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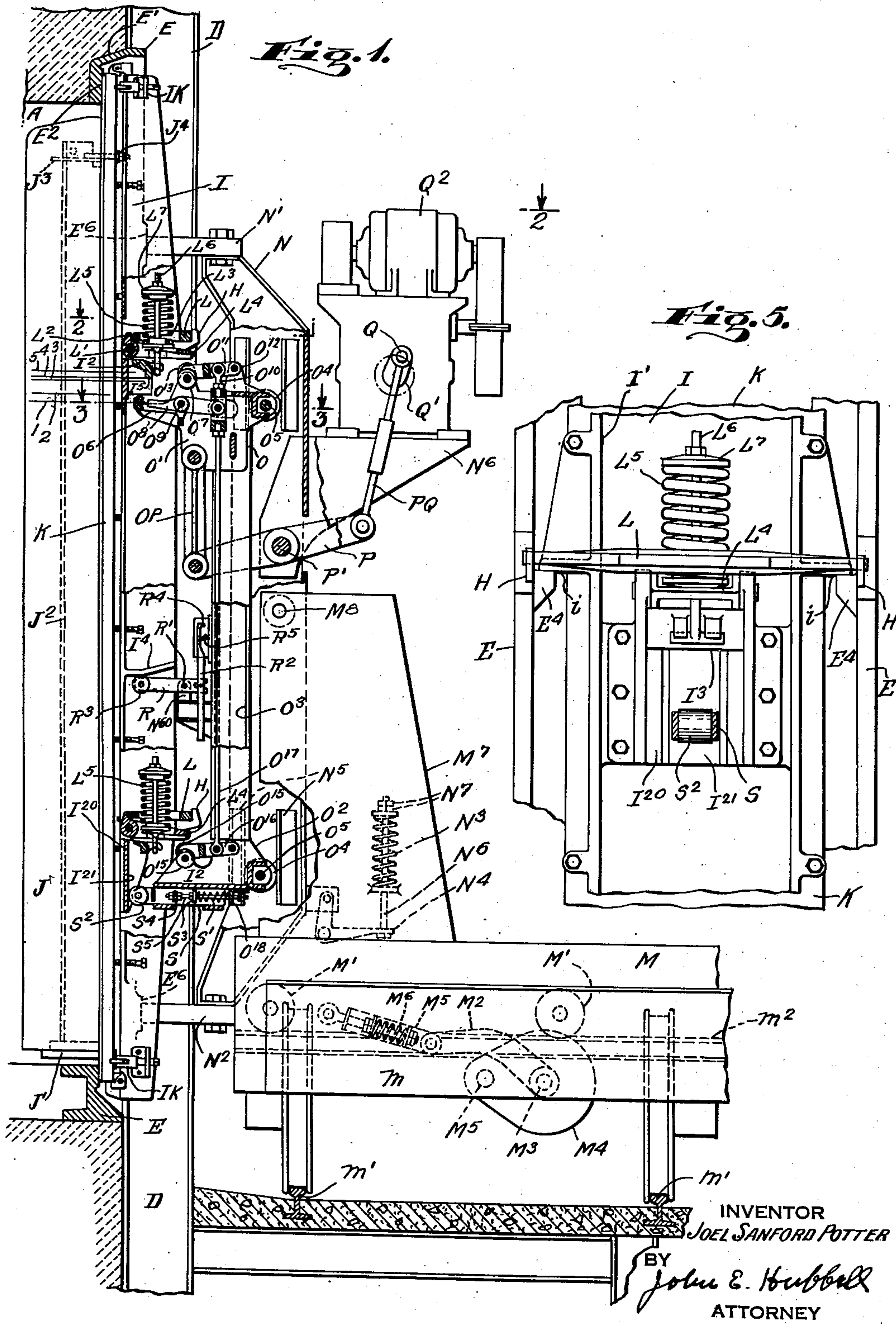
J. S. POTTER

2,183,753

COKE OVEN DOOR MACHINERY

Filed Aug. 13, 1936

3 Sheets-Sheet 1



Dec. 19, 1939.

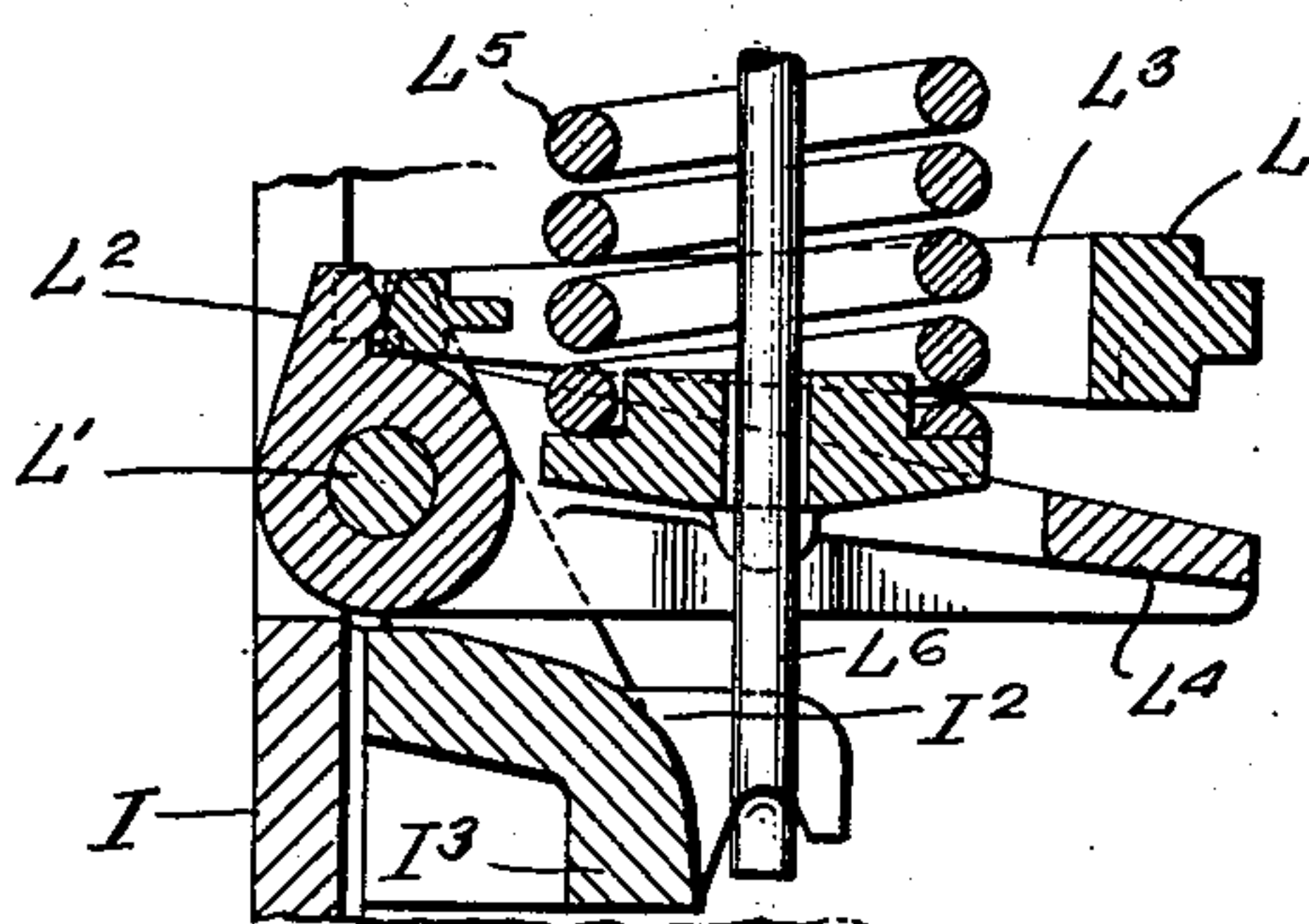
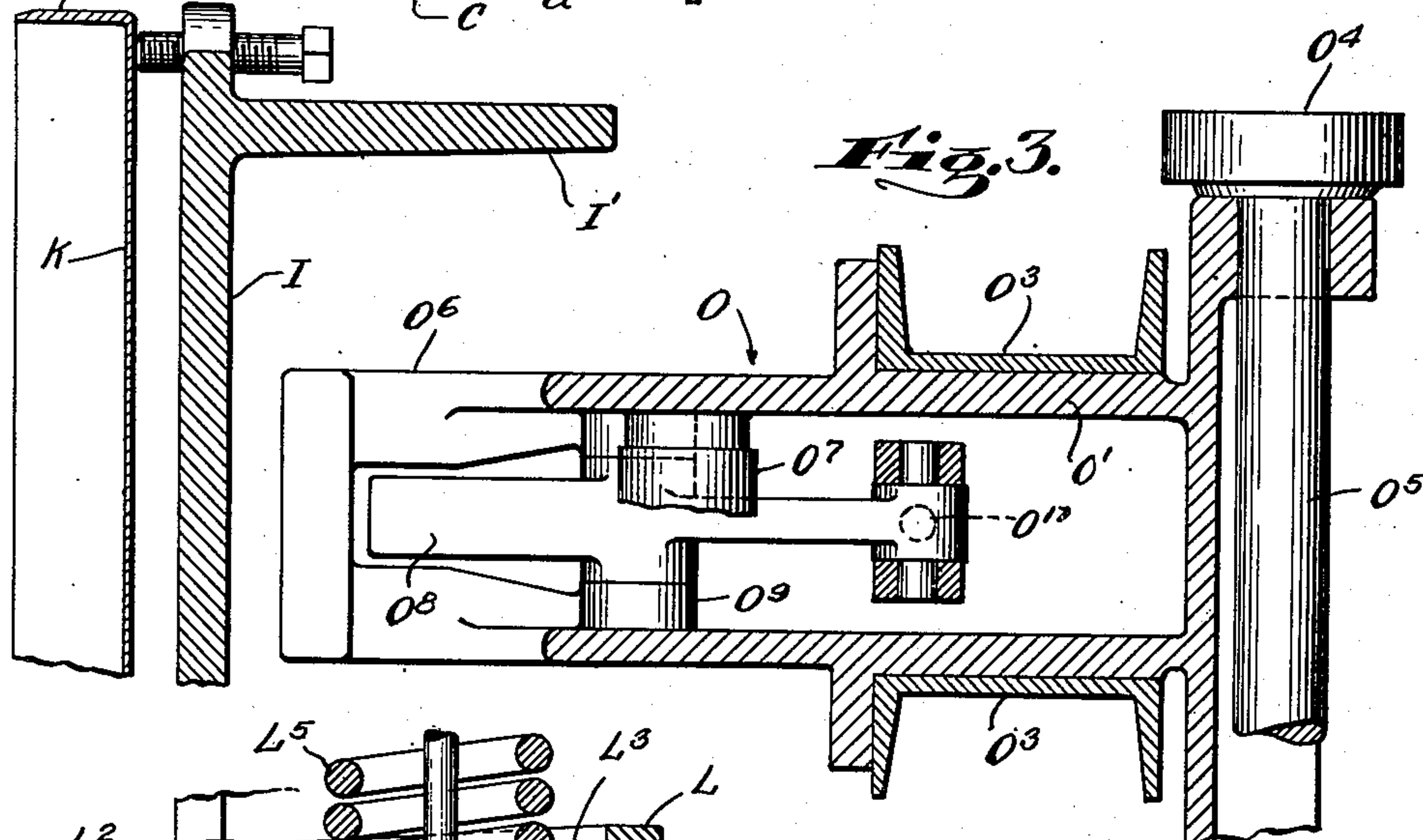
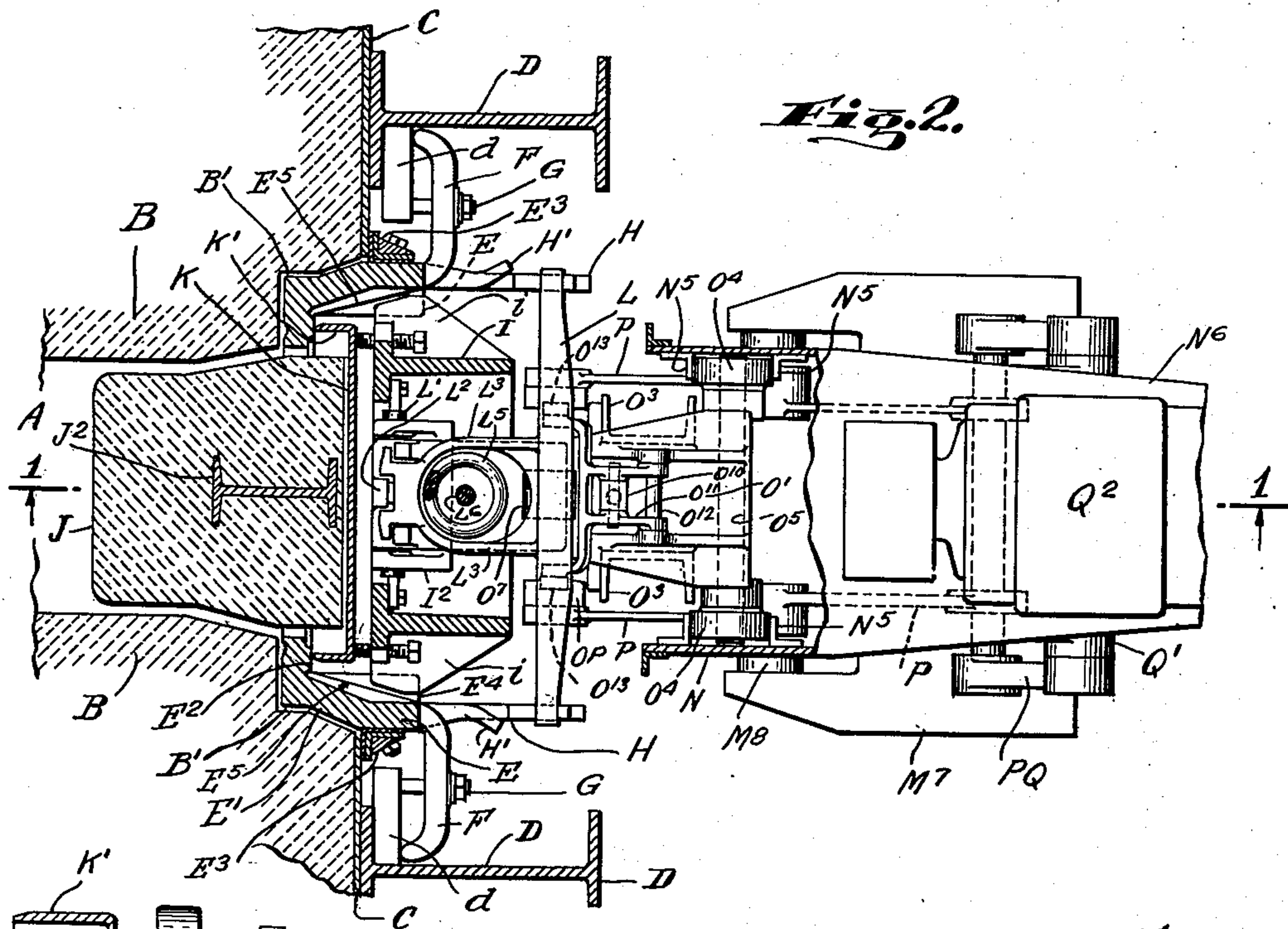
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COKE OVEN DOOR MACHINERY

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3 Sheets-Sheet 2



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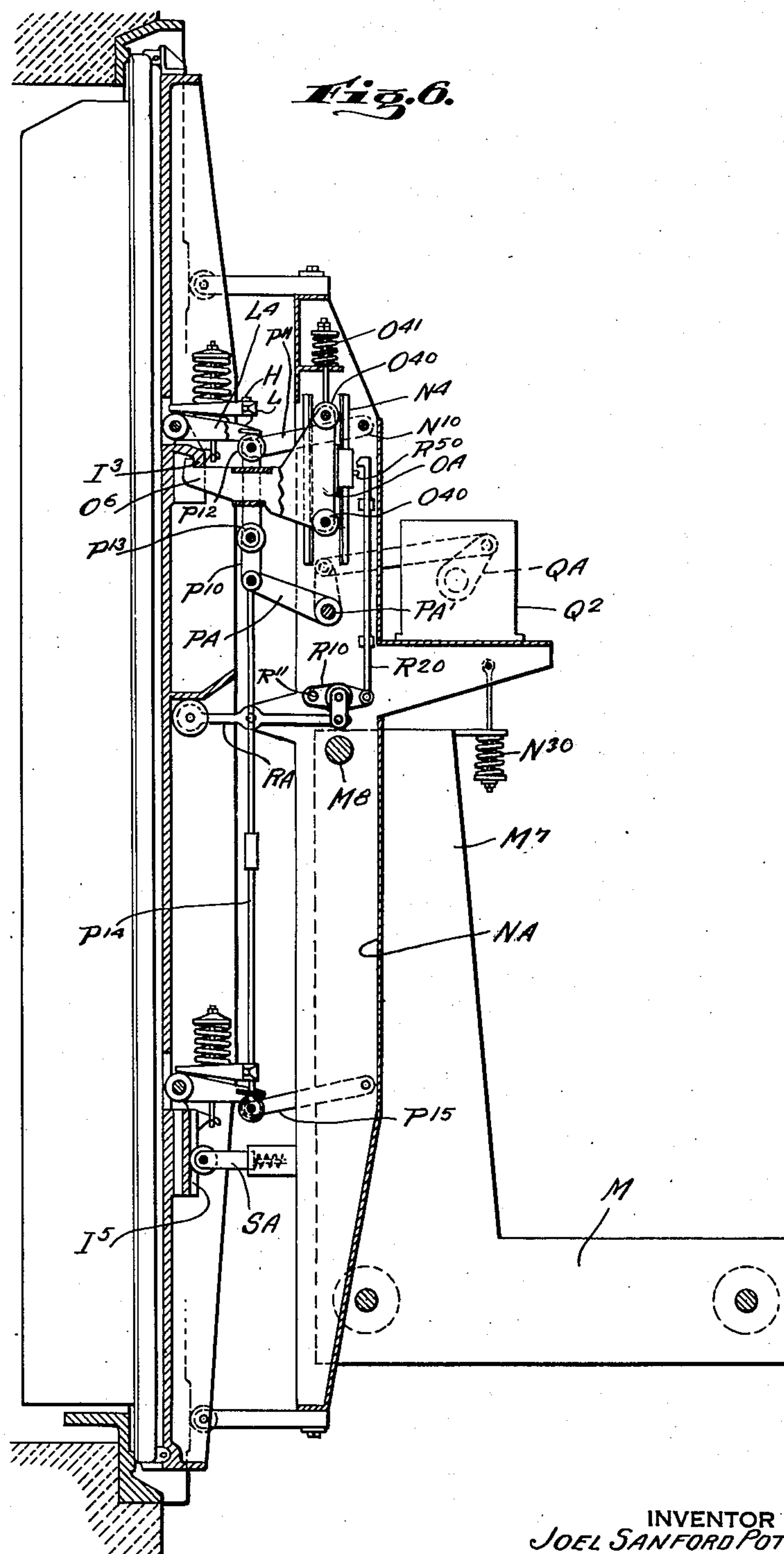
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COKE OVEN DOOR MACHINERY

Filed Aug. 13, 1936

3 Sheets-Sheet 3



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COKE OVEN DOOR MACHINERY

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Application August 13, 1936, Serial No. 95,806

21 Claims. (Cl. 202—248)

The general object of the present invention is to provide improvements in door machine mechanism for use in removing and replacing the doors which normally close the ends of the coking chambers of a horizontal coke oven battery. More specifically the object of the invention is to provide improved mechanism for removing and replacing self sealing coke oven doors comprising special door locking provisions, devised by me, whereby, in the normal closed position of the door, spring means act between the door and its locking bar, or each of its locking bars, to press the door inward against the stationary door frame and to press the locking bar outward into engagement with stationary door retaining members, which ordinarily are hook projections from the door frame.

The present invention relates particularly to a door machine bodily movable, as is usual, toward and away from the door frame for each door served, and comprises means for giving each door served, the vertical movements required for the transfer of the weight of the door between its door frame and the door machine in the door removing and replacing operations, and for acting on a door having the above-mentioned special locking provisions, to relieve the spring action between the door and each locking bar and to raise the latter out of engagement with the corresponding retaining hooks during the door removing operation, and to lower each locking bar into engagement with said hooks and restore said spring action during the door replacing operation.

A further specific object of the present invention, is to provide means whereby the vertical bodily movements given to each of the doors served by a single door machine, will be suitably small and approximately the same, notwithstanding variations which may amount to several inches, in the vertical distance between the general level of the door machine and the general levels of the different doors served by the door machine. The means which I have devised for the attainment of the last mentioned object, are not necessarily restricted to use in connection with coke oven doors having the special locking provisions mentioned above or even with self-sealing doors, but may be used in door machines handling the clay luted coke oven doors in use on most existing coke oven batteries in this country.

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 a preferred embodiment of the invention.

Fig. 1 is an elevation in section on the line 1—1 of Fig. 2, showing a portion of a coke oven battery with a door thereof in its closed position, and an associated door handling machine;

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

Fig. 3 is a partial horizontal section on the line 3—3 of Fig. 1;

Fig. 4 is a partial elevation in section on larger scale than Fig. 1, of parts therein shown;

Fig. 5 is a fragmental elevation of the door taken at right angles to Fig. 1; and

Fig. 6 is a view, taken similarly to Fig. 1, illustrating a door machine of modified form.

In the type of coke oven structure shown in part in Figs. 1 and 2, horizontally elongated coking chambers A and heating walls B, are arranged side by side in a row, in which the coking chambers alternate with the heating walls. The coke oven masonry is reinforced and supported at the sides of the battery by a metallic armor, which as shown, comprises a flash plate C at each heating wall end, a corresponding vertical buckstay D by which the flash plate is held in place, and a door frame member E at each end of each coking chamber. Each door frame member E may be, and as shown, is a one piece casting extending around the door opening, and including a portion E' which extends into the coke oven brick work, and is shaped to provide an outwardly facing sealing surface E². The latter extends transversely to the length of, and surrounds the coking chamber. The corners of the heating walls are recessed at B' to permit the door frame member to extend into the oven structure as shown.

As shown the door frame member E is provided with adjustable side flanges E³ abutting against the adjacent flash plate C, and is anchored in place by adjustable clamping connections between its sides and the adjacent buckstay members D, said connections comprising parts d welded to the buckstays, clamping levers F, and bolts G. Each door frame member E, has rigidly attached thereto an upper and a lower hook part H at each side of the door, for engagement with locking bars L normally holding a door in position to close the doorway opening

surrounded by the door frame member. The hook parts all extend upwardly.

Associated with each of the different door frames E of the battery is a coke oven door. The different doors at one side of the battery ordinarily are exact duplicates of one another. The particular door form illustrated, is one in which each door comprises a rigid outer section I, an inner plug section J and an intermediate sealing section K. As shown the outer section I is a metal casting comprising a plate-like body or web portion with an outwardly extending marginal flange or rim portion I'. The sealing section shown comprises a flat sheet metal body portion with a transverse marginal inwardly extending sealing rim or flange K'. The latter in the closed position of the door has its inner edge in engagement with the door frame sealing surface E². As shown, the plate K and a bracket part J' at the inner side of the latter, are rigidly secured to the door section I at the bottom of the door. The plug section J of the door has its weight supported by the bracket portion J', and comprises a body of refractory material reinforced by a metal post J² which, in the assembled condition of the door, is mechanically anchored at its lower end in the bracket J', and is connected at its upper end to the sealing member K by means of a keeper part J³ having a bolt extension J⁴ passing through the body portion of the member K. So-called clamping connections IK between the marginal portion of the sealing member K and outer door section I are provided to give the sealing edge of the flange K' the contour required for gas-tight engagement with the door frame surface E², notwithstanding relative door frame and door distortion which may occur in use.

In its closed position, the weight of each door is carried by lugs E⁴ projecting from the side edges of the door frame E, beneath and in supporting relation with outwardly extending lugs i projecting from the sides of the rigid door section I. To insure the proper relative lateral positions of the vertical portions of the door sealing flange K' and the surface E², the lugs E⁴ are provided with inclined guide surfaces E⁵ between which the projections i must enter as the door is moved in the door-replacing operation into its normal closed position shown in Figs. 1 and 2. For additional preliminary guidance of the door as it is being replaced, the hook members H are formed with inclined guide portions H' in position to be engaged by one or another of the projections i, if the door is not in lateral register with the door frame during the initial movement of the door toward the door frame.

In respect to the features of door construction already specifically referred to, the door shown comprises nothing claimed as novel herein, or forming a part of the present invention, which is not restricted to use in connection with the particular door construction illustrated. The door shown is normally secured in place by upper and lower locking bars L, each of which is adapted to engage a corresponding pair of hook parts H, and is movable horizontally toward and away from the door, and is movable vertically relatively to the door between a lower hook engaging and an upper hook clearing position. Resilient means act between each locking bar and the door when the latter is in its normal closed position, to press the locking bar outward against the hooks, and to press the door inward and thereby maintain a gas tight joint

between the door edge K' and the door frame surface E². The resilient means normally acting on each locking bar may be rendered inoperative by an upward thrust, given it by the door machine, so as to free the locking bar for vertical movement out of and into engagement with the hooks H.

In the construction shown, the mounting means for the upper locking bar L comprises a horizontal rock shaft L' supported by the door member I, and provided with an uprising arm L² to which are pivotally connected arms L³ connected at their outer ends to the locking bar L. Said shaft L' also carries a horizontally disposed arm L⁴, adapted to be tilted counter-clockwise by the door machine, as hereinafter described, and thereby move the locking bar toward the door. In the normal closed position of the door, the upper locking bar is subject to a resilient force tending to move it away from the door by means of a spring L⁵ acting between the arm L⁴ and a part I² carried by the door section I. As shown, the spring L⁵ is a vertically disposed compression spring acting above and having its lower end engaging the lever L⁴, and engaged at its upper end by an adjustable abutment L⁷ connected to the part I² by a tie bolt L⁸. In the construction shown, the part I² is a casting detachably connected to the web or body portion of the member I, and provided with bearings for the ends of the shaft L'. The part I² is provided with a depending portion I³ for engagement by the door machine lifting means.

The lower locking bar L is mounted and supported and resiliently acted upon by parts shown as identical with those associated with the upper locking bar, except that the lower bracket I²⁰ differs from the corresponding upper bracket I², in that it includes no part corresponding to the previously mentioned part I³, and in that it is provided with a special bearing surface I²¹ for engagement by a door machine part.

The door machine shown in Figs. 1 and 2 comprises a carriage m, which runs on track rails m' alongside the battery, and supports horizontal rails m² which extend transversely to the rails m'. The rails m² support the wheels M' of a carriage M which is movable on the carriage m toward and away from the side of the coke oven structure. The door handling mechanism proper is mounted on the carriage M. At the coke side of the battery, the carriage m may well be a special door machine carriage, as shown, while at the pusher side of the battery, the carriage M may be mounted on the pusher machine, which may then be regarded, for the purpose of the present invention, as constituting one form of the carriage m.

Any usual or suitable means may be employed to give the carriage M its movements toward and away from the adjacent side of the coke oven structure. As shown, the carriage M is given such movements by a crank arm M² carried by a crank shaft M³ journaled in the carriage m and rotated through speed reducing gearing enclosed in a casing M⁴ by a motor driven shaft M⁵. The crank arm M² is connected to the carriage M by a link including a spring M⁶ permitting the link to contract in length when the door handling machinery engages a door frame as hereinafter described. As shown, the crank arm M² and link M⁵ are so disposed that their pivotal connection moves slightly through dead center position as the movement of the carriage M toward the coke oven structure is completed

so as to slow down that movement as the door handling machinery operatively engages the door frame.

The carriage M includes an uprising hollow column M⁷ to which a member N is pivotally connected by a horizontal pivot shaft M⁸. The member N comprises a body portion in the form of a vertical beam of channel bar cross section, to the ends of which are swivelled top and bottom buffer portions N¹ and N², respectively adapted to engage the door frame at or adjacent the top and bottom of the latter, to thereby properly position the door engaging machinery in each door engaging or replacing operation. As shown, the buffers engage side surfaces E⁶ of the door frame which are displaced for definite distances from the adjacent portions of the door frame sealing surface E². The movement permitted the member N about the shaft M⁸, is limited by a connection including an adjustable spring N³ and lever N⁴, between the member N and column M⁷. The said connection tends to hold the beam N in such position that the lower buffer N² is nearer to the door frame than the upper buffer N¹ except when the spring N³ is compressed by movement of the carriage M to bring the upper, as well as the lower buffer parts into engagement with the door frame surfaces E⁶. This helps to insure that in each door replacing operation, the lower portion of the sealing edge K' will be brought into snug engagement with the surface E² before the weight of the door is transferred from the door machine to the door frame, as is desirable to insure proper sealing. The amount which the spring N³ tends to hold the lower end of the beam N in advance of its upper end may be varied by adjustment of the nuts N⁷ forming the abutment for the upper end of the spring N³ along the rod N⁶ on which the nuts are threaded and through which the spring acts on the lever N⁴.

The door lifting and locking bar adjustment parts of the door machine are carried by a member O mounted on the member N for straight line movement relative to the latter in a direction which is parallel to the plane including the portions E⁶ of the door frame engaged by the buffers. The member O comprises an upper cross head part O', which may be a casting, a lower cross head part O², which may also be a casting, and a connecting portion shown as formed by two channel bars O³ bolted or otherwise rigidly connected at their ends, to the upper and lower cross heads O' and O². The member O is guided in its general vertical movements relative to the member N by guide wheels O⁴ carried by a shaft O⁵ journaled in the upper cross head O' and similar guide wheels O⁴ carried by a shaft O⁵ journaled in the lower cross head O². The guide wheels O⁴ run between guides N⁵, shown as formed by angle bars secured to the inner sides of the member N. The member O is given its up and down movements through a link OP pivotally connected at its upper end to the head O', and pivotally connected at its lower end to a lever P carried by a shaft P' secured at its ends to the member N. The opposite end of the lever P is connected by a link PQ to a crank pin Q carried by a crank disc Q'. The latter is oscillated through suitable speed reducing gearing, by a motor Q² which, with said reducing gearing, is mounted on bracket extensions N⁶ of the member N.

The head O' is formed with a door lifting arm O⁶ adapted to engage the under side of portion I³ of the door to lift the latter in the door

removing operation and to support the door until the latter is returned into supporting engagement with its door frame. The arm O⁶, commonly called a lifting hook, has an upper hook extension which extends between the body portion of the door section I and the part I³ when the door is operatively engaged by the arm O⁶. In each door removing operation the member O is given an up movement sufficient to raise the arm O⁶ from an initial inoperative position occupied when the door machinery is moved into operative relation with the door, into a final position in which the door is lifted a distance of a half or three quarters of an inch or so to provide proper clearance for the subsequent horizontal movement of the door out of the door frame. In the subsequent door replacing operation, the member O is lowered to return the lifting arm O⁶ from said final position to said initial position.

In Fig. 1 the horizontal lines 1, 2, 3, 4 and 5 represent successively higher levels of the lifting surface formed by the upper horizontal edge of the arm O⁶, in different stages of a door removing or replacing operation. The levels 1 and 5 are those of the above mentioned initial inoperative and final positions, respectively, of the lifting surface of the arm O⁶, and the level 2 is the level of said surface at which the door is first engaged by the member O, operatively, in the sense of subjecting a door part to a significant upwardly acting force. The distance between the different levels 2—5 depend solely upon door or door machine proportions, and are the same for all the doors at one side of the battery when the doors are duplicates of one another as should be the case. The actual height of those levels above the earth's surface or other horizontal datum plane, may be different for different doors as a result of nonuniformity in the vertical dispositions of the different door frames E, due to lack of precision in the initial construction of the battery, or the distortion of the latter occurring in use. The level 1 is the level of the lifting edge of the arm O⁶ in the position of the latter when the carriage M is moved into operative engagement with a door frame E at the beginning of a door removing operation, and out of such engagement at the end of a door replacing operation. The level 1 for each door is thus at a fixed distance, depending on the door machinery proportions, above the level of the wheel engaging surfaces of the adjacent portions of the track rails m'.

The actual distance between the levels 1 and 2 may be different for different doors. In the case of a long battery, even though well constructed and in good condition, the variation in the distance between the levels 1 and 2 may be as great as 3". The minimum distance between the levels 1 and 2 must be sufficient to provide adequate clearance between the top of the upwardly extending hook and the top of the inner end hook portion of the arm O⁶, when the latter is in its initial level 1 position.

When the lifting arm O⁶, moving upward from the level 1, reaches the first operative level 2, the upper locking bar actuating lever L⁴ is engaged by an engaging part of the member O, which, as shown, is a roller O⁷ carried by a shaft having its ends supported in the head O'. As the upward movement of the member O continues from the level 2 to the level 3, the arm L⁴ is turned counter-clockwise against the action of the spring L⁵, and the latch bar L is given a

corresponding movement toward the door, the ends of the locking bar then sliding on horizontal edge portions of the hook members H.

It is practically feasible to have the locking bar engaged and lifted by the arm L^4 after an initial horizontal movement of the latter sufficient to move the locking bar out of frictional engagement with the vertical portions of the hooks H, but in the construction shown in Fig. 1, separate means are provided to lift the locking bar above the tops of the hooks as the arm O^6 is moved from the level 3 to the level 4. The said means comprises a lever O^8 journaled on a pivot shaft O^9 carried by the head O' , and adapted to engage and be tilted by the underside of the projection I^3 , while the arm O^6 is moving between the levels 3 and 4. The outer end of the lever O^8 is connected by a link O^{10} to a locking bar lifting lever O^{11} pivotally connected to the head O' by a pivot shaft O^{12} , and carrying rollers O^{13} . The latter engage the ends of the locking bar L and lift the latter, as the head O' moves between the levels 3 and 4. As shown, the leverage is such that the locking bar lifting movement effected as the arm O^6 moves between the levels 3 and 4, is several times the vertical distance between those levels. When the arm O^6 reaches the level 4, it operatively engages the door part I^3 , and as the movement of the arm O^6 continues from the level 4 to the final level 5, the door is lifted for a distance equal to the vertical distance between the levels 4 and 5.

The lower locking bar actuating lever L^4 is engaged by a roller O^{15} mounted on the lower head I^2 , and corresponding in form and purpose to the roller O^7 , and serving to move the lower locking bar toward the door, while the arm O^6 is moving between the levels 2 and 3. While the member O is moving between the levels 3 and 4, the lower locking bar is lifted by a lever O^{16} mounted in the lower head I^2 and corresponding to the upper lever O^{11} , by means of a link O^{17} connecting the two levers.

The door lifting operation terminates when the arm O^6 reaches the level 5. The door may then be removed from the door frame by horizontal movement of the carriage M away from the adjacent side of the coke oven structure on the rail m^2 . In replacing the door, the carriage M is again moved toward the adjacent side of the coke oven structure until the upper and lower abutments N^1 and N^2 are brought into operative engagement with the door frame surfaces E^5 , after which the weight of the door is transferred from the door machine to the door frame, and the door is automatically locked in place by down movement of the member O, as the latter moves from the level 5 to the level 1.

The up movement of the member O is terminated at the appropriate level 5 for each door engaged, by means automatically effective to insure that the lift given each door is the same, notwithstanding such variations as may be expected to occur in the case of different doors, in the vertical distance between the level of the track rails m' and the level of the under side of the door portion I^3 . The means by which this is accomplished shown in Figs. 1 and 2, comprises a limit switch control for the motor Q^2 terminating the movement of the latter in the direction to lift the member O when its arm O^6 has reached the desired final level 5, regardless of the actual difference between the levels 1 and 5. The limit switch operating means shown in Fig. 1, comprise a lever R pivoted at R' to a

supporting bracket N^6 carried by the member N. The outer end of the lever R is connected by pin and slot connection to a vertically movable limit switch actuating bar R^2 . The weight of the bar R^2 gives the lever R bias for clockwise movement about the shaft R' sufficient to carry a roller R^3 to a level high enough to insure engagement with the outer upwardly inclined rib portion I^4 of the rigid outer door section I, so that as the door machinery is moved toward the door, more or less down movement will be given the roller R^3 , depending on the vertical distance between the under side of the horizontal inner portion of the rib I^4 and the level of the track rails m' . When the movement of the door machine toward the door is concluded, a hook portion R^4 of the bar R^2 is at a level which bears a fixed relation to the actual levels of the door parts I^4 and I^3 .

The hook portion R^4 of the bar R^2 , engages and actuates a limit switch arm R^5 mounted on the member O, as the hook portion R^4 moves down and arm R^5 moves up during the door lifting operation, and their engagement interrupts the operation of the motor Q^2 in the door-lifting direction, after an up movement of the member O corresponding to the distance between the levels 2 and 5, that distance being the same in the case of all doors. The movement of the member O between the levels 1 and 2 is thus an idle movement, and will vary with the displacements of the different doors vertically with respect to the level of the adjacent portions of the track rails m' . The distance between the track rail level and the level 1 depends upon the door machine construction and is always the same. The motion of the motor Q^2 in the direction to lower the member O may be limited by the operation of a second limit switch (not shown), which may be of any usual form, and may be actuated by the movement into a predetermined position of one or another of the moving door machine parts, such as the crank disc Q' .

To insure a gas-tight closure it is practically essential that the lower portion of the sealing flange K^1 should be in snug engagement with the door frame sealing surface E^2 at the time at which the weight of the door is transferred from the door machine to the door frame lugs E^3 , in the door replacing operation. The means, including the spring N^3 , for tilting the lower end of the beam toward the door frame, contributes to the proper engagement of the lower portions of the flange K^1 and surface E^2 during the door replacing operation, but its action is desirably supplemented by means mounted on the beam N for exerting a resilient thrust against the surface I^{21} of the lower bracket I^{20} . To this end the door machine shown in Fig. 1 is provided with a plunger S mounted in the lower head I^2 of the member I and biased by a spring S^1 for horizontal movement of a roller S^2 carried by a plunger into a position in which the roller acts resiliently on the surface I^{21} of a door supported by the lifting arm O^6 . As shown, the spring S^1 acts between the abutment O^{18} carried by the part I^2 and an adjustable abutment S^3 in the form of a nut threaded on a rod S^5 which extends axially through the spring S^1 and passes loosely through, and is guided by, the bracket O^{18} , and is anchored at its inner end in a bracket-like portion S^4 of the plunger S.

The principles of the present invention may be utilized in apparatus quite different in form

from that illustrated in Figs. 1-5, and in Fig. 6 I have illustrated one modification of the apparatus already described. The machine shown in Fig. 6 comprises a member NA corresponding generally in its mounting and operation to the previously described member N. Mounted on the member NA is a member OA, which may be a casting generally like the upper head O' of the previously described member O. The member OA carries upper and lower guide wheels O⁴⁰ travelling in guideways formed by guide members N⁴ secured to the member NA. The member OA carries a door lifting arm O⁶ adapted to engage a door projection I³, as does the arm O⁶ of the member O.

In Fig. 6 the latch bars L are released and the door is lifted as a result of the oscillation of a rock shaft arm PA corresponding generally to the lever P of the construction first described. The arm PA is carried by a rock shaft PA' journaled in the member NA, and link connected to a crank arm QA rotated through suitable speed reducing gearing by the motor Q². To the inner end of the arm PA is pivotally connected the lower end of a link or thrust member P¹⁰ which is pivotally connected at its upper end to a link P¹¹ pivotally connected to the member NA at N¹⁰. The member P¹⁰ carries rollers P¹² engaging the upper latch bar actuating arm L⁴ when the arm PA is turned clockwise in the door removing operation.

After a slight initial counterclockwise movement of the arm L⁴, sufficient to relieve the spring action on the latch bar, the latter is engaged by the arm L⁴, so that the further turning movement of the latter, lifts the latch bar above the tops of the hook members H. As the member P¹⁰ is moved upward into engagement with the latch bar the member OA moves upward under the action of a spring O⁴¹ carried by the member NA which forms a suspension connection for the members OA. The tension of the spring O⁴¹ is more than sufficient to support the weight of the member OA, but is not great enough to subject the door to a significant lifting force. When the arm O⁶ engages the door part I³, the upward movement of the member OA is temporarily arrested. After the further up-movement of the member P¹⁰, which releases the upper latch bar and raises it above the level of the cooperating hooks H, a yoke portion of the member P¹⁰ in the form of a roller P¹³, engages the under side of the arm O⁶ and gives the arm O⁶ its door lifting movement.

In the initial position of the door machine, the roller P¹³ is in engagement with the upper side of the arm O⁶, and holds the latter suitably below the door part I³. In Fig. 6, the parts are shown in the position occupied after an initial up-movement of the member P¹⁰ sufficient to permit the arm O⁶ to operatively engage the door part I³.

In the door removing operation, the up-movement of the member P¹⁰ relieves the spring action on the lower locking bar L and raises the latter by means of a link P¹⁴ connecting the member P¹⁰ to a lever P¹⁵ similar to the lever P¹¹ which is pivotally connected to the beam NA and acts directly on the arm L⁴ associated with the lower locking bar. The beam NA supports a spring pressed plunger SA engaging the door surface I²¹ as does plunger S of the construction first described. The beam NA is biased for movement of its lower end toward the side of the coke oven battery by means including a spring

N³⁰ similar in its action to the spring N³ of the construction first described, though differing from the latter in its location.

The door machine shown in Fig. 6 includes a limit switch mechanism controlling the extent of movement of the motor Q² in the direction giving a rising movement to the door lifting arm O⁶ which is identical in principle with the limit switch mechanism for the same purpose of the mechanism first described. The limit switch mechanism of Fig. 6 comprises a lever RA which may be identical in its form, mounting, and action with the lever R previously described, but as shown in Fig. 6, the lever RA is operatively connected to a vertical movable bar R²⁰ corresponding to the previously mentioned bar R², by a link and lever R¹⁰, the latter being pivotally supported R¹¹ by the member NA. The hook at the upper end of the bar R²⁰ coacts with a limit switch arm R⁵⁰ carried by the member OA and corresponding to the arm R⁵ of the construction first described.

Novel features of coke oven door construction and arrangement, disclosed but not claimed herein, are disclosed and claimed in my prior copending applications, Serial No. 28,264, filed June 25, 1935, Serial No. 84,596, filed June 11, 1936, and Serial No. 88,676, filed July 2, 1936. Novel door machinery construction and arrangement features disclosed in common in said prior applications, Serial Nos. 28,264 and 84,596, and in the present application, are claimed herein.

In particular, said prior applications collectively disclose and claim coke oven doors comprising various forms of the special locking provisions illustrated and described herein, and disclose and generically and specifically claim various forms of coke oven door machines, specifically different from those disclosed and claimed herein, but adapted to relieve and restore the spring action between coke oven doors and their locking bars in the course of the door removing and door replacing operations.

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. A door machine for removing and replacing doors normally closing the ends of horizontal coke oven chambers, comprising in combination a door engaging member adapted for movement upward to engage a door occupying its normal closed position and lift the door to a higher level, means for moving said member upward from an initial position fixed by the door machine and independent of the door position and below its position of engagement with the door, and means for interrupting the upward movement of said member after a movement of the latter upward from its said position of engagement, which is predetermined and independent of the distance between said initial position and said position of engagement.

2. A door machine as specified in claim 1, in which the means for interrupting the up move-

ment of said member is a limit switch mechanism comprising a part moved by said member, and a part engaging, and vertically positioned by the door.

5 3. In a coke oven door machine for removing and replacing a coke oven door which in its closed position is seated in a vertically disposed door frame, the combination with a supporting structure movable toward and away from said
10 door frame, of a beam pivotally connected to said structure to turn about a horizontal axis and including upper and lower portions adapted to engage upper and lower portions, respectively,
15 of the door frame, and formed with a vertically disposed guideway, and a door lifting member mounted on said beam for vertical movement in said guideway.

4. In a coke oven door machine for removing and replacing a coke oven door having movable door locking means and which in its closed position is seated in a vertically disposed door frame, the combination with a supporting structure movable toward and away from said door frame, of a beam pivotally connected to said
25 structure to turn about a horizontal axis and including upper and lower portions adapted to engage upper and lower portions, respectively, of the door frame, and formed with a vertically disposed guideway, a door lifting member mounted
30 on said beam for vertical movement in said guideway, locking bar actuating means mounted on said beam and including an actuating part, and a common actuating mechanism for giving said member vertical movements in said guideway and for giving said actuating part up and
35 down movements related to but dissimilar to the vertical movements given said member.

5. In a coke oven door machine for removing and replacing a coke oven door having movable door locking means and which in its closed position is seated in a vertically disposed door frame, the combination with a supporting structure movable toward and away from said door frame, of a beam pivotally connected to said
45 structure to turn about a horizontal axis and including upper and lower portions adapted to engage upper and lower portions, respectively, of the door frame, and formed with a vertically disposed guideway, a door lifting member mounted
50 on said beam for vertical movement in said guideway, locking bar actuating means mounted on said beam and including an actuating part, and a common actuating mechanism for giving said member vertical movements in said guideway and for giving said actuating part up and down movements of greater extent than the vertical movements given said member.

6. In a coke oven door machine for removing and replacing a coke oven door which in its closed position is seated in a vertically disposed door frame and is resiliently held in place by a locking mechanism including a locking bar movably mounted on said door and resilient means tending to move said bar away from the
65 door, the combination of a supporting structure movable toward and away from said door frame, a beam pivotally connected to said structure to turn about a horizontal axis and including upper and lower portions adapted to engage upper and lower portions, respectively, of
70 said door frame, a door lifting member mounted on said beam for straight line movement relative thereto in the longitudinal direction of the beam, means for actuating said locking mechanism comprising a part pivoted to said beam,

an engaging part given up and down movements by angular movements of the first mentioned part, and a common actuating mechanism for giving separate up and down movements to said member and said engaging part.

7. In a coke oven door machine for removing and replacing a coke oven door which in its closed position is seated in a vertically disposed door frame and is resiliently held in place by a locking mechanism including a locking bar movably mounted on said door and resilient means
10 tending to move said bar away from the door, the combination of a supporting structure movable toward and away from said door frame, a beam pivotally connected to said structure to
15 turn about a horizontal axis and including upper and lower portions adapted to engage upper and lower portions, respectively, of said door frame, a door lifting member mounted on said beam for up and down movements relative thereto, means for actuating said locking mechanism,
20 mounted on said beam for up and down movements relative thereto, and an engaging part given up and down movements by angular movements of the first mentioned part, and a common actuating mechanism for giving separate up and down movements to said member and last mentioned means, directly connected to the latter, and connected to said member through a lost motion connection.

8. In a coke oven machine for removing and replacing a coke oven door which in its closed position is seated in a vertically disposed door frame and is held in place by locking means including a locking bar movably mounted on said
35 door, the combination of a support movable toward and away from said door frame, a door lifting member and a locking bar lifting part mounted on said support for up and down movement, and a common actuating means for said
40 member and part mounted on said support and directly connected to said part for giving the latter its up and down movements, and connected to said member through a lost motion connection permitting limited up and down movement of said part without a corresponding up and down movement of said member.

9. In a door machine for removing and replacing doors normally closing the ends of horizontal coking oven chambers, the combination of a supporting structure horizontally movable
50 into operative relation with each of a plurality of oven chamber ends, a door engaging member mounted on said structure for movement upward relative to the latter to first operatively engage
55 a door occupying its normally closed position and thereafter to lift the door to a higher level, means for moving said member upward from an initial position which is below its position of engagement with the door and is independent of the door position and is dependent on the position of said structure, and a limit switch mechanism for terminating the door lifting movement of said member after an extent of movement of the latter upward from its said position of engagement which is predetermined and independent of the distance between said initial position and said position of engagement.

10. In a door machine for removing and replacing doors normally closing the ends of horizontal coking oven chambers, the combination of a supporting structure horizontally movable into operative relation with each of a plurality of oven chamber ends, a door engaging member mounted on said structure for movement upward
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relative to the latter to first operatively engage a door occupying its normally closed position and thereafter to lift the door to a higher level, means for moving said member upward from an initial position which is below its position of engagement with the door and is independent of the door position and is dependent on the position of said structure and a limit switch mechanism for terminating the door lifting movement of said member after an extent of movement of the latter upward from its said position of engagement which is predetermined and independent of the distance between said initial position and said position of engagement, said mechanism comprising relatively movable parts and means for giving them a relative movement of predetermined extent as said member is given the said door lifting movement, and means including an element engaging and vertically positioned by the door for insuring the same relative positions of said parts at the beginning of the said door lifting portion of its up movement into its door engaging position.

11. The combination with a coke oven door structure comprising a door body adapted to engage the door seat of a coke oven structure having door holding means associated with said seat, and comprising a locking member mounted on said body for movements toward and away from said body and comprising resilient means acting between said locking means and door body and tending to move them apart whereby said door body may be pressed against said seat by said resilient means when the locking member engages said holding means and is thereby held against movement away from said seat, of a door lifting and moving mechanism including means for subjecting said door structure to substantially self-contained stresses, including opposing stresses acting on said resilient means to interrupt the action of the latter between the door body and locking bar.

12. The combination with a coke oven door structure comprising a door body adapted to engage the door seat of a coke oven structure having door holding means associated with said seat, and comprising a part adapted to be engaged by a door lifting hook, and comprising a locking member mounted on said body for movements toward and away from said body, and comprising resilient means acting between said locking member and door body and tending to move them apart, whereby said body may be pressed against said seat by said resilient means when the locking member engages said holding means and is thereby held against movement away from said seat, of a door lifting and moving mechanism including a door lifting hook and means movable relative to said hook for subjecting said door structure to substantially self-contained stresses including opposing stresses acting on resilient means to interrupt the action of the latter between the door body and locking bar.

13. The combination with a coke oven door structure comprising a door body adapted to engage the door seat of a coke oven structure having door holding means associated with said seat, a locking member mounted on said body for movements parallel to said body between locking and releasing positions and for movements toward and away from said body, and resilient means acting between said locking member and door body and tending to move them apart, whereby the door body may be pressed against said seat by said resilient means when the locking

member engages said holding means and is thereby held against movement away from said seat, of a door lifting and moving mechanism including means for subjecting said door structure to substantially self-contained stresses including opposing stresses acting on said resilient means to interrupt the action of the latter between the door and locking bar, and for engaging and lifting said locking member out of engagement with said holding means.

14. The combination with a coke oven door including a rigid outer portion and adapted to be removably seated in a stationary door frame, of door locking means movably mounted on said door, and a door machine including a structure movable toward and away from said door frame, a beam pivotally connected to said structure to turn relatively thereto about a horizontal axis and thereby bring upper and lower portions of said beam into engagement, respectively, with upper and lower portions of said door frame, and means mounted on said beam operable when said beam is in engagement with said door frame, to actuate said locking means to release the door and to lift the latter.

15. A combination as specified in claim 14, in which said beam is biased for movement about the axis of its connection to said structure, into a position in which a door engaged and supported by said beam has its lower portion nearer than its upper portion to the door frame, whereby in the door replacing operation, the lower portion of the door will engage and be held against the lower portion of the door frame as the upper portion of the door is moved into engagement with said frame.

16. The combination with a coke oven door adopted to seat in a vertically disposed door frame, and provided with an engaging portion above and at the outer side of the center of gravity of the door, and a door machine including a structure movable toward and away from the door frame and comprising a beam pivoted to turn about a horizontal axis relative to said structure to effect engagement of upper and lower portions of the door frame by upper and lower portions of said beam, respectively, when said structure is moved toward said door, an upwardly movable part mounted on said beam and adapted to engage the said engaging portion of the door and lift the latter and resilient means carried by said beam and adapted to engage and prevent outward movement of the lower portion of the door relative to its upper portion, as the door is being lifted by said upwardly moving part.

17. The combination with a coke oven door adapted to be removably seated in a door frame, and provided with a horizontal locking bar movable toward and away from the door, and having its ends extending beyond the side edges of the door and adapted to engage hooks carried by said door frame and including resilient means acting between the door and bar and tending to move the latter away from the door, and a door machine including a structure movable toward and away from said door frame, and door engaging parts mounted on said structure and movable upward relative to the latter and adapted to engage and render said means inoperative during an initial portion of their upward movements, and during a subsequent portion of their upward movement to lift said door and latch bar out of engagement with said door frame and hooks, respectively.

18. The combination with a coke oven door

including a rigid outer portion and adapted to be removably seated in a stationary door frame, of door locking means movably mounted on said door, resilient means normally acting between, 5 and tending to separate said door and locking means, and a door machine including a structure movable toward and away from said door frame, a beam pivotally connected to said structure to turn relatively thereto about a horizontal axis 10 and thereby bring upper and lower portions of said beam into engagement, respectively, with upper and lower portions of said door frame, and means mounted on said beam operable, when said beam is in engagement with said door frame, to 15 render said resilient means inoperative and to lift the door.

19. A coke oven door machine for removing and replacing a coke oven door which in its closed position is seated in a vertically disposed door 20 frame, said machine comprising a supporting structure movable toward and away from said door frame, a beam pivotally connected to said structure to turn about a horizontal axis and including portions respectively above and below said 25 axis and adapted to engage upper and lower portions, respectively, of the door frame, door lifting means mounted on said beam, and yielding means acting between the structure and beam and tending to hold the lower and upper portions 30 of the latter at lesser and greater distances, respectively, from the door frame.

20. A coke oven door machine for removing and replacing a coke oven door which in its closed position is seated in a vertically disposed door frame, said machine comprising a supporting 5 structure movable toward and away from said door frame, a beam pivotally connected to said structure to turn about a horizontal axis and including portions respectively above and below said axis and adapted to engage upper and lower 10 portions, respectively, of the door frame, door lifting means mounted on said beam, yielding means acting between the structure and beam and tending to hold the lower and upper portions of the latter at lesser and greater distances, 15 respectively, from the door frame, and means adjustable to vary said distances.

21. The combination with a coke oven door, of an element mounted on said door for angular movement about a horizontal axis and comprising 20 a vertically disposed portion and a horizontally disposed portion, a locking bar, a connection between the latter and said vertically disposed portion, a spring connecting said door and element and tending to turn said element in the 25 direction to move said locking bar away from the door, and a door machine including means upwardly movable and adapted on its upward movement, to engage said horizontally disposed portion and move said locking bar toward the 30 door, and thereafter to engage and lift the door.

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