May 19, 1964 J. L. HUNT ETAL 3,133,513

FURNACE

Filed May 22, 1961

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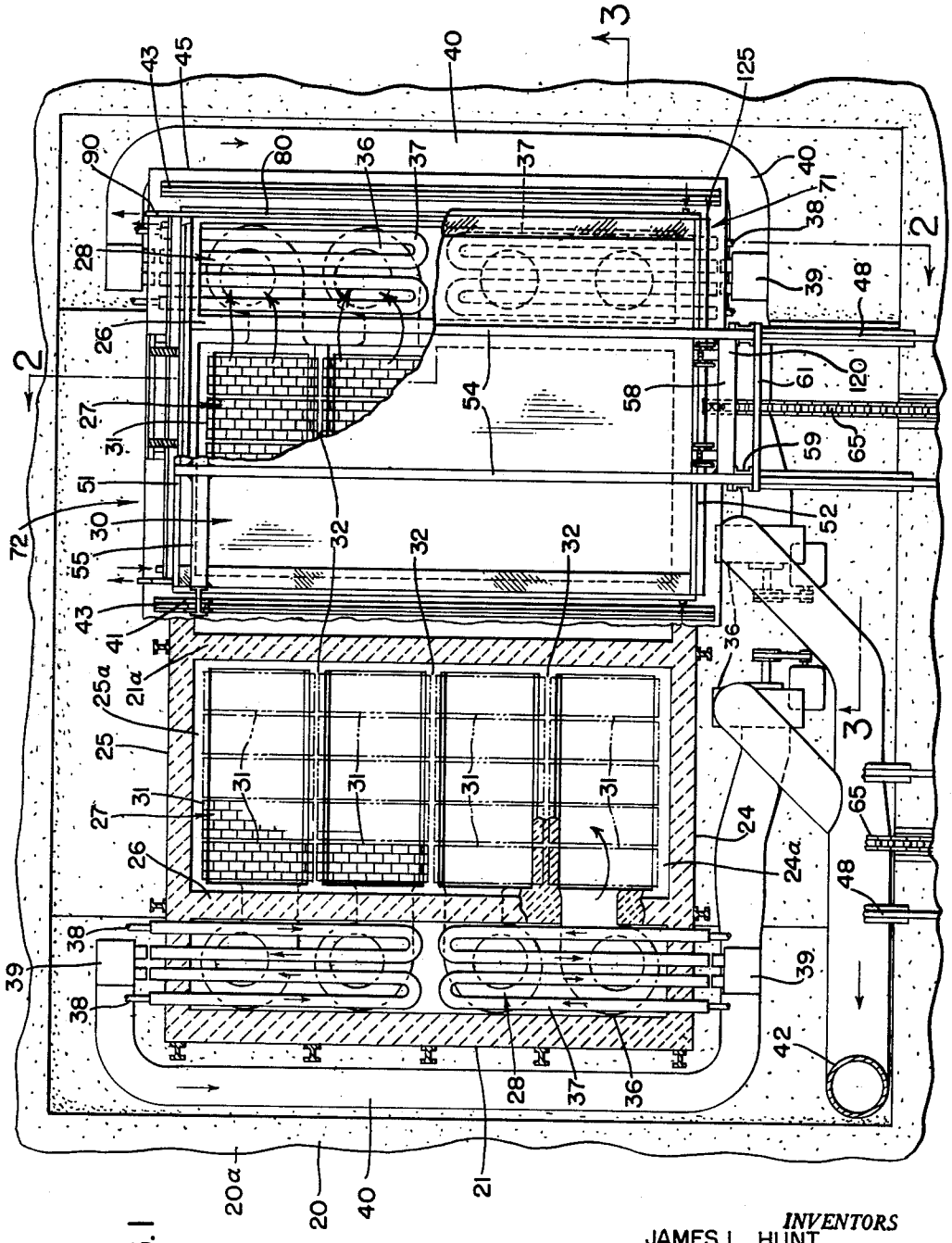


FIG. 1

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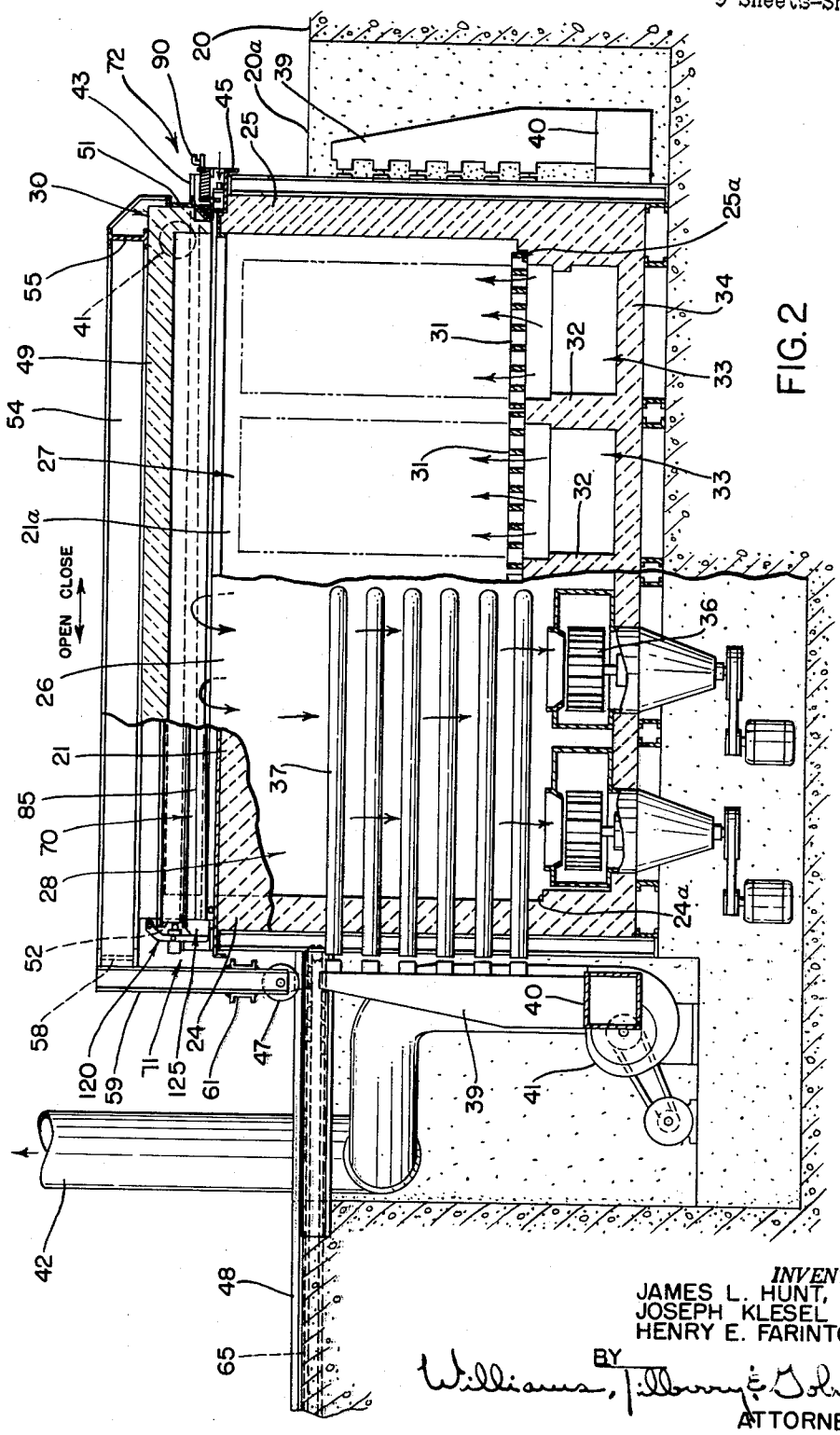


FIG. 2

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Filed May 22, 1961 9 Sheets-Sheet 3

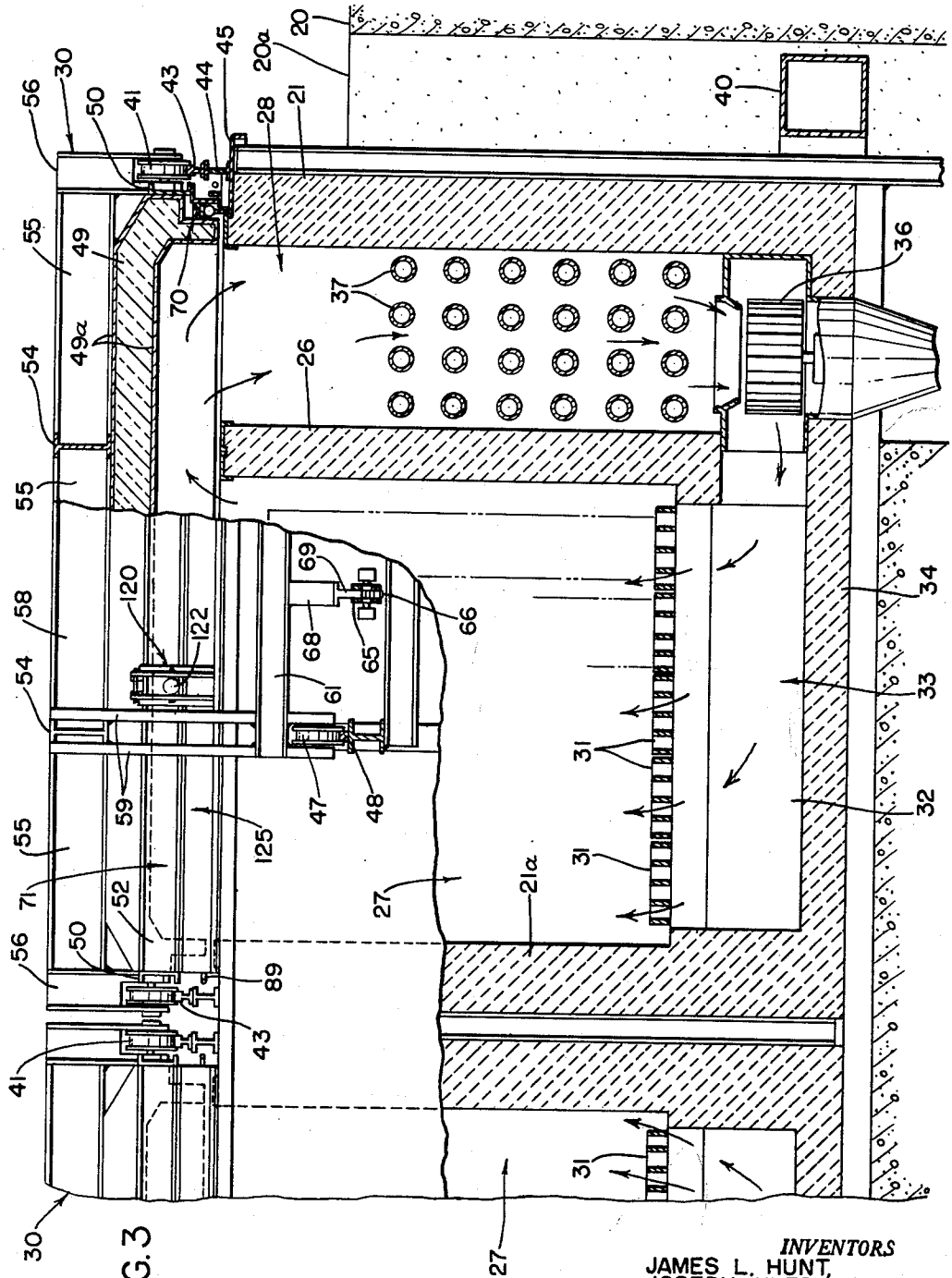


FIG. 3

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Filed May 22, 1961 9 Sheets-Sheet 4

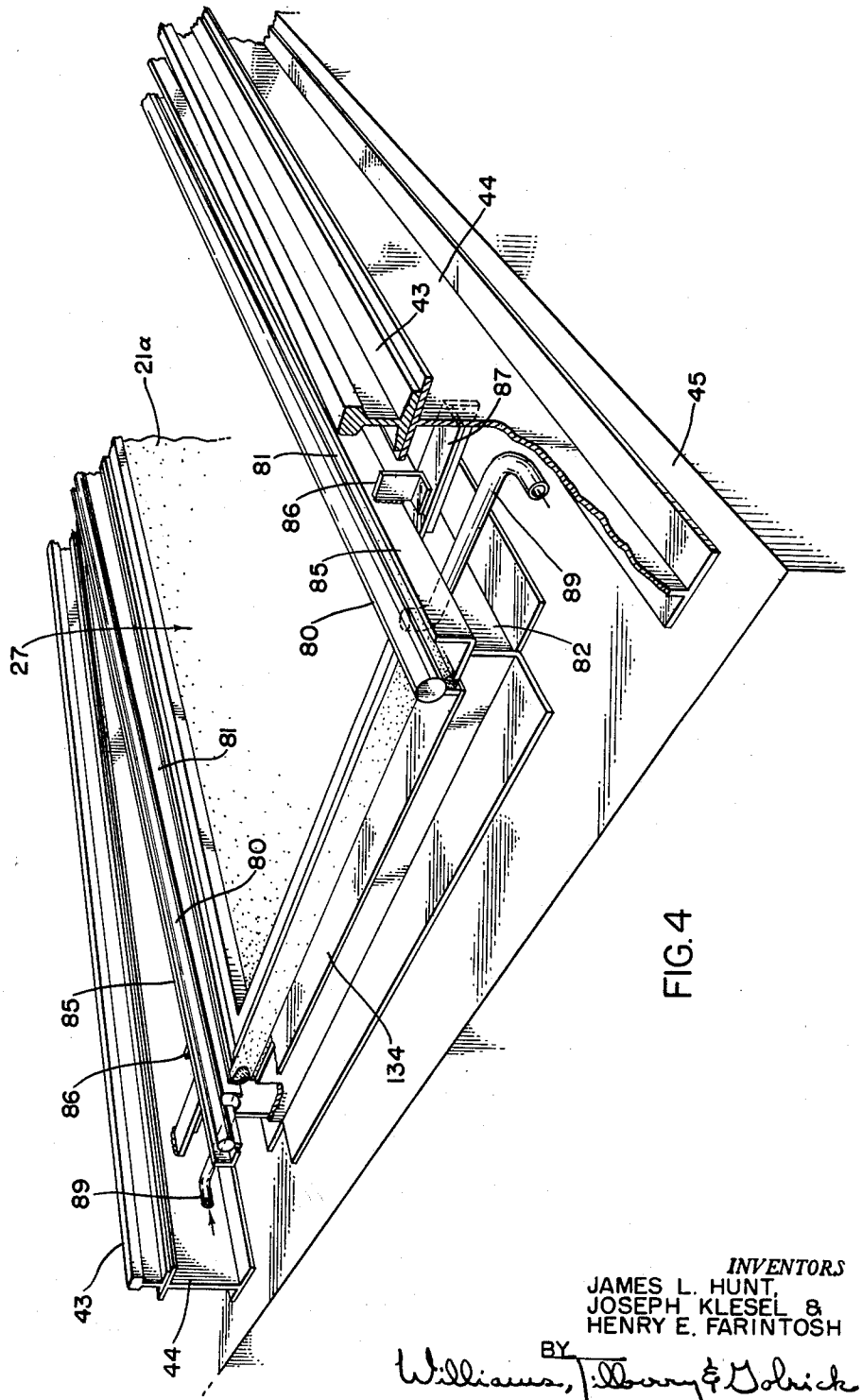


FIG. 4

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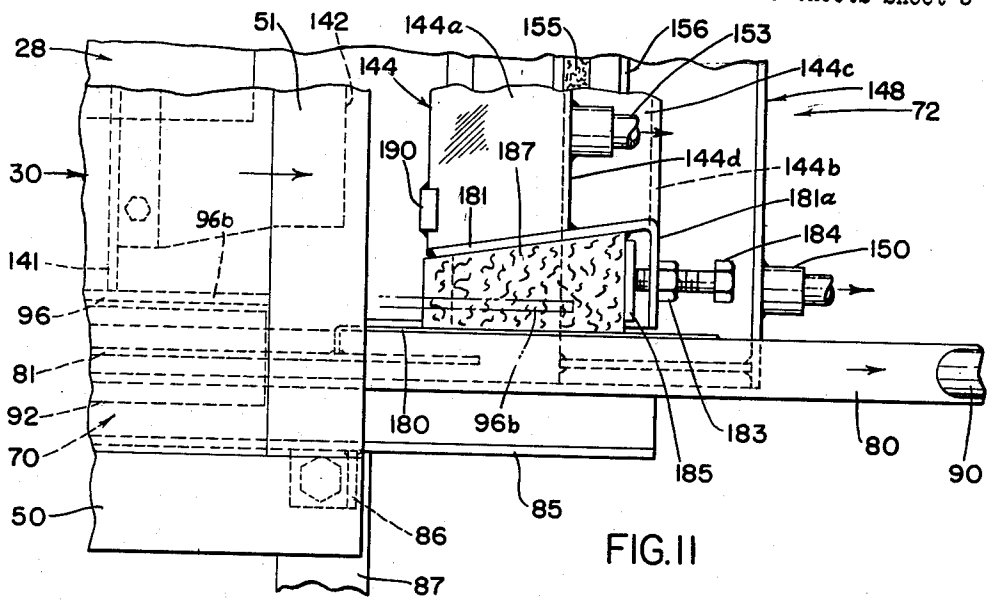


FIG. 11

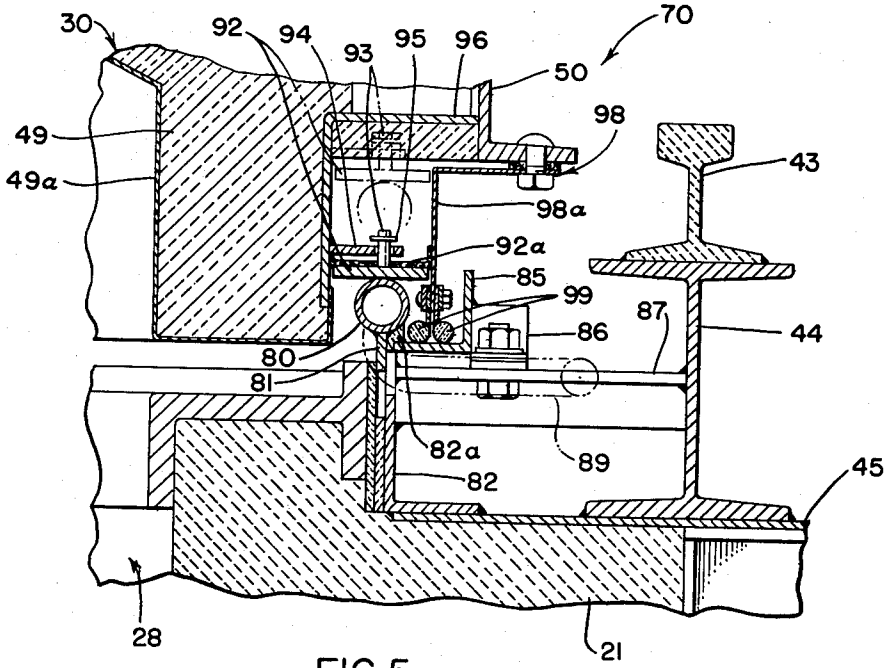


FIG. 5

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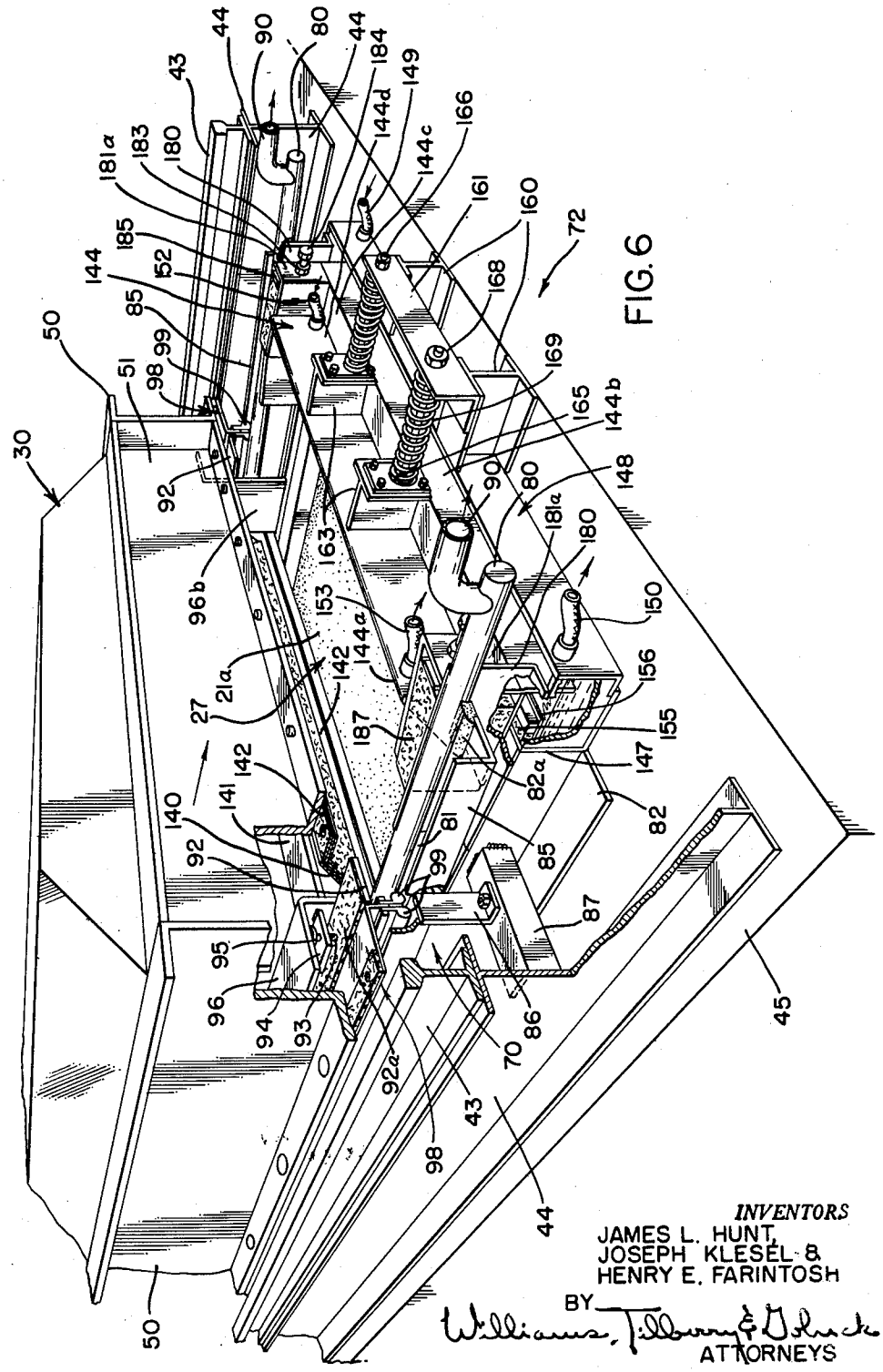


FIG. 6

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Filed May 22, 1961 9 Sheets-Sheet 7

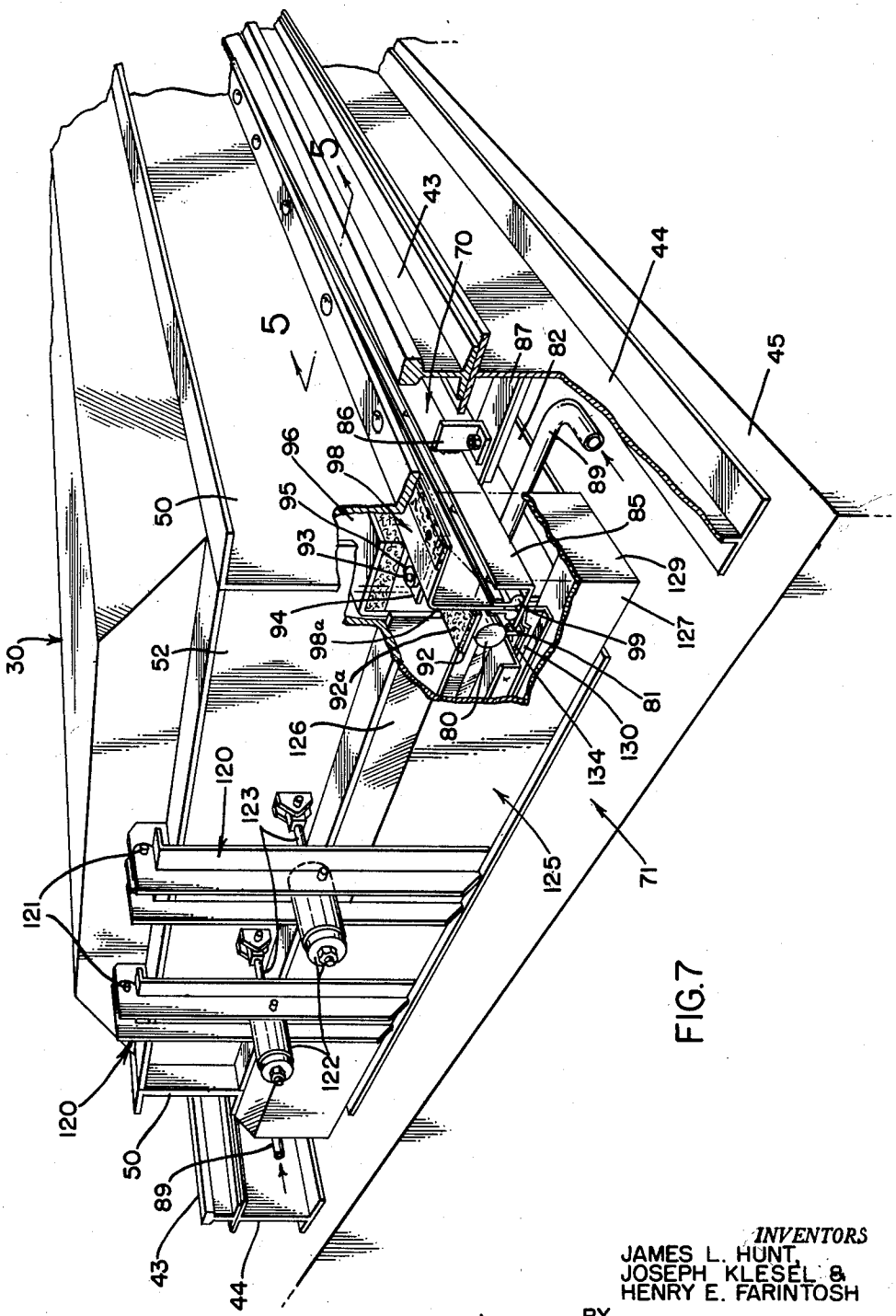


FIG.7

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Filed May 22, 1961 9 Sheets-Sheet 8

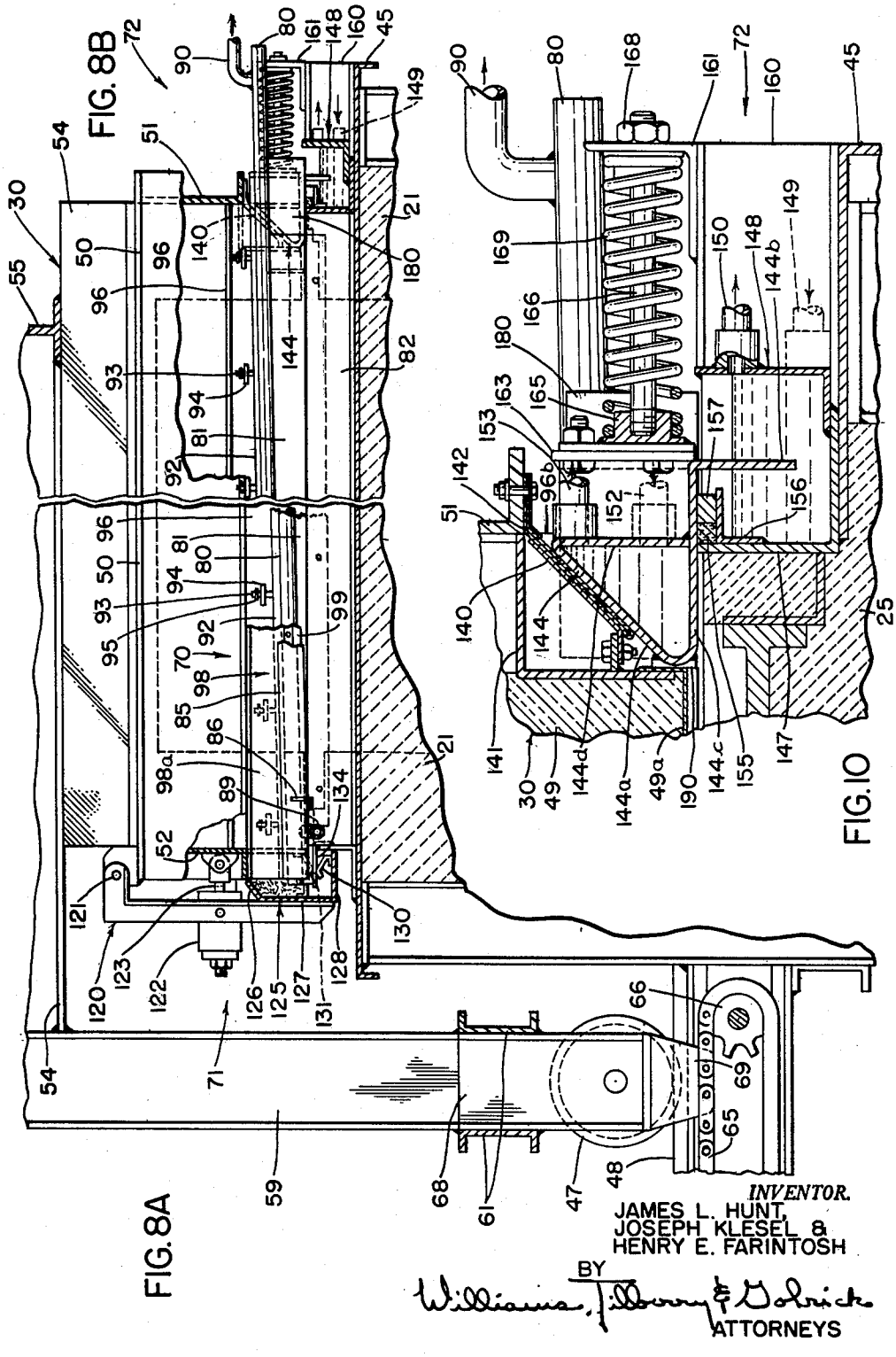


FIG. 8A

FIG. 8B

FIG. 10

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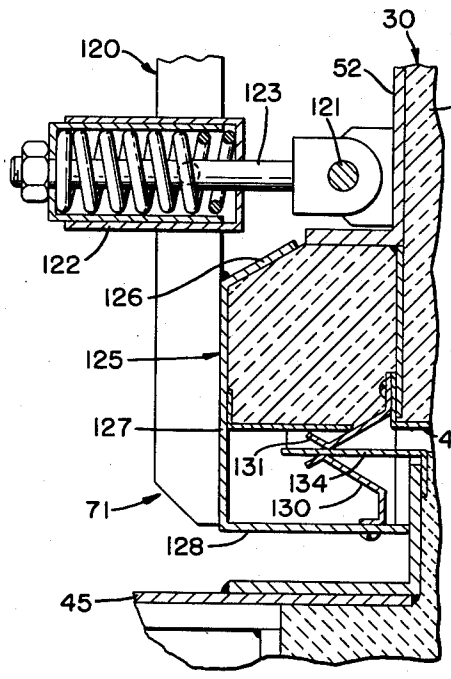


FIG. 9

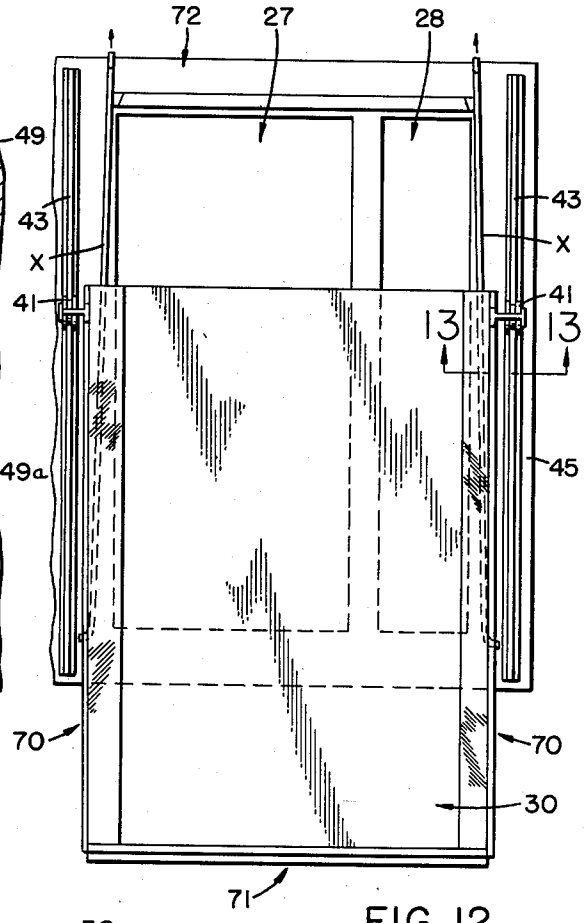


FIG. 12

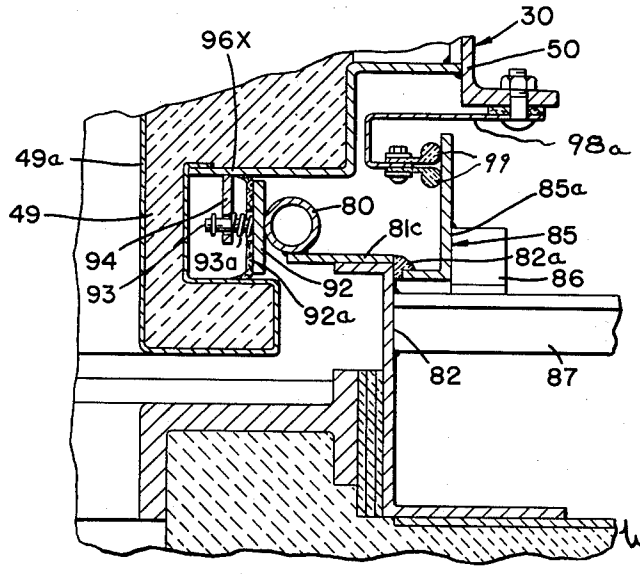


FIG. 13

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United States Patent Office 3,133,513 Patented May 19, 1964

3,133,513

FURNACE

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Filed May 22, 1961, Ser. No. 111,669
9 Claims. (Cl. 110—173)

The present invention generally relates to pit-type industrial furnaces, and more particularly to a novel cover arrangement and cover sealing structure for furnaces of the character described.

Preparatory to metal processing operations such as rolling or forging, for example, ingots or other metal objects are often placed in appropriate furnaces or soaking pits for relatively extended periods of time to bring the entire body of each object to a temperature desired for subsequent working, or to a homogeneous metallographic character before subsequent operations. Annealing furnaces and soaking pits, as these words are commonly understood, are examples of the furnaces here in question.

In a furnace of the character here in question, quite commonly it is desirable to maintain a certain atmosphere about the metal objects being heated therein; either in the sense that the internal furnace gas or atmosphere is retained as far as possible to avoid loss of heat energy by leakage of the internal atmosphere to the external atmosphere; or in the sense that it is desirable to maintain about the objects being heated an internal furnace atmosphere specific and as constant as possible in composition. In the latter case, for example, the atmosphere may be essentially nitrogen, or a nitrogen and carbon dioxide mixture, usually to avoid oxidation of the metal surface.

By prior art practice, a furnace unit of the character described comprises a large chamber adapted to receive the ingots, an adjacent heat generating or firing chamber, both upwardly open and separated by a common wall, and a common cover, which has had to be totally removed and replaced as ingots are loaded into or unloaded from the furnace. Because of the large size of such a furnace and therefore its cover, a crane has to be used in handling the latter. Further each furnace unit includes blowers for circulating the internal atmosphere between the firing space and load chamber.

In usual plant installations, whether the cover be removed to and deposited on an adjacent free floor area, or as is often the case the cover be merely stacked upon the cover of an adjacent furnace during the period of loading or unloading, much time is lost in bringing the crane to position and then actually moving the cover on or off a given furnace. Moreover, where it is the practice to stack the covers on adjacent furnaces, if a particular furnace has to be opened for an extended period, an awkward situation may arise meanwhile in approaching and servicing the adjacent furnace, where two covers then have to be handled.

In common prior installations, by virtue both of the fact that the cover is completely removed, and of the fact that a relatively long time is consumed even during the actual cover moving operations, there is a loss of heat energy from the furnace first by way of radiation to the exterior, and secondly by loss of the hot furnace gas, the latter also causing change in the composition of the furnace atmosphere. Also in prior art practice there have appeared difficulties in appropriately sealing the covers used with respect to the top of the fixed structure of the furnace with similar loss of heat from or change of composition of the atmosphere within a covered furnace. The problem is aggravated since pressure differentials established by the positively recirculated furnace gas at some points result in a loss of the internal atmosphere to the external atmosphere and at other regions an intake of a corresponding gaseous volume from the external atmosphere. Such leakage into and from the chamber or furnace thus obviously represents an economic loss on the one hand by the described thermal energy loss; and also where a particular composition is to be maintained for the furnace atmosphere, by loss of material requiring replacement from an external source.

By the present invention there is proposed a furnace having a cover removed and replaced without dependence upon the usual overhead cranes or like cover handling means while ingots or like metal objects are put into or removed from the furnace. This is achieved by use of a cover horizontally shiftably mounted on the furnace and mechanism for shifting the cover.

There is further provided by the present invention in conjunction with a horizontally translatable cover a novel and effective sealing means between the cover and the stationary furnace structure.

The sealing means herein disclosed as provided between the movable cover and the general fixed structure of the furnace permits of both a relative opening or closing of the pit by the cover, and a placing of the cover and basic furnace structure in a practical effectively sealed relation, in an expeditious and efficient manner.

By such means ingots are the more expeditiously loaded or removed, inasmuch as any operations by a crane or the like mechanism are occupied entirely with load handling. Thus cover shift and crane travel can be carried out simultaneously. Hence both as to economy of equipment utilization and the opportunity for loss of heat energy and material from the furnace, the proposed arrangement is far more effective than the present practices for these purposes.

With the arrangement here presented, it becomes possible to open a pit or furnace part way, only as much as required to insert or remove a load; thereby diminishing the heat and atmosphere loss. Generally speaking the actual time of cover opening and closing movement is shortened. For like reason is diminished the "downtime" of the burners, which by usual practice are shut off at the time that the cover is to be removed therefrom and only turned on again when the furnace is closed.

In the particular form of the invention here disclosed there is a further advantage that maintenance operations are in general out of the line of operation or shifting of the cover and therefore safer for the personnel involved. Furthermore the seal elements primarily concerned in maintenance are on the sliding or slidable cover, thereby facilitating the inspection and maintenance of the same.

In addition to the advantages and objects apparent from the aforegoing discussion, other objects and advantages will appear from the following description and the drawings wherein:

FIG. 1 is a plan view of two adjacent furnaces involving the present invention, certain parts having been broken away or removed for clarity of representation;

FIG. 2 is an irregular vertical section view taken as indicated by the line 2—2 in FIG. 1;

FIG. 3 is a view partially in elevation and partially in section, taken as indicated by the lines 3—3 in FIG. 1;

FIG. 4 is a fragmentary perspective view of certain parts of the cover supporting and sealing elements at the front end of one furnace;

FIG. 5 is a vertical detailed section of a lateral seal taken as indicated by the lines 5—5 in FIG. 7;

FIG. 6 is a perspective view of the rear end of a furnace, with cover partially closed, having certain portions broken away;

FIG. 7 is a generally perspective view of the front end of one furnace with certain parts broken away for clarity of representation;

FIGS. 8A and 8B represent, for what are herein respectively identified as the front and the rear ends of the furnace, cover and sealing arrangements partially in side elevation and partially in section;

FIG. 9 is a detailed vertical sectional view of a front end sealing arrangement;

FIG. 10 is a detailed vertical section of an arrangement for the rear seal;

FIG. 11 is a fragmentary plan detail view of a rear end corner seal arrangement appearing in FIG. 6;

FIG. 12 is a generally schematic or outline drawing of another approach to longitudinal sealing of the cover with respect to the stationary furnace structures; and

FIG. 13 is a detailed vertical section taken as indicated by the lines 13—13 in FIG. 12.

General Construction

The general environment of the present invention is shown by FIGS. 1, 2 and 3, representing an adjacent set of two furnaces, such as aluminum ingot homogenizing furnaces. For convenience and definiteness of description, the terms "front" and "rear" will be used in specification and claims to designate the ends of a furnace towards which the hereinafter described cover is horizontally moved in opening and closing respectively.

The major height of the furnace structure is disposed below the working level or surface 20*a* of surrounding environment 20, which at least locally surrounding the furnaces may be poured concrete or the like walling the space about the furnace.

Apart from the cover sealing means and mounting hereinafter described, the furnace is of usual construction comprising for the paired furnace unit the extreme side walls 21, 21, a common wall 21*a*, front and back walls 24 and 25 respectively. Each furnace further includes a longitudinal wall 26, therefore parallel to walls 21 and 21*a*, dividing the furnace space into a larger load space for ingot heating designated generally as 27, and a smaller "firing" or atmosphere heating space generally designated 28.

The staggered section of FIG. 2 is taken at the right hand furnace of FIG. 1, as indicated, to show for one furnace in vertical section a portion of the ingot heating section or space 27 and the corresponding firing space 28.

Each furnace is provided with a cover 30 removable or displaceable to provide access to the ingot heating space; the cover being generally an inverted shallow box-like structure, sealed at all four sides or edges with respect to the walls 21, 21*a*, 24 and 25. An apertured floor for each heating space 27 is provided by grate elements 31 shown supported at opposite ends on wall ledges 24*a*, or 25*a* and adjacent pier structures 32, in spaced relation from the bottom 34 of the furnace. The spaces transverse to each furnace between the adjacent pier structures 32 or end walls, the grates 31 and the bottom 34 form respective plenum chambers 33 under the ingot heating space communicating with respective outlets of the circulating fans or blowers 36.

The inlets of the fans 36 at the bottom of the heating chamber or chambers 28 each circulate gas or furnace atmosphere heated by radiant heating tubes 37 from the common "firing" or atmosphere heating space 28 to respective plenum chambers 33, upwardly through the grates into the common ingot heating chamber, then between the top of the wall 26 and the cover 30 and back through the firing space or chamber 28. The U-shaped heat tubes 37 are supplied at 38 by hot or burning fuel gases at points external of the firing chamber and are exhausted at the exhaust manifold 39 through exhaust ducts 40 by exhaust blower units 41 to the exhaust stack 42.

The basic structure thus far described for the environment is like to that commonly used in such furnaces and hence wall structure gratings, burners, general construction of the covers proper, blowers and exhaust system in the surrounding foundation and like structures will be no further described or detailed.

Cover Mounting

However, in contrast to the prior art practice, the manner of mounting and shifting the cover 30 in opening and closing a furnace is quite different, for each cover is supported and guided to be shiftable or displaceable in a straight line horizontal movement through a fixed path without need of recourse to cranes.

For such movement longitudinal of the furnace in opening and closing movement, each furnace cover is supported and guided at one end (here designated the rear end for purpose of descriptive orientation) by a pair of wheels 41, 41 rotatably mounted on framing of the cover and rolling on respective rail members 43 affixed to I-beam members or like structural elements 44 secured along the edge of the apron 45 or the top edge of the longitudinal walls 21, 21*a*; and at the front end by a centrally located spaced pair of wheels 47 rolling on rails 48 disposed at the level of the surrounding ground or working area surface level 20.

At this point it may be noted that the primary framing of a cover includes longitudinal channel structural elements 50 at each side, and rear and front transverse channel members 51, 52 respectively welded into a rectangular peripheral frame; spaced parallel longitudinal top I-sections 54, and a set of transverse I-beam sections 55 respectively welded between the two longitudinal members 54, and between members 54 and depending members 56. The latter, secured near the lower ends to respective longitudinal side channel members 50, are cut out to accommodate respective rolls 41 suitably mounted on the bottom ends thereof by apt shaft and journal or bearing structures.

At the front ends of the longitudinal top members 54 and there secured in spaced relation by intervening transverse I-beam sections 58, respective spaced pairs of dependent vertical channel members 59 each form a downward leg at the bottom of which is mounted a respective front roller wheel 47. A pair of transverse parallel channels 61 span the front and back of the dependent legs formed by the aforedescribed channels 59.

Within the aforedescribed framing there is of course supported the actual effective closure comprised of insulating materials, designated by the reference numeral 49 in FIGS. 2 and 3, enclosed by an auxiliary supporting envelope again generally designated as 49*a* in FIG. 3, such as suitably formed sheet metal welded or otherwise attached to the primary framing above described.

For opening and closing the cover there is provided an endless sprocket chain 65 (see FIGS. 1, 2, 3 and 8A), reaved at opposite ends about respective sprockets 66, one of which is an idler and the other a powered driving sprocket; while at the center of the spanning member 61 of the legs 59 a dependent member 68 is engaged as at 69 between opposed parallel plates of a link section of the chain 65. The chain 65 is then driven in either of opposite directions for opening or closing of the cover by suitable motor means with appropriate controls. Preferably, as is obvious to those skilled in the art, there is used an electric motor and gear reduction unit, the control system for which includes not only manually operated primary switch control means, but also limit switches operatively disposed between the cover and fixed furnace structure for cutting off motor operation automatically at either end of the cover travel toward open or closed position, and with such means being preferably subject to a stopping control at the manual control point to halt cover motion at any desired intermediate position where a particular given load space may happen to be accessible without complete opening of the cover.

Since the particular control means which may be used are obvious to those skilled in the art of controls for the situation here represented, and further since such con-

trol means are per se no part of the present invention as it is now deemed to be broadly patentable, no further details are here given thereon.

On the opposite sides of each furnace the drawings show similar side seal means generally designated **70** (see FIG. 3 for location and one specific form) front seal means designated by the general reference numeral **71**, and a rear seal means generally designated by the reference numeral **72**, as appears in FIG. 2. The transverse seal means **71** and **72** are at the corners each in effect continued into the longitudinal seal means or interlocked with the cover, when the cover is closed, thereby to provide an effectively peripherally continuous seal means. Insofar as these generally designated structures have been denominated herein as sealing means or seals, individually or as a whole, it should be here noted that these terms are to be accepted in a practical sense, in view of the large extent and mass of the cover and furnace structure; and are not to be interpreted necessarily in any theoretical sense of absolute seals.

The fragmentary perspective view of FIG. 4, taken at the front end of and to one side of one furnace unit shows the angular relation of the stationary seal elements for the longitudinal seals (exaggerated for clarity) to the horizontal parallel rails determining the cover travel; while FIG. 5 is a typical transverse section showing the overall disposition of the movable and stationary seal elements in the longitudinal seals **70**. FIGS. 6 and 7 though showing primarily respectively the rear and front seals also show the further relations of the side seals to surrounding structures.

Alternate forms of the longitudinal side seals are also shown and described with respect to FIGS. 12 and 13.

Side Seals

Each side seal comprises a stationary element mounted or secured, as far as practically possible in gas-tight relation, on a respective side wall **21** or **21***a* of the furnace and a cooperating member or assembly on a corresponding side of the cover, which are disposed angularly relative to the direction of translation or movement to attain on cover closing what might be termed a wedging relation.

As shown in FIG. 4 and FIG. 5, one form of seal comprises a longitudinal pipe **80**, supported to extend in a generally longitudinal direction but slightly inclined to horizontal, through a vertically disposed longitudinally tapering plate **81** welded thereto, having a bolt and slot connection to the vertical leg of an angle iron **82** secured on the top of a furnace wall **21** (or **21***a*) the bolt-slot connections at longitudinally spaced points providing for adjustment of vertical position and angularity of the member **80**. A further part of the stationary seal assembly includes a longitudinal angle iron **85**, with horizontal leg located below the element **80**, secured at longitudinally spaced points as at **86** on respective bridging elements **87** welded respectively to the vertical legs of the angles **82** and the web of the track or rail supporting I-section element **44**.

To minimize problems arising from longitudinal expansion and contraction of the stationary seal element, especially in maintaining a gas-tight relationship with the underlying supporting structure, and as well to mitigate the influence of heat on adjacent elements, the element **80** takes the specific form of a pipe through which cooling water is passed from the lower inlet connections **89** to the upper outlet connection **90**.

Cooperating with the aforedescribed stationary longitudinal side elements or assembly are certain elements carried by the cover. First, within a laterally and downwardly open longitudinal cover recess, as a longitudinal movable seal, bar **92** is vertically shiftably supported by longitudinally spaced vertical studs **93** extending upward through spaced apertures either in an inclined longitudinal member or in longitudinally spaced lugs **94** located at different elevations corresponding to the inclination of **80**. The studs **93** have retaining spring washers **95** on the upper ends thereof; whereby the bar **92** is suspended when out of contact with **80**. The elements **94** are welded to an angle iron section **96** bounding a longitudinal downwardly and laterally open recess in the cover and forming a part or continuation of the cover envelope **49***a*.

To the outwardly projecting flange of the cover side framing channel **50**, there is attached the inverted L-shaped flexible sheet metal longitudinal member **98**. Along the inclined bottom margin of the vertically dependent longitudinal skirt portion **98***a*, there is attached on opposite sides a pair of asbestos "tadpole" section seal strips **99**, contacting under gravity bias in sealing relation the top horizontal (and preferably graphite lubricated) surface of angle iron **85**. The bottom edge of **98***a*, and elements **99** are inclined at a similar angle to the inclination of the tube **80**. Cemented to the top surface of the seal bar element **92** is a somewhat flexible asbestos sealing element **92***a* having upwardly turned longitudinal lateral edges in wiping contact with the resilient spring metal member **98***a* and the angle iron member **96**. A bead of asbestos caulking cement applied at **82***a* furthers the seal; so also the preferred use of an asbestos gasketing strip between **98** and the flange of **50**. The skirt portion **98***a* closes laterally the longitudinal cover recess to form an inverted channel enclosing the stationary seal components when the cover is closed. In this arrangement, there is actually provided a double longitudinal seal by virtue of the contact of the tube **80** with respect to the sealing bar **92**, in turn sealed at opposite longitudinal edges with respect to the members **96** and **98***a*, and the further seal by contact of the members **99** longitudinally disposed and meeting with the upper transverse surface of the angle member **85**. The provision of the flexible seal element **92***a* with upturned legs as described in contact with **96** and **98***a* substantially eliminates leakage at the outer connections remote therefrom between the lateral channel member **50**, the refractory structure **49** and the laterally projecting portion of **98**.

The described relation of elements with the downward inclination of the stationary seal elements **80** and the transverse surface of **85** and the complementing angular relationship of the mating elements in the cover, conjoined with the vertical movability of **92** and the flexibility of the elements **98** and **99** permit a certain "wedging" relation between the sealing elements or assemblies as the cover approaches a final closed position. For example, with a cover length on the order of 23 or 24 feet, an inclination of the sealing elements on the order of about three inches can be arranged to permit a generally longitudinal engagement of respective pairs of movable and stationary sealing elements, say, at about two to three feet from the final cover position, with the freedom of movement of **92** and flexibility in **98** thereafter permitting further cover movement to firm up the sealing engagement and also establish the sealing relationship of front and rear seal structures as hereinafter described.

An analogous geometrical arrangement for the longitudinal seals is hereinafter described with respect to FIGS. 12 and 13, wherein the sealing is effected in respective vertical planes convergent to the line of cover movement on closing, rather than along transverse planes inclined angularly to the direction of cover movement.

In FIG. 12 there is shown in schematic form an alternative arrangement for effecting the side seals. Whereas in the aforedescribed paragraphs there is a vertical inclination of respective stationary and movable seal elements relative to the direction of movement of the cover, here there is a horizontal convergence (again exaggerated for clarity in the drawing); that is, the plane of meeting or sealing as viewed in a horizontal or level plane of projection is inclined relative to the horizontal direction of motion of the cover. For the particular relation here shown the cover is moving between opposed lateral

stationary seal formations X, X, having no vertical inclination, but inclined toward or convergent toward the end of the furnace to which the cover moves in closing direction.

In FIGS. 12 and 13 elements analogous to or similar to those described for the previous side seal or longitudinal seal arrangement are designated with like numerals. Here, however, the fixed sealing member, the water tube **80**, is secured to a horizontal plate member **81** secured to a corresponding horizontal leg of a Z structural element **82** in horizontally rather than vertically adjustable relation, while the fixed sealing surface for contact by the flexible asbestos elements **99** is the vertical surface of the angle iron structural element **85**, the elements **99** here being mounted on a somewhat channel-shaped element **98***a* secured to the bottom side of a bottom flange of channel member **50** outside of an intervening plate element **96***x*. The water tube **80** and the vertical face of the channel member **85***a* are secured in generally parallel and horizontal disposition according to FIG. 13.

Here the sealing bar **92** is movably disposed in a vertical plane, complementing the angular disposition of the tube **80**, being supported by studs **93** as previously described in a now vertical plate or spaced series of elements **94** dependent from the plate **96***x*, with a bias of the sealing bar **92** toward the tube **80** by helical springs **93***a* disposed about each stud between the plate **92** and the vertical plate **94**. A similar asbestos sheet gasketing arrangement **92***a* cemented on **92** is used to seal at its opposite inwardly turned longitudinal edges the bar **92** relative to the plate **96***x* and the sheet metal sealing or envelope **49***a* of the cover **30**. Likewise there is used a locally applied bead of asbestos caulking cement **82***a* between the elements **81** and **82**.

With respect to either arrangement of the lateral or longitudinal seals as above described, the transverse end sealing arrangements hereinafter to be described are applicable.

Front End Seal

The front end seal may be seen in general exterior arrangement in FIG. 7 wherein certain portions of the cover primary framing elements and supports are omitted for clarity of representation; and also in the fragmentary partially elevational, partially sectional view of FIG. 8A.

At the front end of the cover structure (see particularly FIG. 7), dependent similar leg structures **120** are at their upper ends pivoted at **121** to the cover, and at intermediate points connected by spring biasing units **122** and connecting rods **123** to the cover to be urged inwardly toward the cover. At the lower ends of the members **120** there is carried a movable front end sealing box assembly, designated by the general reference character **125**. The box structure **125** is comprised of an inclined transverse top wall **126** in contact with but free from the bottom flange of transverse framing member **52**, vertical wall **127** and bottom wall **128**, fabricated either as by welding of separate elements or bending of a single integral piece and closed by end elements **129**. The box thus presents an inwardly facing transverse vertical opening.

Further a transversely extending resilient metal sealing element or lip **130**, attached to the box bottom wall **128**, and an opposed rather similar element **131** attached to an end face portion of the cover, provide a pair of parallel opposed horizontally disposed wiper blades of resilient character for engagement with a fixed horizontal forwardly projecting blade element **134** (see FIGS. 4, 7, 8A and 9) extending between the supporting structures of fixed side elements **80**. The space within the box **125** is filled with loosely packed asbestos fibers or the like to further impede the leakage of gas or atmosphere from the furnace.

Thus at the front end, between the longitudinal sealing elements **80** and the underlying supporting structure there is effected a transverse front seal by the movable spring elements or wiper blades **131**, **130** with respect to the fixed blade element **134**. The lateral ends of the box structure **125** beyond the ends of the blades respectively receive and enclose the projecting ends of the stationary longitudinal seal elements **80** and **85** in a generally sealing relation when in closed position. The lateral end portions of the box structure **125** for this purpose also are packed with loose mineral wool, asbestos fibers or the like to embrace the ends of the fixed side seal elements.

The movable arrangement, i.e., biased pivotal suspension of the box **125** thus permits some tolerance of overtravel, or variation in positioning of the cover relative to the fixed elements of various sealing structures while attaining a sealing relation.

Rear Seal Structure

The rear seal structure is shown by FIG. 6, FIG. 8B, the fragmentary vertical longitudinal section of FIG. 10, and at the corner by the fragmentary plan end view of FIG. 11.

In preference to a possible wiper blade arrangement, reversed as to fixed and movable portions relative to that described for the front end arrangement, possibly also cooled by an auxiliary transverse cooling section, there is here shown (see FIG. 6) at the rear end of the cover the inclined transverse resilient metal blade or movable contact blade **140** (see also FIG. 11), secured to an angle iron element **141** transversely disposed within the bottom edge of the cover behind the transverse framing element **51**, beneath which is located a transversely extending asbestos pad or sheet **142** secured to the bottom flange of **51**.

As a stationary element engageable therewith, a hollow transversely extending, triangularly-sectioned hollow element **144**, with face **144***a* disposed at like angle of inclination to **140** for sealing therewith by the interposed sealing pad **142**, is supported on the inward wall **147** of an upwardly open water sealing trough generally designated **148**, having a water inlet **149** and water outlet **150**. In baffle-like arrangement, the downward leg **144***b*, depending from the outward edge of the bottom wall **144***c* of **144** is immersed in the trough. For cooling of the structure **144** the vertical wall **144***d* is provided with a cooling water inlet **152** and outlet **153**. For direct sealing of the member **144** with respect to the surrounding and underlying supporting structure **147**, there is provided a transverse bottom sealing member **155** of asbestos or other like material, disposed between **147** and **157** and supported by an angle iron bracket **156**. Thus the shiftable "fixed" member **144** is sealed both by **155** and by **144***b* dipping into trough **148**.

Shiftably supporting the box **144** for resilient engagement with the movable rear end cover sealing elements **140**, **142** there is provided a base comprised of the laterally spaced I-beam sections **160** secured to the top of the furnace wall spanned by the angle **161**, a similarly spaced pair of pads **163** secured to **144***d* and **144***c* and mounting anchor plate assemblies **165** for spaced parallel guide rods **166** projecting outwardly through apertures in the angle **161** and having external limiting or stop nuts **168**, and helical prestressed compression biasing springs **169** disposed about respective guide rods between the anchor elements **165** and the angles **161**.

Inwardly adjacent each longitudinal fixed sealing member **80** at each end of the sealing box **144**, see especially FIG. 11, there is provided a "pocket" structure bounded by an extension of **144***c* as a bottom wall, a local dependent skirt **180** on the inner side of **80**, and the inwardly divergent end wall **181** closing the structure **144** reflected at its outer rear end **181***a* into a transverse direction. Engaged in the attached nut element **183** or other like threaded formation in **181***a* is an adjusting nut **184** bearing against a pressure plate **185** for adjusting or compressing a body **187** of mineral wool, asbestos fibers or the like, receiving in sealing relation a dependent projec-

tion 96*b*, the continuation of the angles 96 aforedescribed with respect to the longitudinal seals; thereby to provide a further sealing at each rearward corner of the furnace structure.

Stops 190 secured on the lower edge of 144*a* limit the mutual approach of 144*a* and the cover to protect the sealing sheets 142 from excessive wear, by engaging the lower edge of the cover directly.

Here again the inclined face 144*a* makes contact with seal member 142 backed by 140 to effect the primary transverse end seal in a wedging type relation; cooling being provided in this region to minimize thermal expansion and contraction.

In all cases the seal structures have a certain built-in yieldability to accommodate a degree of uncertainty or of overtravel in the placement or final position of a rather massive cover.

We claim:

1. A furnace having structure defining a space for heating objects placed therein and removed therefrom generally vertically, a horizontally translatable cover for said furnace for opening and closing of said space, means for supporting and guiding said cover in horizontal translation along opposing directions, said furnace structure and said cover having corresponding opposing side portions extending longitudinally of the direction of cover movement and corresponding opposing end portions extending transversely of said direction of cover movement, a fixed elongated seal element on each side portion of said furnace, seal means on each side portion of said cover, said seal elements and seal means extending substantially longitudinally of said direction of cover movement, each said seal means including first and second adjacent seal members, each said first seal member being in sealing contact with one of said seal elements and movably mounted on said cover for movement in a direction substantially perpendicular to the line of said sealing contact, each said second seal member being in sealing contact with one of said seal elements at a point spaced transversely of said direction of cover movement from that of an adjacent first seal member.

2. A furnace as claimed in claim 1 wherein said elongated seal elements are inclined downwardly in the direction of cover-opening movement, and said first movable seal members being resiliently biased in a substantially vertical direction and in sealing contact with said seal elements when said cover is in the closed position.

3. A furnace as claimed in claim 1 wherein said elongated seal elements horizontally converge in the direction of cover closing movement, and said first movable seal members being resiliently biased in a substantially horizontal direction in sealing contact with said seal elements.

4. A furnace as claimed in claim 1 including sealing means interposed between said corresponding opposing end portions of said cover and furnace structure for sealing same upon closure of said cover.

5. A furnace as claimed in claim 4 wherein said sealing means includes a transverse blade on an end portion of said cover, and at least one wiper plate on the corresponding end portion of said furnace structure for sealing said corresponding end portions upon closure of said cover.

6. A furnace as claimed in claim 1 including means for water cooling said fixed seal elements.

7. A furnace as claimed in claim 4 wherein means are provided for water cooling at least one of said sealing means.

8. A furnace as claimed in claim 1 wherein said end portions and side portions at one end of said furnace

structure define a pair of corners, a body of fibrous material secured to said furnace structure at each said corner, and a pair of transversely spaced projections depending downwardly from said cover and extending substantially longitudinally of said direction of cover movement and arranged to engage said fibrous material in sealing engagement upon closure of said cover.

9. A furnace having structure including a wall defining a heating space for heating objects placed therein and removed therefrom generally vertically and a firing space separated from said heating space by said wall; a cover assembly including means for opening and closing said spaces comprising a cover horizontally and longitudinally shiftable relative to said spaces between open and closed positions; said furnace structure and said cover having corresponding opposing side portions extending longitudinally of the direction of cover movement and corresponding opposing end portions extending transversely of said direction of cover movement; sealing means including first and second lateral seal structures arranged along each said corresponding opposing side portions of said cover and said furnace, and front and rear seal structures respectfully arranged along said corresponding opposing end portions of said cover and furnace; said first lateral seal structure comprising a pair of fixed elongated elements each mounted on one of said opposing side portions of said furnace and a pair of movable elements each on one of said opposing side portions of said cover in sealing contact with one of said elongated elements and movably mounted on said cover for movement in a direction substantially perpendicular to the line of said sealing contact, each said second lateral seal structures being mounted to said cover adjacent one of said first movable elements and in sealing contact with one of said fixed elongated elements, said rear seal structure including a first transverse element mounted to one end portion of said cover and a second transverse element resiliently mounted on said corresponding rear end portion of said furnace structure in sealing contact with said first transverse element upon closure of said cover, said front seal structure including a transverse plate mounted on said other opposing end portion of said cover and sealing means mounted on said corresponding front end portion of said furnace structure including a pair of upper and lower wiper blades for receiving said transverse plate in sealing contact upon closure of said cover.

References Cited in the file of this patent

UNITED STATES PATENTS

445,002	Grohbrugge	Jan. 20, 1891
1,074,509	Leask	Sept. 30, 1913
1,499,801	Bond	July 1, 1924
1,691,369	Baker	Nov. 13, 1928
1,858,434	Colby	May 17, 1932
1,861,465	Woodson	June 7, 1932
2,039,761	Weniger	May 5, 1936
2,189,280	Croft	Feb. 6, 1940
2,199,182	Leonard	Apr. 30, 1940
2,336,698	Morrill	Dec. 14, 1943
2,394,298	Fox et al.	Feb. 5, 1946
2,835,048	Olthuis et al.	May 20, 1958
2,881,942	Allbright et al.	Apr. 14, 1959
2,953,108	Kelsen	Sept. 20, 1960

FOREIGN PATENTS

345,913	Great Britain	Apr. 2, 1931
655,095	Great Britain	July 11, 1951