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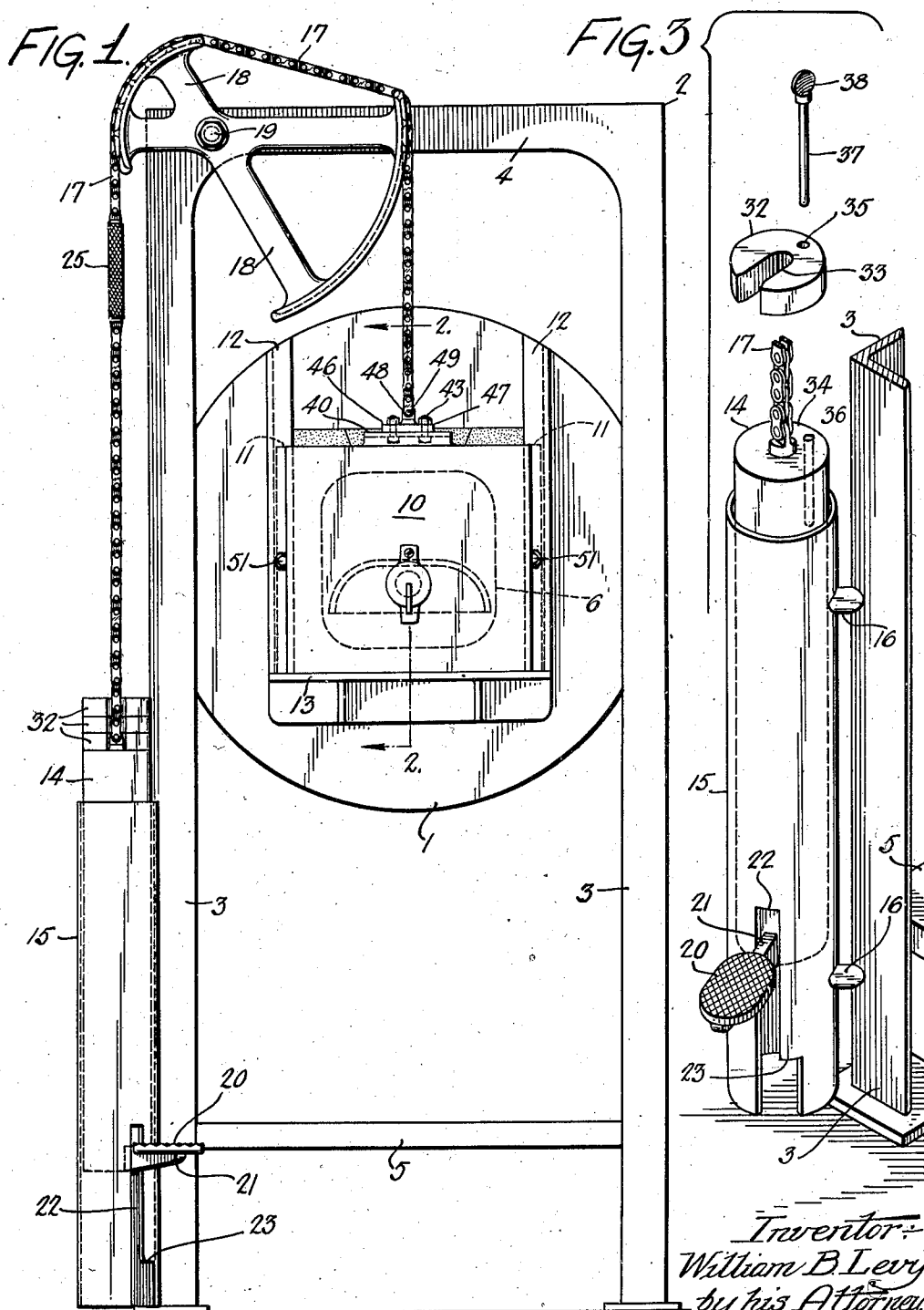
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FURNACE DOOR OPERATING MECHANISM

Filed Nov. 18, 1942

2 Sheets-Sheet 1



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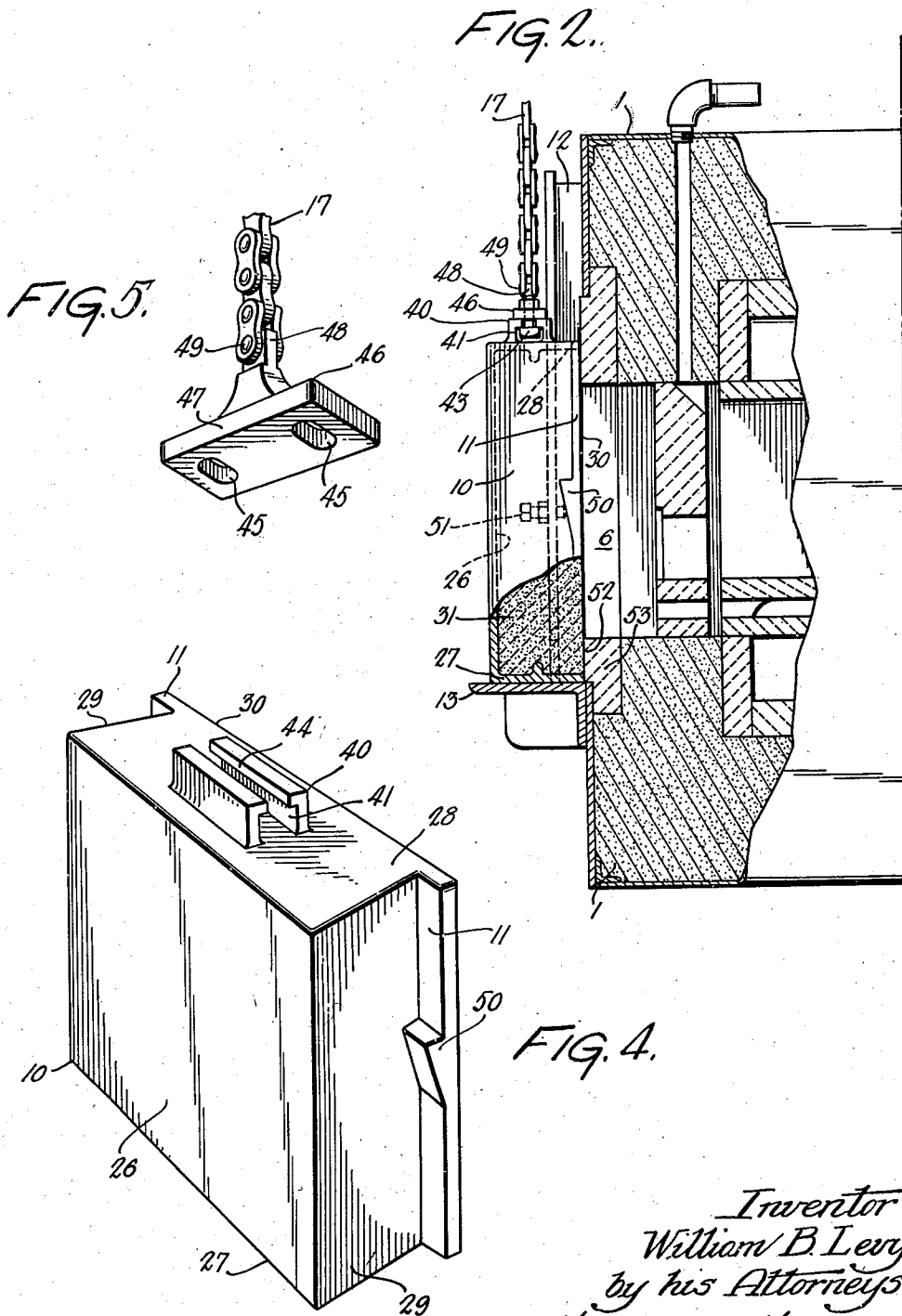
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FURNACE DOOR OPERATING MECHANISM

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7 Claims. (Cl. 110—176)

This invention relates to metal-heating furnaces, and particularly to furnaces of the type disclosed in the United States Letters Patent, No. 2,277,591, dated March 24, 1942, which issued to William B. Levy (the present applicant) and Sylvan N. Levy, as joint inventors.

The present invention relates to mechanism for balancing and operating the door of the furnace which, in the kind of furnace previously referred to, is of the vertically slidable type.

Heretofore, considerable difficulty has been experienced during the operation of the aforesaid type of furnace doors as a result of the door jamming or binding in the guideways in which the door is slidably mounted.

Another difficulty encountered in the operation of the aforesaid type of furnace doors resides in the door having a tendency to creep open, in some instances, and in other instances, to lose balance with its counter-weight, thereby requiring excessive manual labor to raise the door.

One object of the invention is to provide means whereby the balance between the door and its counter-weight may be readily adjusted, as the weight of the door changes under the circumstances hereinafter noted.

Another object of the invention is to provide means whereby the attachment point of the counter-weight chain, or equivalent flexible element, may be kept in line with the center of gravity of the door, to prevent jamming or binding of the door in its guide-ways.

In the accompanying drawings:

Fig. 1 is a face view of a furnace equipped with operating mechanism constructed and adapted to function according to the principles of the present invention;

Fig. 2 is an enlarged fragmentary longitudinal sectional view of the furnace, and its door, as taken on the line 2—2, Fig. 1;

Fig. 3 is a detached perspective view of the counterbalancing mechanism of the door;

Fig. 4 is a detached perspective view of the door; and

Fig. 5 is a detached perspective view of the door hanger.

As shown in Fig. 1, the furnace 1 is supported by a rigid framework 2, which includes vertical uprights 3, 3, and a horizontal cross member 4 at the top of the uprights 3, 3. Adjacent the bottom of the framework 2, the uprights 3, 3, are rigidly connected by a shelf 5, in the present instance.

The front face of the furnace 1 is provided with an entrance opening 6, by which the metal to be

treated is passed into and removed from the interior of the furnace. The entrance 6 is adapted to be closed by a vertically slidable door 10, having vertical side flanges 11, 11 which are respectively located in channel guides 12, 12 disposed at opposite sides respectively of the entrance 6. Below the bottom of the entrance 6 is a sill 13 on which the door 10 normally rests when in its lower entrance-closing position.

10 The weight of the door 10 is adapted to be counterbalanced by a weight 14 which is vertically slidably mounted in a guide tube 15. The tube 15 is secured to one of the legs or uprights 3, in any suitable manner, as by brackets 16, 16.

15 The counter-weight 14 is connected to the door 10 by a chain, or other flexible connector 17, passing over a differential rocking lever 18, which latter is pivotally connected to the frame 2, at 19.

The lower end of the counter-weight 14 is provided with a foot treadle 20, which includes an arm 21, secured to the lower end of the counter-weight 14 and slidable in a vertical slot 22 formed in the lower end of the guide tube 15. If desired, the lower end of the slot 22 may be laterally enlarged to provide a shoulder 23 under which the upper edge of the arm 21 may be hooked by rotation of the arm 21 slightly about the axis of the weight 14. To assist the operator in raising the door 10 by placing his left foot, for example, on the treadle 20, the connecting chain 17 is provided with a knurled hand grip 25.

The door 10 includes a hollow integral main body structure which is preferably composed of cast iron or steel, and consists of a substantially flat rectangular front plate 26, a bottom marginal flange 27, a top marginal flange 28, and a pair of side marginal flanges 29, 29 disposed at acute angles to the front plate 26, and which converge toward the rear face 30 of the door 10 where the guide flanges 11, 11 are located and extend laterally in opposite directions from the rear edges of the side flanges 29, 29, respectively.

The rear face 30 of the door casting is open and defined by the rear edges of the flanges 27, 28 and 29. The hollow interior of the door casting is provided with a body of heat-resisting material 31, preferably a suitable fire brick or its equivalent.

In assembling, the heat-resisting material 31 is initially in a plastic or semi-plastic state, and is moulded directly in the hollow interior of the door casting, with the rear face of the heat-resisting material 31 flush with the rear edges of the marginal flanges 27, 28 and 29, coincident with the rear face 30 of the door. After mould-

ing, the material 31 is dried within the hollow casting. When the furnace to which the door is attached is put into operation, the extremely high temperatures, at which the furnace operates, effect a super-drying of the material 31, which produces a loss in weight of the door 10, as a whole.

When the furnace is first assembled, prior to initial operation, the counter-weight 14 is adjusted to balance the weight of the door 10, so that the door may be readily raised by a relatively light foot pressure on the treadle 20, supplemented, when desired, by a pull on the chain 17 by gripping the handle 25 thereon.

In order to make the counter-balancing adjustment, the counter-weight 14 is preferably provided with a plurality of supplementary weights 32, 32 which, as shown in Fig. 3 particularly, are recessed inwardly from the peripheral edges thereof, as indicated at 33, to pass around the counter-weight chain 17, whereby the supplementary weights 32 will rest directly on the top surface 34 of the counter-weight 14.

In order to prevent accidental displacement of the supplemental weights 32, each of the said weights is provided with an opening 35 which is adapted to be placed in vertical alignment with a corresponding opening 36 formed in the upper surface 34 of the counter-weight 14, for the reception of a locking pin 37. The pin 37 fits more or less loosely through the openings 35 and 36 and locks the supplementary weights 32 in position on the main weight 14. The locking pin 37 is provided with a suitable knob or head 38 by which the pin may be raised to permit removal of any one or all of the supplementary weights 32.

After the furnace 1 has been operated initially for a substantial period of time, and the super-drying of the heat-resisting material 31 has taken place, and the balance between the door 10 and the counter-balancing weights 14 and 32 has been disturbed, such balance may be readily restored by removing the supplementary weights 32, one after another, from time to time, as the super-drying of the material 31 progresses, whereby the balance between the door and its counter-balancing mechanism may be maintained at all times.

The above noted arrangement is particularly advantageous where the furnace is being used for annealing or tempering etc. of small objects, where it is necessary for the operator to open and close the door 10 frequently in the treatment of large numbers of pieces. Thus, fatigue of the operator, for which the lifting of the heavy door is responsible, is reduced to a minimum, whereby his energy may be directed to the proper handling of the work rather than being expended in the operation of the door.

The hand grip 25 functions also as a safety device, to prevent the operator's hand from being caught between the chain 17 and the short-radius segment of the locker 18, when closing the door. Invariably, the natural and inherent instinct of the operator, when operating the door, is to grip the chain 17 with the left hand while operating the door, primarily through the foot treadle, by the left foot while using the right hand at the same time, to place the work in the furnace and to remove the work from the furnace.

By placing the grip 25 at the proper place in the chain 17 with respect to the rocker 18, when the door 10 is closed, danger of injuring the fingers of the operator is obviated, as the operator

instinctively will grip the knurled handle 25, and not the bare chain 17, when such a handle is available.

In order to prevent jamming or binding of the door flanges 11, 11 in the guides 12, 12, by the door leaning from a truly vertical plane, either forwardly or rearwardly, the top marginal flange 28 is provided with a rectangular lug 40 having an undercut slot 41 for the reception of the heads 42 of bolts 43 which pass through the top slot 44 of the lug 40 and through openings 45 formed in the base 46 of a chain attachment fitting 47, said fitting having a vertical lug 48 to which oppositely disposed links of the chain 17 are connected by a pin 49.

As shown in Fig. 5, the fitting 47, by reason of the elongation of the bolt openings 45, is adapted to be adjusted toward the rear face 30 of the door 10 or toward the front face 26 thereof, whereby the center line or axis of the chain 17 may be placed in vertical alignment, fore and aft of the door 10, with the center of gravity of the door. Also, the fitting 47 is adapted to be adjusted laterally, abreast of the door 10, by sliding the bolts 43 in either direction, crosswise of the door, within the lug 40 in which the undercut slot 41 is formed. In this way, the axis of the chain 17 may be accurately aligned with the center of gravity of the door 10, thus making it possible for the guide flanges 11 of the door 10 to ride freely and truly in the channels 12 without binding therein.

The above alignment also adds to the ease of operation of the door and contributes to the conservation of the energy of the operator when the door of the furnace is necessarily operated at frequent intervals.

As disclosed in the aforesaid co-pending application, the door flanges 11, 11 may, if desired, be provided with wedge shaped lugs 50 which, as the door approaches its closed position, engage the inner ends of adjustable abutment screws 51 which move the door toward the front of the furnace until the rear face 30 thereof engages the front face 52 of face tile 53 which frame the opening 6 of the furnace, thereby effectively sealing the furnace entrance against loss of heat around the door when closed.

When large pieces of work are being treated in the furnace, which require the use of both the operator's hands and that both of his feet remain on the floor, for stability, or when small pieces of a particular nature requiring quick operation of the door by one attendant, while another makes the work transfer into and out of the furnace, or in any other instance which may require the service of a special operator for the door while another handles the work, the handle 25 on the chain 17 is used, in many cases exclusively, to operate the door, by the door-attendant standing to one side, out of the work-attendant's way. This is made possible by reason of the door being kept substantially in balance, with just enough over-balance in favor of the door to keep it seated on the sill, against creeping.

I claim:

1. Operating mechanism for a vertically slidable furnace door, comprising a counter-weight for the door, a flexible element operatively connecting the door and the counter-weight, means for attaching one end of said flexible element to the top of said door comprising a fitting secured to said one end of said flexible element and adapted to be adjustably mounted on the top of said door, said top and said fitting being respectively

provided with intersecting bolt slots, and bolts mounted in said slots for securing said fitting to said top, said intersecting slots affording universal horizontal adjustability of said fitting relative to said top.

2. Operating mechanism for a vertically slidable furnace door, comprising a counter-weight for said door, a motion multiplying rocker lever comprising a short arm and a long arm above said door and said counter-weight and in a common vertical plane therewith, flexible means connecting the long arm of said rocker with said door and the short arm thereof to said counter-weight, the weight of said door being variable under conditions of use of the furnace, manual operating means for the door connected to the short arm of said rocker lever, and means for varying the weight of said counter-weight in accordance with predetermined variations in the weight of the door.

3. Operating mechanism for a vertically slidable furnace door, comprising a counterweight for the door, a rocker above the door and counter-weight and in a common vertical plane therewith, flexible means connecting the rocker with the door and the counter-weight, a foot treadle connected to the lower end of counter-weight for operating the door, and a complementary hand grip on said flexible means intermediate said rocker and said counter-weight in predetermined relation to said foot treadle for simultaneous operation therewith for facilitating the operation of the door.

4. Operating mechanism for a vertically slidable furnace door, comprising a cylindrical counter-weight for the door, a tubular guide for the counter-weight, a rocker above the door and counter-weight, flexible means connecting the rocker with the door and the counter-weight, a foot treadle connected to the lower end of counter-weight for operating the door and having a portion projecting through a slot in said tubular guide, a shoulder formed in said slot for engagement with said treadle when rotated slightly about the axis of said counter-weight, and a complementary hand grip on said flexible means intermediate said rocker and said counter-weight in predetermined relation to said foot treadle for simultaneous operation therewith for facilitating the operation of the door.

5. Operating mechanism for a vertically slid-

able furnace door, comprising a flexible element for raising and lowering said door, an attachment fitting connecting said element to the top surface of the door, an elongated lug integral with said door and projecting above said top surface with an undercut slot extending longitudinally of said lug, said fitting having transverse slots adapted to lie in intersecting relation to said undercut slot, and bolts extending through said slots at said intersections for securing said fitting to said lug, said intersecting slots affording universal horizontal adjustability of said fitting relation to said door for aligning the point of attachment of said flexible element relative with the center of gravity of the door.

6. Operating mechanism for vertically slidable furnace doors, comprising a flexible element for raising and lowering said door, an undercut slot formed in the top of the door, an attachment fitting connected to said flexible element and superposed above said slot, a pair of elongated slots formed in said fitting at right angles to said undercut slot, and bolts passing through said elongated slots and said undercut slot to afford horizontal universal adjustment of said fitting relative to said door for aligning said flexible element with the center of gravity of said door.

7. Operating mechanism for vertically slidable furnace doors, comprising a counter-weight for said door, a motion multiplying rocker lever comprising a short arm and a long arm above the door and the counter-weight and in a common vertical plane therewith, a flexible element connecting the short arm of the rocker to the counter-weight and the long arm of the rocker to the door, the door being subject to manual actuation by operators of various weights and physical abilities and the weight of said door being subject to variation during operation of the furnace, manual operating means for the door connected to the short arm of said rocker lever, a series of supplemental weights on top of and axially aligned with said counter-weight and recessed to fit around said flexible element to compensate for said variations in operation of said door, said counter and supplemental weights having alignable openings formed therein, and a locking pin fitting through aligned openings in said supplemental weights and in said counter-weight to maintain substantial alignment therebetween.

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