

July 8, 1941.

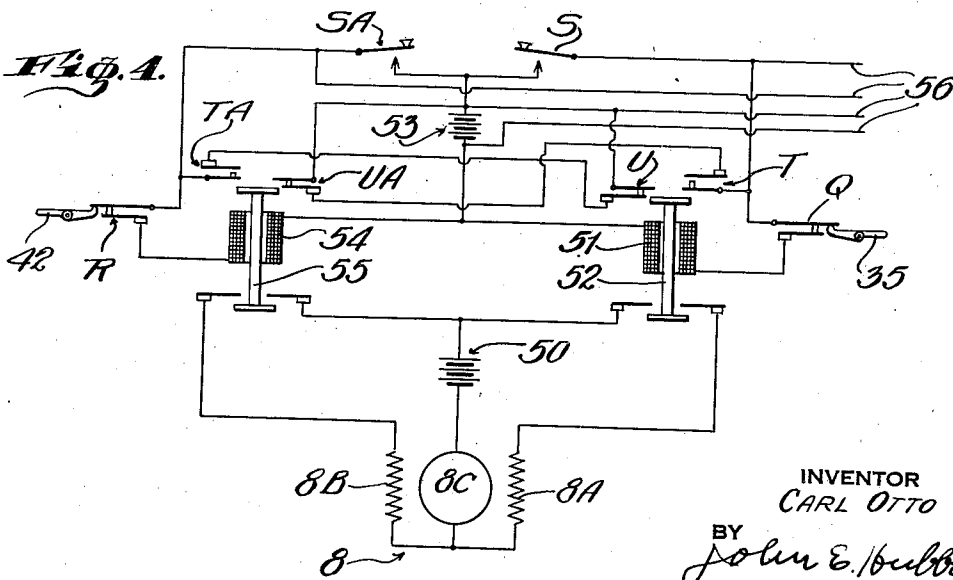
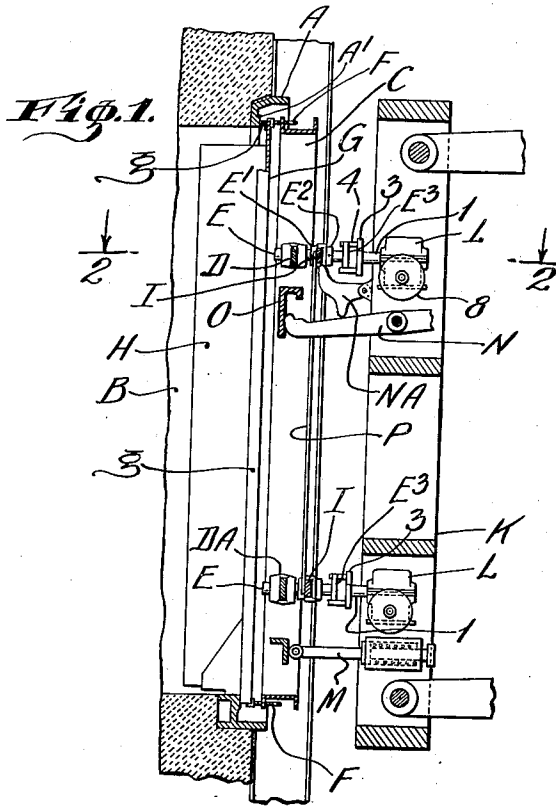
C. OTTO

2,248,187

ACTUATING MECHANISM FOR COKE OVEN DOOR LOCKING SCREWS

Filed July 16, 1938

3 Sheets-Sheet 1



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July 8, 1941.

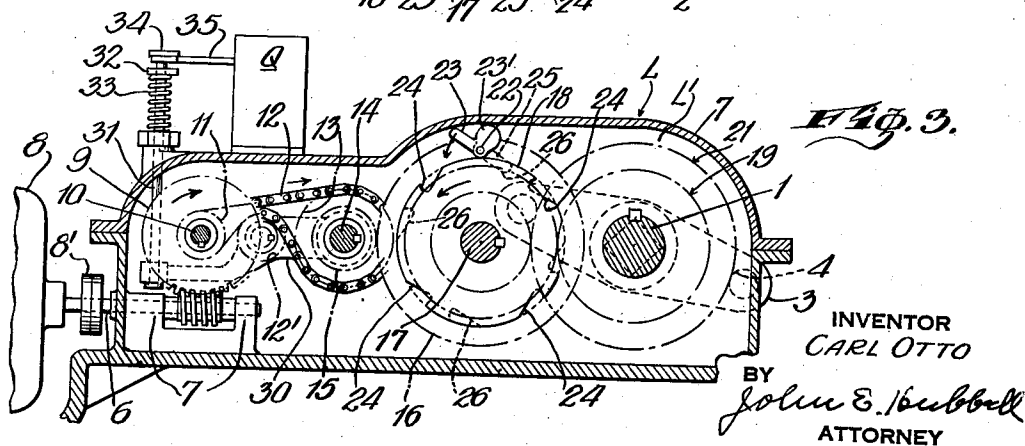
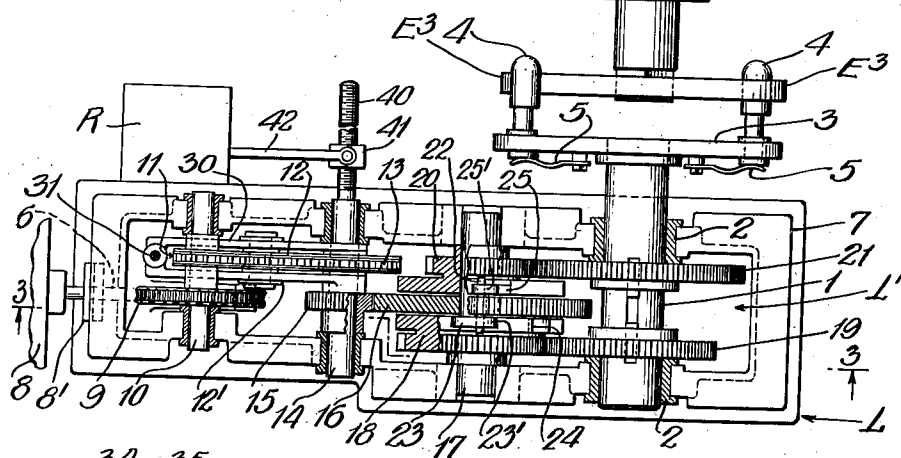
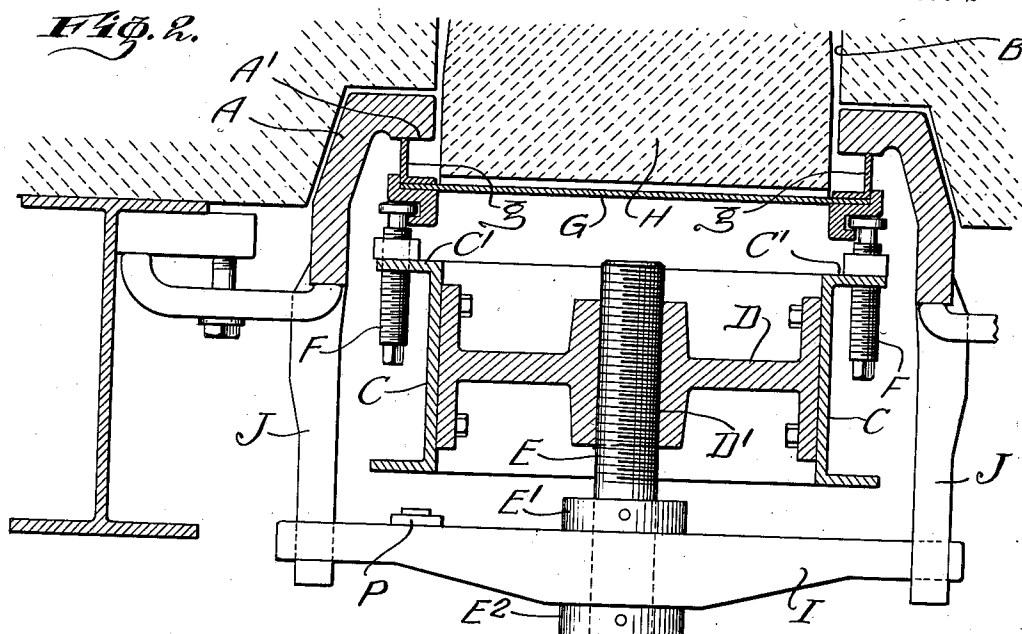
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ACTUATING MECHANISM FOR COKE OVEN DOOR LOCKING SCREWS

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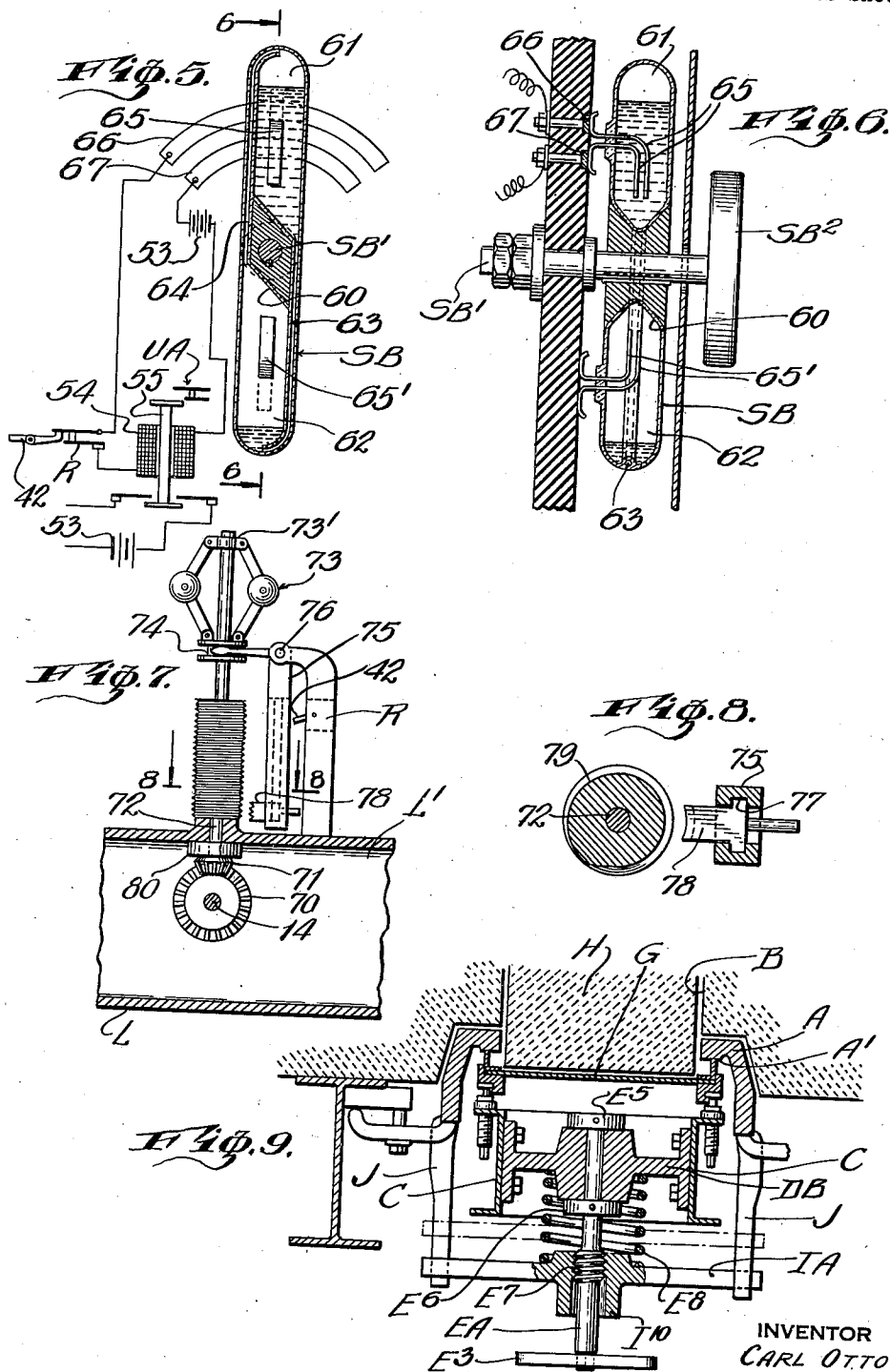
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ACTUATING MECHANISM FOR COKE OVEN DOOR LOCKING SCREWS

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3 Sheets-Sheet 3



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ACTUATING MECHANISM FOR COKE OVEN
DOOR LOCKING SCREWS

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Application July 16, 1938, Serial No. 219,534

2 Claims. (Cl. 202—248)

The general object of the present invention is to provide improved means for automatically rotating the screws by which coke oven doors are clamped in their oven closing positions. While not limited to such use, the invention is especially adapted for use in connection with a coke oven door of the large modern self-sealing type, in which a gas tight joint between the door and a door frame is established by pressing the edge of a flexible metallic flange member against a metallic door frame sealing surface.

Such a self-sealing coke oven door is customarily secured in its closed position by means of upper and lower locking bars, each connected to a rigid portion of the door by a supporting spindle passing through the locking bar and in threaded engagement either with the locking bar, or with the door structure, so that the locking bar may be moved away from the rigid portion of the door in the door locking operation, by rotating the spindle in one direction, and by a reverse rotation, may be moved toward the rigid door portion in the door unlocking operation. In the closed and locked position of the door, each end of each locking bar engages and presses outwardly against a retaining device which ordinarily is a hook extension from the door frame.

To resist the outward thrust against the door, of the charge in a large coking chamber, and to resist the occasional excess of gas pressure in the coking chamber over the atmospherical pressure, and to bend the sealing member as required to bring the sealing edge into contact with the door frame sealing surface, notwithstanding door and door frame deformations occurring in use, and to cut through pitch or other material depositing on the sealing surface or sealing edge, and to cut through coke or coal particles, which may be caught between the sealing edge and the sealing surface, requires a locking force acting between the rigid portion of the door and each locking bar, which amounts to thousands of pounds, and in some cases, may well be ten or twelve tons. The rotation of one element of a threaded connection transmitting a force of any such magnitude can only be effected manually through long, powerful, and consequently heavy, wrenches, and is especially difficult because the upper locking bar may be a dozen feet or more above the bench at the side of the battery on which the door handling attendant ordinarily must stand.

While the idea of a power actuating mechanism for rotating the locking bar spindles to lock and unlock self-sealing coke oven doors is not novel, having been disclosed by me in German Patent

No. 541,251, dated June 5, 1931, it is still the usual practice to lock and unlock such doors by manual rotation of a threaded locking bar spindle. The present invention was devised with the primary idea of improving the mechanism of said prior patent, and providing such mechanism with certain safety provisions not disclosed in said prior patent.

One specific object of the present invention is to provide a power actuated mechanism, adapted to subject the locking bar spindle to a turning torque in the unlocking direction, which is higher than that required, or provided, for the rotation of the spindle in the door locking operation, so as to thereby eliminate risk of unduly prolonged delay in removing a coke charge from an oven, as the result of insufficient power in the mechanism to unlock the door, when a considerable increase in the frictional resistance to the unlocking movement of the spindle develops, as it may occasionally, during a coking operation.

Another specific object of the invention is to include in the spindle rotating mechanism, provisions which are automatically effective to prevent an unnecessarily prolonged operation of the mechanism in the door unlocking direction from having injurious consequences. The means devised by me for the attainment of the last mentioned object comprises various forms. In one form of said means, the unlocking operation is terminated after and as a direct result of a predetermined extent of such operation. In another form, the unlocking operation is automatically terminated at the end of a predetermined time period following the initiation of the operation. In a third form, the nut and screw parts of the threaded connection through which the rotation of the locking bar spindle locks and unlocks the door, are moved out of threaded engagement with one another by an unlocking operation in excess of a predetermined amount, and are adapted to operatively reengage as soon as the mechanism is operated in the door locking direction.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawings:

Fig. 1 is a fragmentary elevation, with parts broken away and in section, of a door spindle rotating mechanism in operative relation with a coke oven door in its closed position;

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a motor energizing and control circuit diagram;

Fig. 5 is a sectional elevation illustrating a modification;

Fig. 6 is a section on the line 6—6 of Fig. 5;

Fig. 7 is a sectional elevation illustrating another modification;

Fig. 8 is a section on the line 8—8 of Fig. 7;

Fig. 9 is a view, partly in section, illustrating a third modification.

In Figs. 1 and 2, I have illustrated a preferred embodiment of my improved door spindle rotating mechanism, positioned for operating engagement with the two threaded spindles, each supporting a locking bar, of a self-sealing coke oven door of a well known and extensively used type, mounted in the doorway of a coke oven structure of conventional type. That structure, as shown, comprises a heavy cast metal door frame A, which extends into, and forms a lining for the mouth or end of a coking chamber B. The door frame A is formed with a sealing surface A', which is transverse to the axis of the oven chamber, faces outwardly, and extends all the way around the doorway.

The coke oven door shown in Figs. 1 and 2, includes a rigid outer metallic section C, shown as comprising two oppositely facing channel bars rigidly connected by cross bar parts. Two of those parts, D and DA located at upper and lower levels and similar to one another serve as locking bar spindle supports. Each of the parts D and DA has a central hub portion formed with a threaded passageway D', extending in the axial direction of the door midway between the side edges of the latter and into which the corresponding locking bar spindle E is threaded. So-called clamping screws F, are threaded through the inner flange portions C', of the outer door section C into engagement with, and are adapted to adjust the adjacent portions of the flexible sealing section G of the door toward and away from the other section C, as required for the establishment of gas tight seal between the member G and the sealing surface A'. The sealing member G is shown as comprising a flexible metallic body plate extending across the doorway, in the closed position of the door, and a rim portion g extending inwardly away from said plate at the margin of the latter, with the inner edge of the portion g directly engaging the sealing surface A' of the door frame, in the closed position of the door. The rim portion g is shown as formed by one flange of a bar of an angle bar section, having its other flange alongside, and bolted, or riveted, to the flexible body plate portion of the sealing member. The door comprises an inner refractory plug section H, and the door sections C, G and H may be mechanically connected in any usual or suitable manner.

Each of the two threaded spindles or supporting bolts E of the door has a corresponding locking bar I journaled on its outer end portion. In the normal closed condition of the door, each bar is horizontally disposed, and is in engagement with door retaining hook members J, bolted or otherwise secured to the door frame member A. As shown, one of the two hooks J adapted

for engagement by a single locking bar I, faces upwardly and the other faces downwardly, so that the locking bar may be turned about its supporting spindle into and out of engagement with the corresponding hooks J.

As shown in Figs. 1 and 2, each spindle E is provided with a thrust collar E' which engages a bearing surface provided at the inner side of the corresponding locking bar I, so that when the spindle E is rotated in the direction to move the hub D' and collar E apart and the locking bar I is in engagement with the hooks J, the spindle will be held against bodily movement in the direction of its length, and the adjacent portion of the door will be moved toward the coke oven structure forcing the adjacent portion of the sealing edge g against the sealing surface A'. As shown, the spindle E is provided with a collar E² at the outer side of the corresponding locking bar provided to prevent accidental displacement of the locking bar, when the latter is not held in operative relation with the door by the sealing pressure.

As those skilled in the art will understand, the coke oven door structure illustrated, is commercially used, and is illustrated herein as one example of the numerous self-sealing door types and forms with which the present invention may be used with advantage.

For its rotation with the form of mechanism illustrated herein, each locking bar spindle E is provided at its outer end with suitable, oppositely disposed, transversely extending lever arms E³, shown as formed by the opposite end portions of a bar having a central socket which receives the outer end of the spindle E, and in which the latter is secured against rotation relative to the bar, as by making the end of the shaft and the socket square in cross-section.

In the form of embodiment of the invention illustrated in Figs. 1, 2 and 3, a vertically disposed, beam-like, door machine part K, supports similar upper and lower spindle rotating mechanisms L, so relatively positioned that they may be brought into simultaneous operation relative with the upper and lower locking bar spindles E of a coke oven door like that shown in Fig. 1. The door machine part K may also serve as the door lifting and supporting element of the door machine. To that end, the part K is provided with door engaging parts, which may be of customary form, and are shown as comprising a lower spring pressed abutment or door positioning member M, and an upper door lifting hook member N adapted to engage the usual bracket-like part O provided on the door for the purpose, when the part N is given a clockwise door lifting movement. As shown, when the member N turns into lifting engagement with the door part O, it actuates a lever NA to tilt the upper locking bar I about its supporting spindle E and thereby moves the ends of the bar out of engagement with the hooks J. The tilting movement thus given the upper bar I is transmitted to the lower bar I, in the usual manner, by means of a link P connecting the two bars, said means also gives the bars a gravitational bias for turning movement back into engagement with the retaining hooks J, when, in the final portion of the door replacing operation, the member N is lowered to transfer the weight of the door from the door machine to the door frame. The door machine member K may be supported and given the vertical and horizontal movements required for the engagement and disengagement of the parts N

and O, and to raise, lower and transport the door, in any usual or suitable manner, which need not be illustrated or described herein.

As shown, each mechanism L comprises a housing or casing structure formed with a chamber L' enclosing speed reducing gears, through which the main operating shaft 1 of the mechanism is driven. The shaft 1 is journaled in bearings 2 mounted in the front and rear walls of the chamber L', and at its front end carries spindle operating means adapted for engagement with the operating arms E³ of a locking bar spindle. As shown, the engaging means carried by the shaft 1 comprises a lever 3 rigidly secured to the front end of the shaft 1 and provided, adjacent its ends, with pins 4, parallel to the shaft 1, so that one may engage one edge of one, while the other engages the other edge of the other arm E³. As shown, each pin 4 is axially movable in the lever 3, and is normally held in an advanced position by a corresponding spring 5. If, when the mechanism L is advanced, the relative angular positions of the pins 4 and arms E³ are such that the pins 4 engage the outer sides of the arms E³, the advancing movement of the pins is temporarily arrested, but on subsequent angular movement of the lever 3, moving the pins 4 laterally of the arms E³, the pins are advanced by the springs 5 into position to engage the edges of the arms E³. The pins 4 are advantageously long enough, and spaced widely enough apart, to operatively couple the locking bar spindle and shaft 1, even though said spindle and shaft are appreciably out of axial alignment with one another, notwithstanding an appreciable variation in the horizontal displacement of the lever 3 from the lever arms E³. The mechanisms L may thus be used on door machines of the type in which the part K is adjusted to different vertical positions in the door locking and unlocking operations.

As shown, the mechanism L includes a worm supporting drive shaft 6 which extends through an end wall of the chamber L', and is journaled in bearings 7 at the opposite ends of the worm. The shaft 6 is connected by a coupling 8' to the shaft of an electric driving motor 8 mounted on the member K, and engages and rotates a worm gear 9 secured to a shaft 10. The latter is journaled in the front and rear walls of the chamber L', and has a sprocket wheel 11 secured to it. The wheel 11 is connected by a sprocket chain 12 to, and drives a sprocket wheel 13 secured to a shaft 14 also journaled in bearings mounted in the front and rear walls of the chamber L'. The chain 12 also runs over a sprocket wheel 12', forming a part of a safety mechanism hereinafter described. A spur gear 15 secured to the shaft 14, is in mesh with a larger spur gear 16 secured to a shaft 17, also having its ends journaled in bearing supported by the front and rear walls of the chamber L'. A rotatable element 18 journaled on the shaft 17 at the rear side of the gear 16, comprises a spur gear portion in mesh with a spur gear 19 carried by and secured to the shaft 1. A second rotatable element 20 is journaled on the shaft 17 at the front side of the gear 16, and comprises a spur gear portion in mesh with a spur gear 21 rigidly secured to the shaft 1 alongside the gear 19.

The members 18 and 20 may be connected alternately, but never simultaneously, to the spur gear 16, so as to have the same angular movement as the latter, and in the construction shown in Figs. 2 and 3, means are provided for auto-

matically coupling the element 18 to the gear 16 when the latter is rotated counterclockwise, as seen in Fig. 3, to lock a door in place, and to automatically couple the element 20 to the gear 16, when the latter is rotated clockwise to unlock the door. The means shown for this purpose, comprises a rock shaft 22 parallel to the shaft 17 and extending through and journaled in the gear 16, adjacent the periphery of the latter. Secured to the rear end of the shaft 22 is a pawl 23, which when the gear is rotated in the counter-clockwise direction, as seen in Fig. 3, engages one or another of the ratchet teeth 24 of the element 18 then rotates with the gear 16. At its opposite end, the shaft 22 has secured to it a pawl 25, which when the gear 16 rotates in the clockwise direction, engages one or another of ratchet teeth 26 of a ratchet wheel portion of the element 20, which is thereby caused to share the rotative movement of the gear 16.

Ordinarily, when the gear 16 starts into rotation in the counterclockwise direction, the pawl 23 will be out of position to engage a ratchet tooth 24, so that the element 18 will not be started into rotation immediately, but the pawls 23 and 25, have weight portions, 23' and 25', respectively, so disposed, that as the shaft 22 is turned counterclockwise about the shaft 17 away from its uppermost position, the pawl 23 will be gravitationally biased for movement into engagement with a corresponding tooth 24. Conversely, on the clockwise rotation of the gear 16, if the pawl 25 is not initially in engagement with a ratchet tooth 26, it will be turned into engagement therewith by the weights 23' and 25' as the shaft 22 turns away from its uppermost position.

The purpose of the arrangement for rotating the shaft 1 in the door locking direction through the element 18, and in the door unlocking direction through the element 20, is to make the torque available for unlocking the door greater than that available for locking the door, so as to thereby decrease the risk that through accidental reduction in the available power, or increase in the resistance to the rotation of the spindles E, the mechanism will be unable to unlock a door when such unlocking is desirable. To thus vary the torque, the spur gears 19 and 21 and the spur gear portions of the elements 18 and 20, are so relatively proportioned that the gear ratio through which the element 18 rotates the shaft 1, is higher than the gear ratio through which the member 20 rotates the shaft 1. In the construction shown, the first mentioned ratio is a one to one ratio, while the second ratio is a one to two ratio, so that under normal operating conditions, the torque available for unlocking the door is double that available for locking the door.

The safety mechanism sprocket wheel 12' is journaled in a lever 30. The lever 30 is pivotally supported at one end by the shaft 14, and is connected at its other end to a vertically disposed link 31, which extends up through the top wall of the chamber L'. A helical compression spring 33 acts between the collar 32 secured to the external portion of the link 31, and the subjacent portion of the housing L, in the direction to force the sprocket wheel 12' upward against the corresponding portion of the sprocket chain 12, and normally maintain the parts in their positions shown. As the sealing edge g is pressed with increasing force against the sealing edge

A', in the course of the door locking operation, the torque required to rotate the shaft 1 increases. When this torque attains a certain maximum value, dependent upon the normal tension of the spring 33, that spring yields and permits the lever 30 to turn in the counterclockwise direction, as seen in Fig. 3. As the sprocket wheel 12' thus moves downward, the portion of the sprocket chain running between the undersides of the sprocket wheels 11 and 13, straightens out more or less, with no transmission to the gear 13 of the rotative movement of the gear 11 then occurring. The safety mechanism including the sprocket wheel 12' and spring 33 thus operates as a mechanical overload device permitting the rotation of the spindle 1 to stop without stalling the motor 8, when the resistance to further rotative movement of the corresponding spindle 3 corresponds to a predetermined sealing pressure.

If the motor 8 were to continue in operation after the lower run of the chain 12 straightens out, the sealing pressure would then be increased above the desired maximum. To avoid this, the safety mechanism is adapted to interrupt the operation of the motor after a certain extent of compression of the spring 33 and down movement of the link 31, less than that required to fully straighten out the lower run of the chain 12. Thus, as shown in Fig. 3, a second collar 34 on the upper end of the link 31 acts, when the latter is depressed, to give a down movement to the actuating arm 35 of a motor control switch Q, thereby opening said switch and interrupting the energizing circuit of the motor 8.

While the safety mechanism arrangement already described is effective to prevent excessive rotative movement of the spindle 1 in the locking direction, it is not effective to prevent excessive movement of the spindle 1 in the reverse direction, such as would occur if the termination of the unlocking operation of the motor 8 were dependent on action by an operator, who, for some reason, fails to stop the motor 8 at the proper time. As a protection against such overtravel of the spindle 1 in the unlocking direction, with its possibly injurious consequences, I have provided the shaft 14, as shown in Fig. 2, with a threaded axial extension 40. A nut 41 on the threaded shaft 40, is connected to the actuating arm 42 of a control R, so that the latter is operated to interrupt the energizing circuit of the motor 8 after a certain number of revolutions of the threaded shaft 40 in the spindle unlocking direction, and a corresponding movement of the nut 41 away from the housing L.

As those familiar with electric motors will understand, the energizing and control circuits for each motor 8, and the manner in which the corresponding switch Q and R are associated therewith, may take many forms, and are dependent in part on the character of the motor. By way of example, one circuit arrangement is illustrated diagrammatically in Fig. 4. In that arrangement, the motor 8 is shown as of the direct current type, and is energized for operation in the door locking direction when a relay switch winding 51 is energized and moves the associated armature 52 to connect the motor armature 2C of the field winding 8A and motor 70 in series with one another and a source of current 50. In a similar manner, the motor 8 of Fig. 4 is energized for operation in the door unlocking direction, by the energization of relay switch winding 54, whereupon the associated 75

armature 55 is moved to connect the armature 2C and current source 50 in series with a second motor field winding 8B.

As shown in Fig. 4, the relay winding 51 is energized by the momentary closure of a normally open, manually adjustable control switch S, which has one terminal connected through a source of current 53 to one terminal of the winding 51, while the other terminal of the winding 51 is connected to the second terminal of the switch S through the normally closed switch Q. Similarly, the closure of a normally open control switch SA charges a relay winding 54 by connecting the latter in series with the source 53 and normally closed switch R.

The energization of the relay winding 51 closes a so-called "holding in" circuit, by closing a shunt about the switch S, so that the reopening of the latter will not deenergize the winding 51. Said shunt includes a normally open switch T closed by the relay armature 52 when the winding 51 is energized, and a normally closed switch UA, which is opened by the energization of the relay winding 54. The holding in circuit for winding relay 51 may be interrupted, and said winding deenergized, either by actuation of the switch arm 35 to open switch Q, or by the closure of the switch SA and resultant energization of the relay winding 54. A similar holding in circuit for maintaining the energization of the winding 54, is established when the armature 55 is energized to close the normally open switch TA and thereby establish a shunt about the switch SA, said shunt including the switch U, which is opened only when the winding 51 is energized. The relay winding 54, when energized, may thus be deenergized either by opening the switch R, or by closing the switch S and thereby opening the switch U.

As will be apparent, the switches S and SA and current sources 53 of Fig. 4, may be used in simultaneously energizing both the motor 8 shown in that figure, and the second motor 8 of the door machine. To that end, the parts S, SA and 53 shown in Fig. 4, may be connected through conductors 56 to control and energizing elements for the second motor 8, which are duplicates in form and disposition, of the elements 50, 51, 52, 54, 55, T, TA, U, UA, Q and R shown in Fig. 4.

The means shown in Fig. 2 for opening the switch R and thereby interrupting the door unlocking operation of the motor 8, are adapted for use under normal operating conditions in which door locking and unlocking operations are effected in regular alternation. When, as may sometimes happen, two door locking operations occur without an intervening unlocking operation, or two unlocking operations are effected without an intervening locking operation, the mechanism for actuating the switch R is rendered inoperative, and may be injured by the excessive movement which it then gives or tends to give the nut 41. With the arrangement shown in Figs. 5 and 6, however, as with that shown in Figs. 7 and 8, the extent of each unlocking movement of each mechanism L is automatically controlled regardless of the order in which the locking and unlocking operations occur.

In the arrangement shown in Figs. 5 and 6, I employ a self-opening time switch SB, in lieu of the switch SA shown in Fig. 4, to start the unlocking operation of the motors 8. As shown in Figs. 5 and 6, the switch SB is a mercury

switch, comprising an elongated mercury container, or envelope, supported by a shaft SB' journaled in a suitable support and provided with a handle SB² by which the container may be angularly adjusted. Partition means 60 within the container divide the interior of the latter into two chambers 61 and 62, one in each end portion of the container. A pair of contacts 65 extend into the space 61 and are adapted to be operatively connected by mercury in that space when the container is turned so that the space 61 is filled with mercury and is above the space 62, as shown in Figs. 5 and 6. With the container in the position shown, mercury in the space 61 will drain into the then lower space 62 through a restricted drain passage 63, which opens to the space 61, about midway between the two ends of the containers, and opens to the space 62 adjacent the corresponding end of the container. The time required for enough of the mercury in the container to drain out of the space 61 through the passage 63 into the space 62, to break the previously existing mercury bridge between the two contacts 65, determines the length of the period during which the associated motors 8 are then energized for operation in the unlocking direction. The next unlocking operation may be started by giving a half turn to the container so as to locate the space 62 directly above the space 61. As soon as this is done, the mercury will begin to drain from the space 62 into the space 61, through a restricted passage 64, which is a counterpart of the passage 63.

As shown, one contact 65 is in engagement with the contact 66 and the other contact 65 is in engagement with the contact 67 when the parts are in the position shown in the drawings. When the container is given a half turn, one contact 65' engages the contact 66, and the other contact 65' engages the contact 67. The switch SB may be connected into such a motor control and energizing circuit as is shown in Fig. 4, to replace the switch SA, in the manner shown in Fig. 5. No holding in circuit for the relay winding 54 is provided, with the arrangement shown in Fig. 5, since the relay winding 54 will be energized so long as the contacts 65, or 65', engaging the contacts 66 and 67, are connected by mercury within the switch container, provided that both switches R and U remain closed. Each of those switches are connected in the energizing circuit of the winding 54, in series with the current source 53 and the contacts 66 and 67. The elimination of the holding in circuit for the winding 54 makes it unnecessary to provide a switch TA in the arrangement shown in Fig. 5.

The arrangement shown in Figs. 7 and 8 for automatically limiting the extent of unlocking movement, is like that shown in Figs. 1, 2, and 3, in that it makes use of a threaded rotating shaft included in each mechanism L. In the arrangement shown in Figs. 7 and 8, however, the safety mechanism including the threaded shaft, is automatically reset, so to speak, into the same initial condition, prior to each unlocking operation. As shown in Figs. 7 and 8, rotation of the shaft 14 in the door unlocking direction, rotates a vertically disposed safety mechanism shaft 72 through a bevel gear 70 carried by the shaft 14, a cooperating bevel gear 71, and a ratchet or analogous clutch 80 connecting the gear 71 to the lower end of the shaft 72. The clutch 80 is provided to permit the shaft 72 to remain stationary while the shaft 14 rotates

in the door locking direction. The gears 70 and 71 are located in the housing chamber L' and the shaft 72 extends upward through the top wall of that chamber.

Secured to the upper end of the shaft 72, is a top member 73' of a fly ball governor 73. The latter comprises a lower collar 74 loosely surrounding the shaft 72, and raised and lowered by the governor weights as the rotation of the shaft 72 is started and interrupted. A bell crank lever 75, pivotally supported at 76, comprises a horizontally disposed upper arm, with its free end in engagement with the collar 74, so that the lever 75 is tilted about the horizontal pivot pin 76 as the collar 74 is adjusted longitudinally of the shaft 72. The second arm of the lever 75 is generally vertical, and alongside the shaft 72, and is formed with a guideway 77 for a mutilated nut element 78. The threaded end of the latter is moved into operative engagement with the thread on a finely threaded portion 79 of the shaft 72, located below the governor 73. When the motion of the shaft 72 is interrupted, and the collar 74 moves downward, the lever 75 is tilted to move the nut member 78 out of engagement with the threaded portion 79 of the shaft 72. The threads on the shaft portion 79 and nut 78 are so formed, that the rotation given the shaft 72 in the unlocking operation, will move the member 78 upward until a projection therefrom engages and actuates a control element, which, as shown, is the operating arm 42 of the switch R. The latter, in the form shown in Fig. 7, is mounted on top of the housing of the corresponding mechanism housing. As shown when the rotation of the spindle 72 is interrupted, and the governor collar 74 is lowered and tilts the member 78 out of engagement with the threaded shaft portion 79, the member 78 moves down to the bottom of the guideway 77, under the action of gravity, which, if necessary, may be supplemented by the action of a bias spring. The safety mechanism is thus reset at the end of each door unlocking operation.

As will be apparent, instead of swivelling each locking bar on its corresponding spindle and threading the latter into a socket formed in a rigid portion of the door, the spindle may be swivelled in the door, and in threaded engagement with the locking bar, which is then adjusted bodily in the longitudinal direction of the spindle when the latter is rotated. An arrangement of this sort is shown in Fig. 9, wherein a locking bar supporting spindle EA is journaled in an unthreaded passageway through a door part DB, otherwise like the previously mentioned parts D and DA. As shown, the spindle EA is held against longitudinal movement relative to the part DB, by collars E⁵ and E⁶, pinned on the spindle. The latter is formed adjacent its outer end with a threaded portion E⁷, shown as somewhat larger in diameter than its main unthreaded portion, and the corresponding locking bar 1A is normally in threaded engagement with said threaded portion E⁷. In consequence, when the spindle EA is rotated, the locking bar 1A is adjusted longitudinally of the spindle. As will be apparent, if in locking a door in place, the rotation of the spindle EA of Fig. 9 is in the same direction as that of the spindle E of the constructions previously described, the spindle EA should be formed with a right handed thread, and the spindle EA should be formed with a left handed thread, assuming that in the door lock-

ing operation, the shaft 1 rotates in the direction shown in Figs. 2 and 3.

With the threaded connection between the locking bar and supporting spindle shown in Fig. 9, an excessive extent of rotation of the spindle in the door unlocking direction, will have no injurious consequences, if the parts are so arranged that the locking bar 1A may move inwardly along the spindle EA, until it passes out of threaded engagement with the spindle, as is provided for in Fig. 9. A spring E⁸ is provided to bias the locking bar 1A for movement away from the door part DA and the locking bar 1A, and tends to move the bar 1A away from the door, so that the threaded connection between the locking bar and spindle, may be reestablished as soon as the latter begins to rotate in the door locking direction. As shown, the locking bar 1A is provided at its outer side with an annular rib I¹⁰, which has an internal diameter just large enough for the movement therein of the threaded spindle portion E⁷, and cooperates with the latter to maintain the bar 1A with its threaded passage in register between the threaded spindle portion E⁷, when the threaded connection between the bar and the spindle is interrupted.

While in accordance with the provisions of the statutes, I have illustrated and described the best forms of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

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

1. In a self-sealing door, the combination with a rigid portion of the door, of a locking bar spindle having its inner end swivelled in said rigid door portion, and having a threaded outer portion and an intermediate unthreaded portion, of smaller diameter than said threaded portion, a locking bar formed with a threaded socket in which the threaded portion of said spindle is normally threaded but adapted to be moved by excessive rotation of said spindle in the door unlocking direction, into a position in which said threaded spindle portion is at the outer side of, and the intermediate portion of said spindle is within said threaded socket and a spring acting on said locking bar in the direction tending to move the latter outwardly along the length of the spindle, said locking bar being formed with an annular guide portion surrounding said threaded spindle portion and centering the locking bar relative to the spindle, when said intermediate portion is within said socket.

2. In a self-sealing door, the combination with a rigid portion of the door, of a locking bar spindle having its inner end swivelled in said rigid door portion, and having a threaded outer portion and an intermediate unthreaded portion, of smaller diameter than said threaded portion, a locking bar formed with a threaded socket in which the threaded portion of said spindle is normally threaded but adapted to be moved by excessive rotation of said spindle in the door unlocking direction, into a position in which said threaded spindle portion is at the outer side of, and the intermediate portion of said spindle is within said threaded socket and a spring acting on said locking bar in the direction tending to move the latter outwardly along the length of the spindle.

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