank lever having one end pivotally connected to the door top in alignment with the axes of such lever devices and to the other end of which the counterweight is operatively connected, whereby the point of application of the counterweight to said agent shifts

with relation to said common axis as said lever devices swing about such axis.

8. A structure as defined in claim 1, in which the operative connection between said counterweight and the door top on the off furnace side of said common axis comprises two lines equally spaced from the longitudinal center of the door top, the operative connection between said counterweight and said agent consists of one line, a spreader above the furnace to which such three lines are connected, a single line extending from such spreader to said counterweight, and three sheaves above the furnace and between such spreader and the door and over which such three lines pass, whereby swinging of the door toward and from the furnace is minimized; the sheaves over which the lines pass from the door top on the off furnace side of said common axis being axially aligned and the sheave over which the line from said agent passes being further removed from said spreader than the other two sheaves.

9. A structure as defined in claim 1, in which but two hoisting lines are employed and such lines are connected to the arms of the lever devices adjacent the connections of such arms to the means for limiting their upswing.

10. A structure as defined in claim 1 in which

the track engaging elements are mounted on said agent adjacent its ends and take the form of wheels.

11. A structure as defined in claim 1 in which each of said lever devices comprises a lever having a short arm extending from said common axis toward the furnace side of the door top and a long arm extending from such axis toward the off furnace side of the door top; in which said agent extends through the short arms of such lever devices and the track engaging elements take the form of wheels mounted on such agent adjacent such short arms.

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