Jan. 19, 1932. R. Z. HOPKINS ET AL 1,841,533

DRAWING FURNACE

Filed May 26, 1928 7 Sheets-Sheet 1

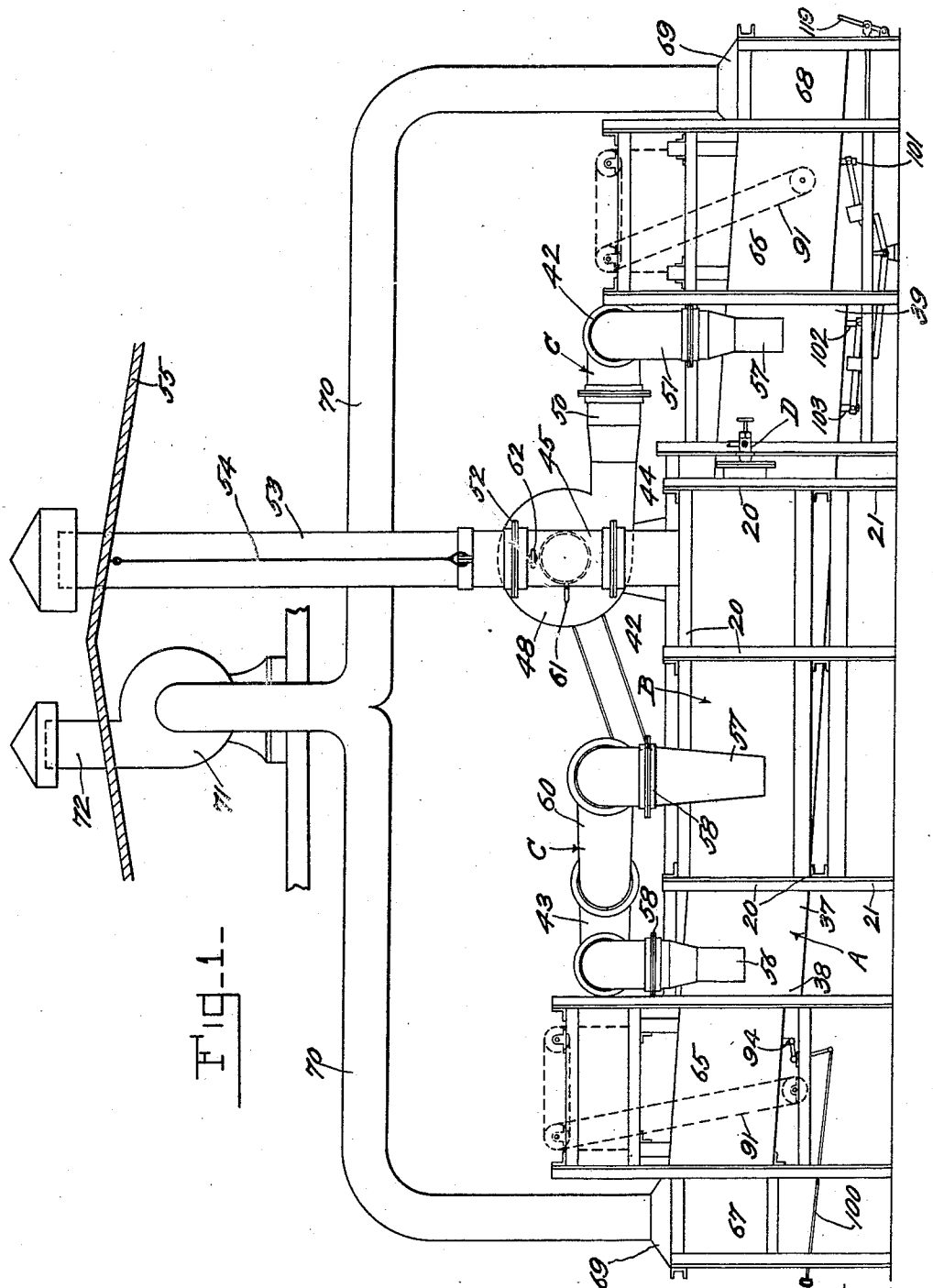


FIG. 1.

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by Headley, Calvo, Copeland & Dike,
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Jan. 19, 1932. R. Z. HOPKINS ET AL 1,841,533

DRAWING FURNACE

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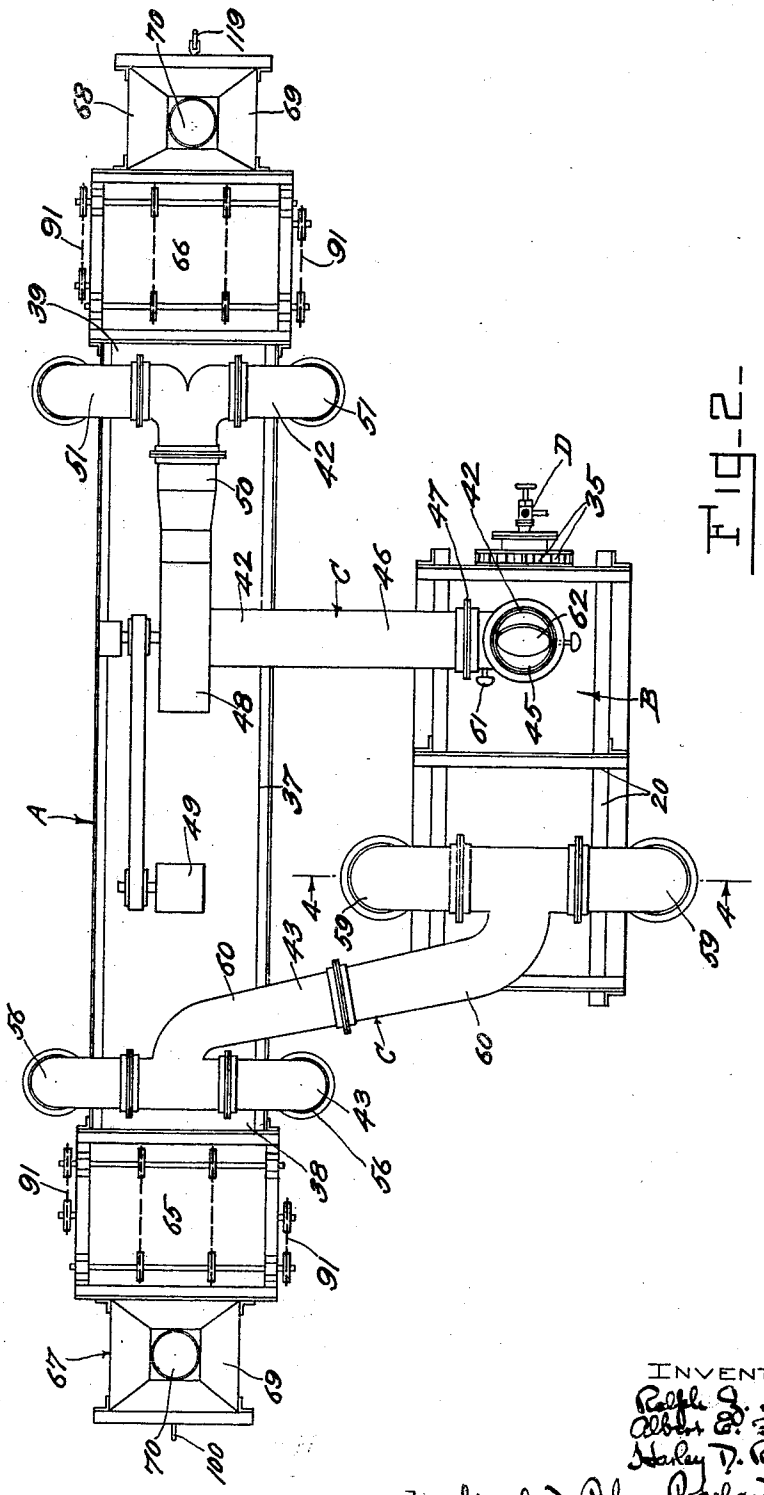


FIG. 2.

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DRAWING FURNACE

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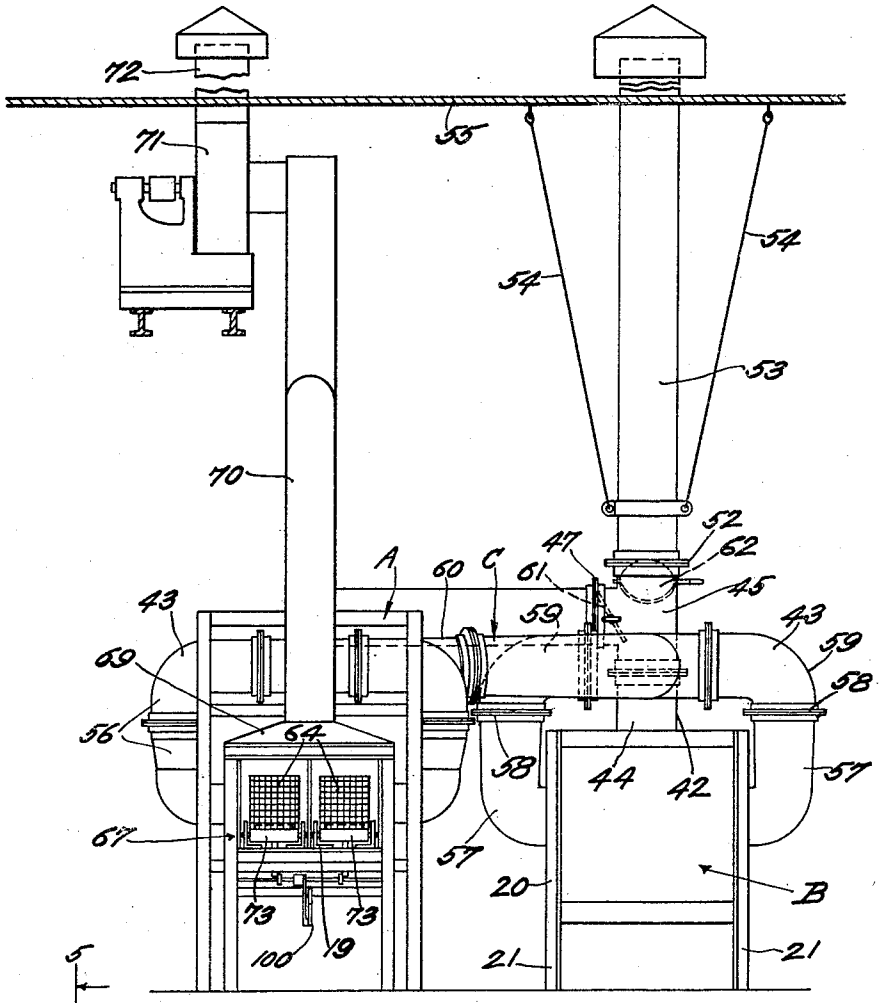


Fig. 3.

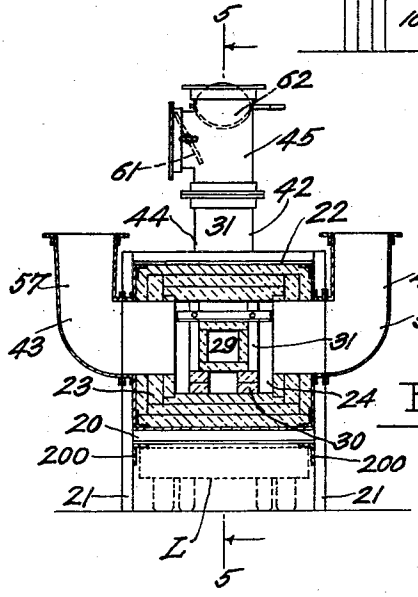


Fig. 4.

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Jan. 19, 1932. R. Z. HOPKINS ET AL 1,841,533

DRAWING FURNACE

Filed May 26, 1928 7 Sheets-Sheet 4

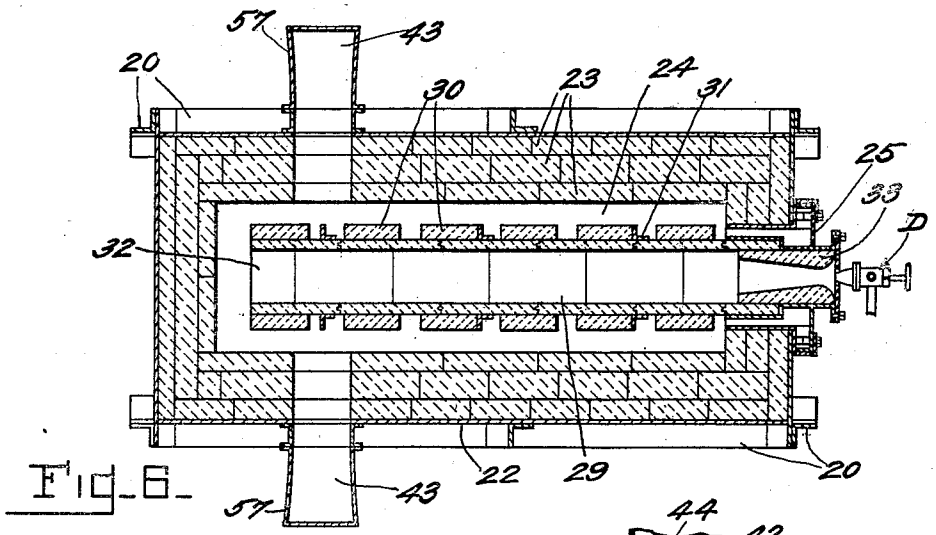


Fig. 6.

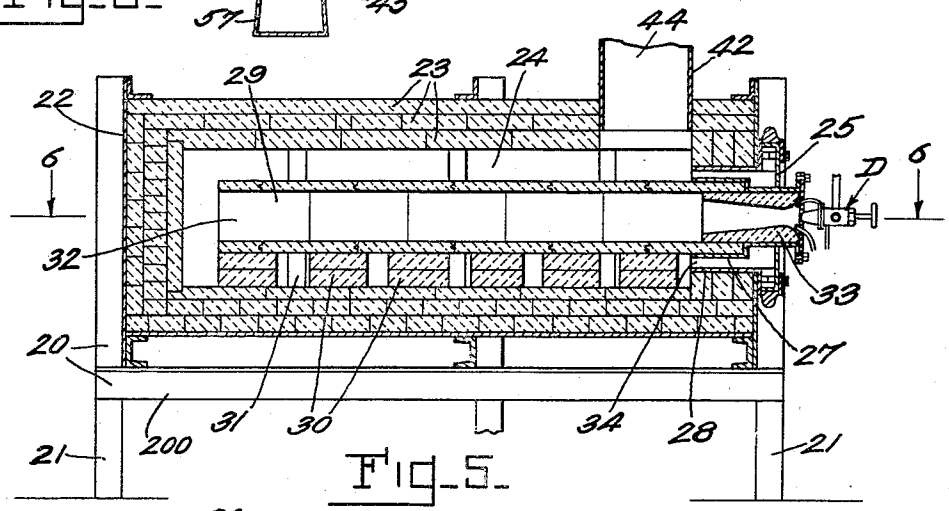


Fig. 5.

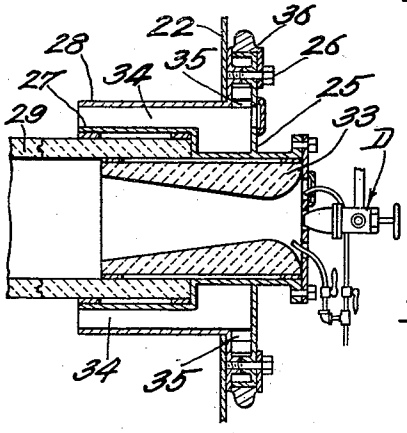


Fig. 7.

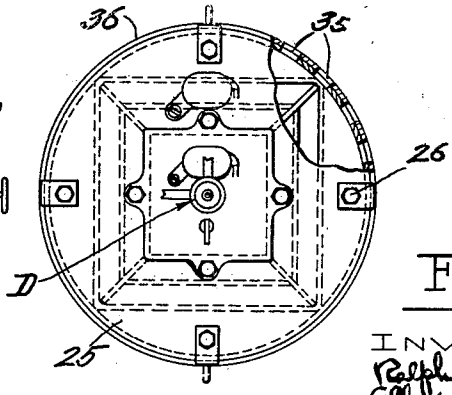


Fig. 8.

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DRAWING FURNACE

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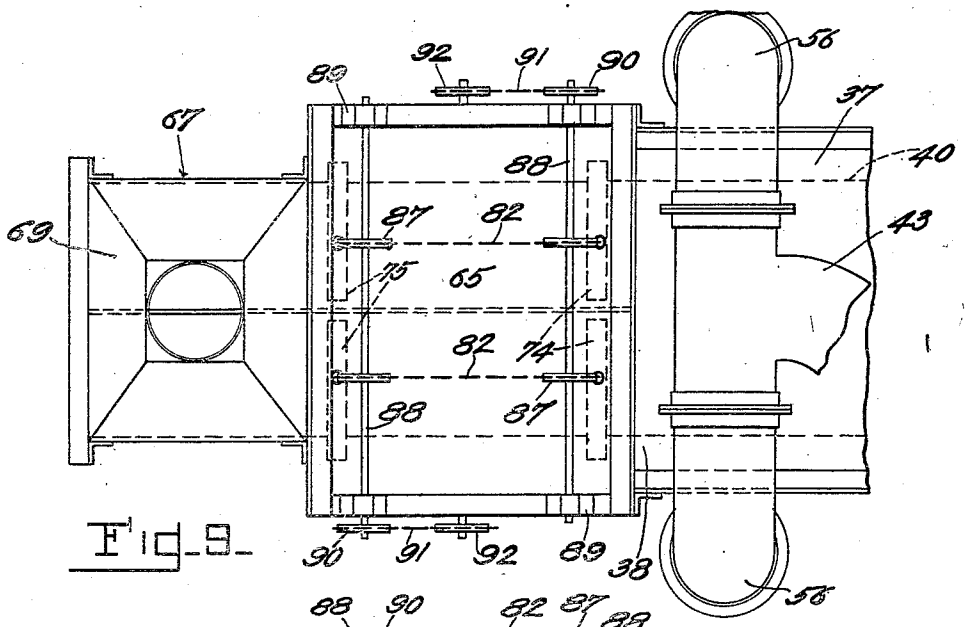


Fig. 9.

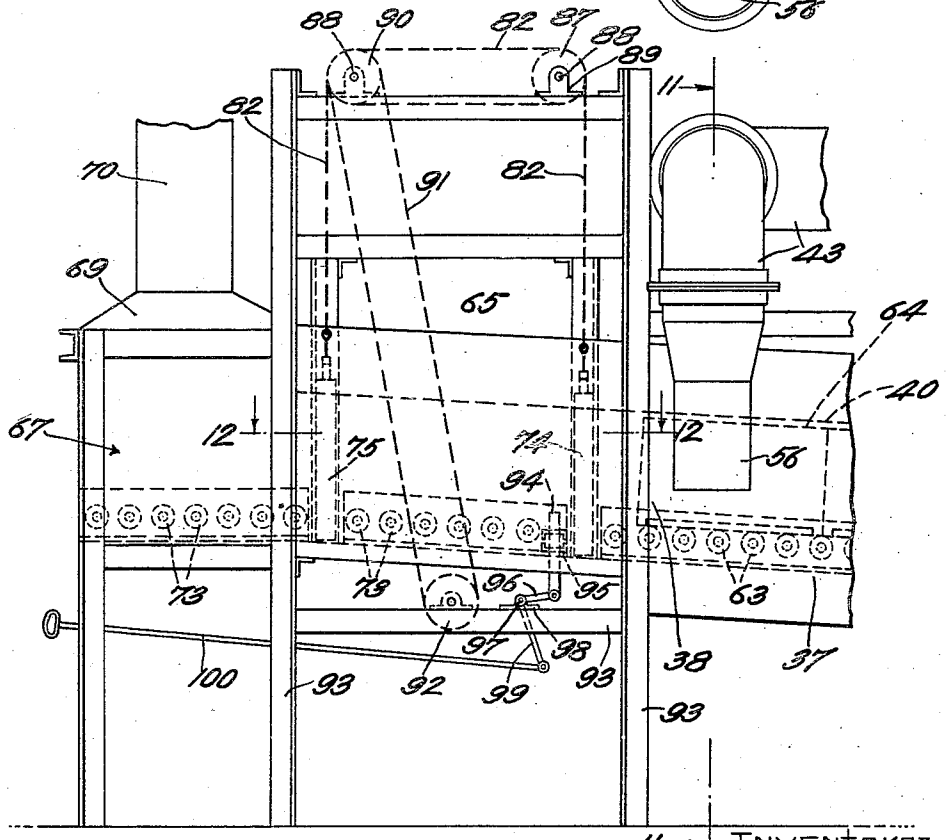


Fig. 10.

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DRAWING FURNACE

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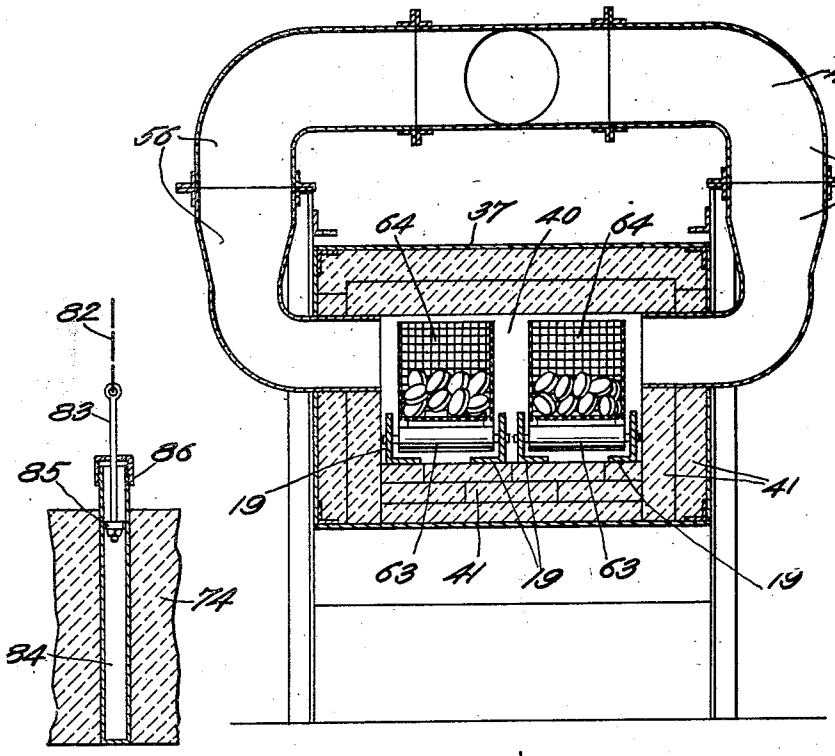


Fig. 13. Fig. 11.

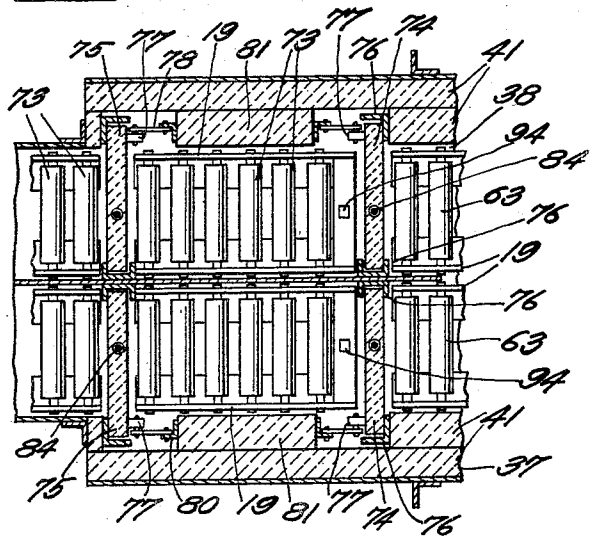


Fig. 12.

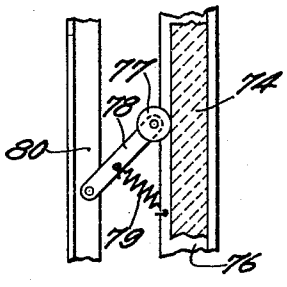


Fig. 14.

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DRAWING FURNACE

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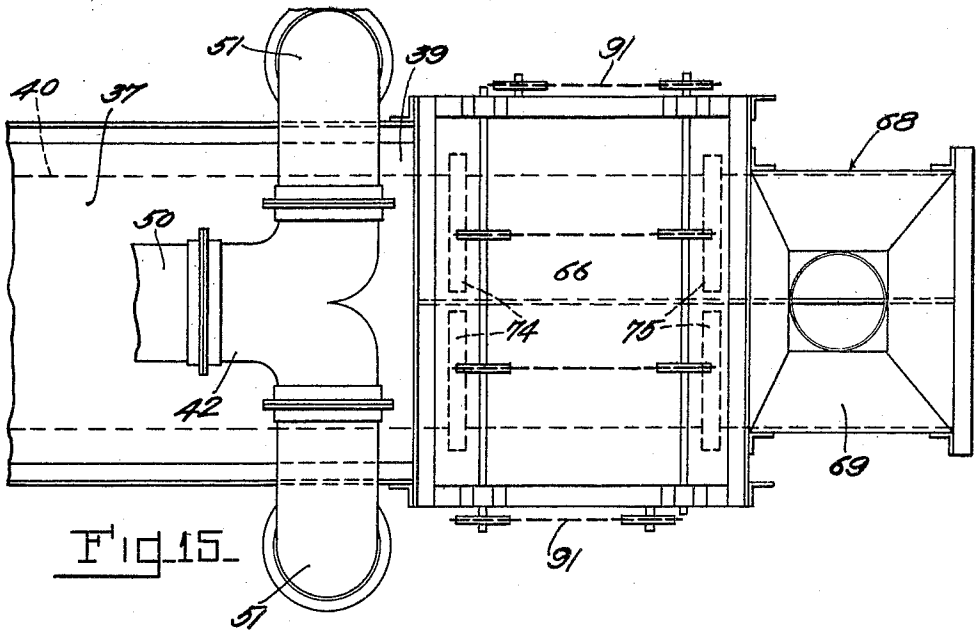


Fig. 15.

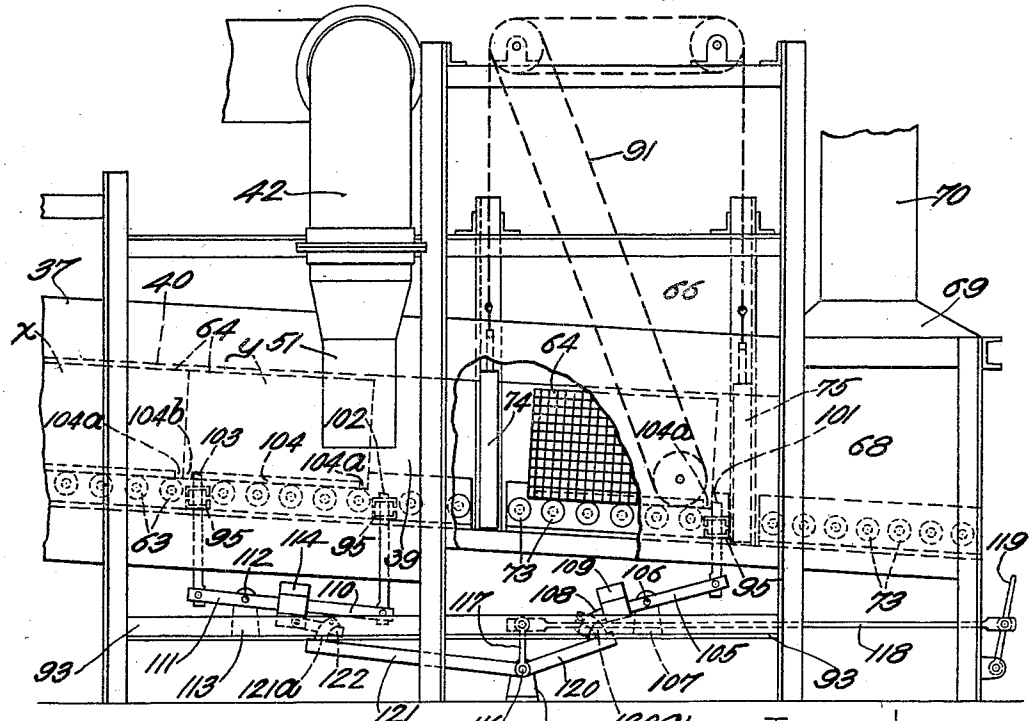


Fig. 16.

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Patented Jan. 19, 1932 1,841,533

UNITED STATES PATENT OFFICE

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DRAWING FURNACE

Application filed May 26, 1928. Serial No. 280,764.

This invention relates especially, although not exclusively, to drawing furnaces of the type adapted for the heat treatment of gears and similar articles at temperatures between 350° F. and 800° F.

The invention has for an object to provide a drawing furnace having a combustion chamber structure of such character as to permit the use of either liquid or gaseous fuel.

Another object of the invention is to provide a drawing furnace having separate oven and burner units, the latter being readily detachable from the former, and being of a portable character so as to be readily replaceable by another spare unit, thereby permitting relining and other necessary repairs without shutting down the whole plant, said burner unit being of such a structure as to permit the ready and convenient renewal of the combustion chamber lining.

A further object of the invention is to provide a drawing furnace in which the heat is fully and efficiently utilized but in which the burner is at the same time adequately cooled.

A still further object of the invention is to provide a drawing furnace capable of continuous operation so constructed as to provide for the convenient introduction and removal of the work and for the even and efficient heating thereof during its passage through the oven.

The foregoing and other objects of the invention, together with means whereby the latter may be carried into effect, will best be understood from the following description of a preferred construction thereof illustrated in the accompanying drawings. It will also be understood, however, that the particular construction and arrangement described and shown have been chosen for purposes of exemplification merely, and that said invention, as defined by the claims hereunto appended, may be otherwise embodied without departure from the spirit and scope thereof.

In said drawings,

Fig. 1 is a somewhat diagrammatic side elevation, looking from the burner side of the apparatus, of the complete furnace.

Fig. 2 is a plan view, partly broken away.

Fig. 3 is an end elevation looking from the inlet end of the oven, or from the left in Figs. 1 and 2.

Fig. 4 is a transverse vertical section, taken substantially on the line 4—4 of Fig. 2, of a burner unit.

Fig. 5 is a longitudinal vertical section taken substantially on the line 5—5 of Fig. 4.

Fig. 6 is a horizontal section taken substantially on the line 6—6 of Fig. 5.

Fig. 7 is an enlarged detail longitudinal section of the parts adjacent the burner.

Fig. 8 is an outside end elevation of the parts shown in Fig. 7.

Fig. 9 is an enlarged plan view of the inlet end of the oven unit.

Fig. 10 is a side elevation, partly broken away, of the parts shown in Fig. 9.

Fig. 11 is a transverse vertical section taken substantially on the line 11—11 of Fig. 10.

Fig. 12 is a fragmentary horizontal section taken substantially on the line 12—12 of Fig. 10.

Fig. 13 is a fragmentary detail view of the connection between one of the vestibule doors and its operating chain.

Fig. 14 is a fragmentary detail view of one of the devices for maintaining tight joints between the vestibule doors and their guides.

Fig. 15 is a plan view of the discharge end of the oven unit.

Fig. 16 is a side elevation, partly broken away, of the parts shown in Fig. 15.

The apparatus as a whole includes an oven unit, generally indicated at A in Figs. 1, 2 and 3, a separate heater or burner unit, generally indicated at B, and detachable conduit connections, generally indicated at C, whereby the hot products of combustion in the burner unit B, together with a certain amount of air heated thereby, may be circu-

lated in a substantially closed circuit through said units.

The provision of a separate detachable burner unit B for the drawing oven makes it possible to employ a spare burner unit, so that it is unnecessary, in case relining or other repairs are required in the heater, to shut down the entire plant. On the contrary, by disconnecting the conduit connections C, as hereinafter more fully described, the disabled heater may be removed and replaced by a spare heater, whereupon the necessary repairs can be made at leisure while the furnace continues in operation. In order to facilitate this, the burner or heater unit is supported in elevated position by an open frame work comprising transverse structural members 20 and legs 21 providing a space beneath the burner unit proper to receive the platform of an industrial truck which, when repairs are needed, may be run under the unit to lift and carry the same away and in a similar manner to replace it by the spare unit.

As shown in Fig. 4, longitudinal angle iron bars 200 are mounted at each side of the frame along the underside of the members 20, these bars having vertical flanges acting as guides for the truck platform L when inserted beneath the members 20. The bars 200 also have inwardly extending horizontal flanges adapted to overlie the truck platform L and receive the upper thrust thereof when the lift platform is elevated to lift and carry the burner unit.

Referring particularly to Figs. 4 to 8, the burner unit proper comprises a preferably sheet metal casing 22 to which the frame members 20 are riveted or otherwise permanently secured, said casing having a fire brick lining 23 and enclosing a circulation chamber 24. At one end the casing 22 is provided with an opening to receive a thimble 25 removably seated therein, said thimble comprising spaced co-axial inner and outer members or walls 27 and 28 connected by bolts 26. Within the circulation chamber 24 is a combustion tube or tubular combustion chamber 29 carried by fire brick supports 30 within said circulation chamber and spaced from the walls of the latter by crossed angle bars 31. The combustion tube 29 communicates at one end, as shown at 32, with the circulation chamber 24 and at its opposite end is enclosed by the inner member 27 of the thimble 25. Said combustion tube is of relatively small diameter in proportion to its length and has relatively thin sectional walls composed of separate blocks or tiles of highly refractory material, such as a suitable carborundum composition.

Supported by the thimble 25 in alinement with the combustion chamber 29, so as to direct its flame into the latter through a suitable Venturi bushing 33 of refractory material, is a burner proper, generally indicated at D, said burner being of any approved and suitable type capable of employing either oil or gas as a fuel. It will, of course, be understood that the air necessary to support combustion is supplied to or about the burner and enters the mouth of the bushing 33 with the fuel.

The space 34 between the inner and outer members of the thimble 25 communicates with the circulation chamber 24 around the combustion tube 29 immediately adjacent the burner end of said tube and also communicates, outside the casing, with the outer air through suitable air inlets 35 controlled by a manually rotatable ring damper 36, whereby the amount of air admitted to the circulation chamber can be controlled.

The construction and arrangement of parts above described adapts the apparatus for use with either liquid or gaseous fuel. The long thin walls of the combustion tube absorb the interior heat quickly and transfer it quickly to the air in the circulation chamber by which said combustion tube is completely surrounded. The fresh air admitted through the space 34 around the burner cools the hottest end of the combustion tube. As a result, overheating of the combustion tube is effectually prevented and the heat thereof transferred to the air which, as hereinafter explained, is circulated through the oven. For efficient heating by gaseous fuel a long thin combustion chamber is required, whereas oil burning furnaces, as heretofore constructed, have required a larger combustion chamber to prevent overheating. The present construction permits the use of liquid fuel in a combustion chamber of the type required for the most efficient use of gaseous fuel. Renewal of the combustion chamber tiles can, when necessary, be readily effected by removing the thimble 25 and working through the opening in the end of the casing 22.

Referring to Figs. 1 and 2, and also to Figs. 9, 10, 11, 15 and 16, the oven unit A comprises a casing 37 having an inlet end 38 into which the articles to be treated are introduced, an outlet end 39 from which said articles are discharged, and an interior passage or tunnel 40 extending from said inlet end to said outlet end and downwardly inclined from the former to the latter, said passage having a suitable firebrick or other refractory lining 41.

The conduit connections C above referred to include a supply conduit 42 leading from the circulation chamber 24 adjacent the burner end of the combustion chamber or tube 29 to the oven adjacent the outlet end 39 of the latter, and a return conduit 43 leading from said oven adjacent the inlet end 38 thereof to the circulation chamber 24 adjacent the point of communication 32 of the combustion chamber 29 therewith.

The supply conduit 42 includes a short sec-

tion 44 communicating with the circulation chamber 24 at the top of the latter through the lining 23 thereof, a T-fitting 45 communicating with the section 44, a section 46 connected at one end by a detachable coupling 47 with one branch of the fitting 45 and at its opposite end communicating with the inlet of a blower 48 supported on the top of the oven and driven by a suitable motor 49 and a section 50 leading from the outlet of the blower 48 to two branches 51 which communicate with the passage 40 through the walls of the casing 37 and through the lining 41. The other branch of the T-fitting 45 is connected by a detachable coupling 52 with a stack 53 supported independently of the burner unit, as by hangers 54 from the roof 55 of the building within which the furnace is housed. The fitting 45 is provided with dampers 61 and 62 adapted to control communication between said fitting and the conduit section 46 and stack 53 respectively.

The return conduit 43 includes two branches 56 communicating with the passage 40 and two branches 57 communicating with the circulation chamber 24, said branches 57 being connected by detachable couplings 58 with branches 59 with which communicates a sectional trunk connection 60 leading from the branches 56.

It will be seen that, by disconnecting the detachable couplings 47, 52 and 58, the burner unit B, with the portions 44, 45 and 57 of the conduit connections, may be removed as above described and replaced by a substitute unit having corresponding conduit portions.

It will now be seen that the system described provides for a substantially closed circuit circulation induced by the blower 48, of the air and products of combustion through the heater unit and oven unit, the hot gases leaving the heater unit adjacent the burner or hottest part of said unit, entering the oven unit adjacent the discharge end of the latter, leaving said oven unit adjacent the inlet end, and returning to the heater at the cooler end of the latter, being thereafter caused to flow about the combustion tube so as to hold down the temperature of the latter and to be reheated thereby. By suitable regulation of the dampers 36, 61 and 62, sufficient, but only sufficient, outside air is admitted to the system to maintain combustion and make up the losses from the oven in charging and discharging, as hereinafter described, thereby fully utilizing all heat units. In starting the furnace, the damper 61 is closed and the damper 62 opened, thereby cutting off the oven and directing all products of combustion to the stack, until the burner unit has then become thoroughly heated. Thereafter, relative adjustment of the dampers 61 and 62 controls the proportion of gases circulated through the oven or discharged from the stack. Such fresh air as is admitted to the system, in addition to that directly supplied to the burner, is admitted through the space 34 of the thimble 25 immediately around the burner end of the combustion tube so as to become immediately heated as well as serving to cool the hottest end of the tube as above explained.

Referring to Figs. 10, 11, 12 and 16, the floor of the inclined passage 40 through the oven is provided with a series of transversely disposed rollers 63 having trunnions journaled for free rotation in parallel angle bars 19 secured to said floor, so that, due to the inclination of the said passage, articles introduced at the inlet end will travel through the passage by gravity to the outlet. As shown, two series of rollers are provided to permit the simultaneous passage through the oven or tunnel of two lines of articles, but it will be obvious that a smaller or greater number may, if desired, be employed. The articles are preferably carried in baskets 64 of such size and shape as to occupy the greater portion of the cross-sectional area of the passage, which is of constant cross-section throughout its length, said baskets having foraminous walls, preferably composed of heavy wire mesh, whereby, as they travel from the inlet to the outlet and meet the current of gases traveling from the outlet to the inlet, said gases will be caused to pass through said baskets and about the articles therein. A sufficient number of baskets to substantially fill the passage longitudinally is supplied to the latter, so that the time of travel of any individual basket therethrough will be determined by the rate at which said baskets are discharged, as hereinafter explained.

The oven passage or tunnel is provided adjacent both its inlet and outlet ends with locks or vestibules 65 and 66, respectively, through which the articles maye be introduced and discharged with a minimum loss of heated gas from the passage, and also with escapement mechanisms controlling the introduction and discharge of the articles by gravity through the locks or transfer chambers. Beyond the transfer chambers are provided loading and unloading platforms or chambers 67 and 68 provided with suitable hoods 69 connected by conduits 70 with a blower 71 (Fig. 1) which discharges through a stack 72, whereby such products of combustion as may escape through the locks or vestibules is carried away. The tunnel lining 41 is extended, at least in part, into the locks or vestibules, whose floors, as well as those of the loading platforms or chambers, are provided with rollers 73 similar to the rollers 63 in the oven passage or tunnel. The floors of the locks or vestibules are inclined to correspond to the inclination of the floor of the tunnel or passage, so as to discharge ar-

ticles therethrough by gravity under the control of the escapement mechanisms.

Referring to Figs. 9, 10 and 12, the vestibule 65 is provided with inner and outer doors 74 and 75 arranged to slide vertically in guides formed by upright angle members 76 with which they are held in close engagement by rollers 77 (see also Fig. 14) carried by arms 78 connected by springs 79 with said guides 76. The arms 78 are pivoted to upright angle members 80 carried by blocks 81 which form parts of the vestibule lining. The doors 74 and 75 are connected by operating mechanism adapted to open said doors alternately, that is to say, to open selectively either the inner or the outer doors but not both at once. As shown, said operating mechanism includes chains 82 connecting the doors 74 and 75 and having a lost motion connection with each, said chains being of such length as to permit both the inner and the outer doors to be closed simultaneously or to raise either, the other remaining closed. As shown in Fig. 13, the lost motion connection between each door and the corresponding chain 82 preferably comprises a link 83 connected to the end of the chain 82 and received in a tubular guide 84 in the door, said link having a head 85 adapted, when the lost motion is taken up, to engage a cap 86 on the end of the tubular guide and having an opening through which the link passes.

The chains 82 pass over sprockets 87 on shafts 88 journaled in suitable brackets 89 on the top of the vestibule, said shafts having at opposite ends respectively sprockets 90 connected by chains 91 with idler sprockets 92 journaled in the supporting framework 93 adjacent the bottom of the vestibule, so that by manipulation of either chain 91, as may be most convenient, the vestibule doors may be opened as required.

The escapement mechanism for the vestibule 65 comprises stops 94 guided for vertical movement in transverse frame members 95 adjacent the inner doors 74 into and out of the path of movement of the baskets from the vestibule or transfer chamber into the tunnel. The stops 94 are operated by arms 96 on a rock shaft 97 journaled in brackets 98 on the framework 93, said rock shaft having an arm 99 to which is connected an operating rod 100 extended to a convenient point at the front of the furnace.

It will be seen that, with the parts in the position shown in Fig. 10, one of the chains 91 may be operated to raise the outer doors 75, whereupon two baskets may be introduced, side by side, from the loading chamber or platform 67 into the vestibule 65, said baskets moving by gravity into said vestibule until arrested by the stops 94. The doors 75 may then be closed and the inner doors 74 opened, whereupon the rod 100 may be operated to depress the stops 94 and the baskets will then move under the influence of gravity into the tunnel.

The construction and arrangement of the doors for the discharging vestibule 66 and of the operating mechanism therefor are substantially identical in all essential respects with the corresponding parts associated with the vestibule 65 and need therefore not be described in detail. The escapement mechanism for the vestibule 66 is however so arranged as to control the discharge of the baskets singly (or, in the construction shown, in pairs) from the tunnel into the vestibule as well as their discharge from said vestibule into the chamber 68.

This mechanism, as shown in Fig. 16, comprises three sets of stops 101, 102, and 103, each similar to the stops 94 and likewise guided for vertical movement in transverse frame members 95. The stops 101 are located in the vestibule 66 adjacent the outer doors 75, the stops 102 are located in the tunnel immediately adjacent the outlet thereof, while the stops 103 are likewise located in the tunnel and are spaced from the stops 102 a distance approximately equal to the length of a basket 64, said stops 103 cooperating with grooves 104 formed in the bottoms of the baskets and terminating in front and rear abutments 104*a* and 104*b*. The stops 101 are connected to arms 105 on a rock shaft 106 journaled in brackets 107 on the frame work 93, said rock shaft having oppositely extending arms 108 provided with counterweights 109 which tend to rotate the shaft in the direction to elevate the stops 101. The stops 102 and 103 are similarly connected to oppositely extending arms 110 and 111 on a rock shaft 112 journaled in brackets 113, the arms 110 being provided with counterweights 114 tending normally to elevate the stops 103 and depress the stops 102.

Journalled in suitable supports 115 at the base of the apparatus is a rock shaft 116 having an arm 117 connected by a link 118 with an operating handle 119 located at a convenient point adjacent the discharge chamber 68. The rock shaft 116 is provided with oppositely extending arms 120 and 121. The arm 120 has a forked extension 120*a* straddling the arm 108 and having a lost motion connection therewith. In like manner the arm 121 has a forked extension 121*a* straddling an arm 122 secured to the counterweight 114 and having a lost motion connection therewith. Transverse pins at the upward ends of forks 120*a* and 121*a* limit the movement of these parts relative to arms 108 and 122.

In operation, assuming that the mechanism and baskets are in the positions shown in Fig. 16, when it is desired to discharge a basket or group of baskets from the transfer chamber 66 into the outer chamber 68, the workman opens the door 75 by manipulating the chain

mechanism. Thereupon he moves the handle lever 119 to the left in Fig. 16 resulting in swinging the arm 120 upwardly into engagement with the end of arm 108 and depressing the stop 101 and allowing the basket in the chamber 66 to roll out into the outer chamber 68. This operation of handle 119 will not affect the stops 102 and 103 since they normally remain in the positions shown in Fig. 16 by virtue of the counterweight 114.

Upon releasing the handle 119 the weight 109 shifts the arm 105 upwardly thereby automatically returning the stop 101 to the position in Fig. 16, after the basket has been discharged from chamber 66. The workman then closes door 75 and opens door 74, and then moves the handle 119 to the right swinging arm 121 upwardly into engagement with the end of the extension 122. This results in swinging arm 110 upwardly to raise stop 102 and swinging arm 111 downwardly to depress stop 103 and release it from in front of abutment 104*b* on the basket marked Y in the figure. This basket will thereupon slide forwardly a short distance until the front face of the abutment 104*a* strikes the elevated stop 102 arresting the basket. The column of baskets including the basket marked X will also move forwardly the same distance and the stop 103 will in this position be below and slightly in the rear of the abutment 104*a* on the basket X. Upon releasing the handle 119 the weight 114 swings the arms 110 and 111 in the reverse directions depressing stop 102 and elevating stop 103. The latter moves upwardly into the groove 104 directly in the rear of the abutment 104*a* on the basket X and the column of baskets including the front basket marked X moves forwardly a distance equal to the length of the groove 104 until the stop 103 strikes the rear abutment on the basket X. At the same time the basket marked Y in the figure slides into the transfer chamber 66 and the door 74 may then be closed, the door 75 also remaining closed. From the foregoing it will be seen that three sets of stops are provided for controlling the discharge of the baskets and also the movement of the column of baskets, and these stops are all operated by a common-control lever. It will also be seen that the escapement mechanism is operated to give two movements to the column of baskets. When discharging a basket into the transfer chamber 66 the column will first move substantially the distance between the aubtment 104*a* and the stop 102, and upon releasing the handle 119 the column will move the length of the groove 104 between the front and rear abutments 104*a* and 104*b*. The construction is such that the stops will normally move into the positions shown in Fig. 16 when the handle 119 is released, and it is impossible to discharge a basket from the tunnel when a basket is being discharged from chamber 66.

Having thus described our invention, we claim:

1. In a drawing furnace, an oven having an inlet, an outlet, inclined passage extending therethrough from said inlet to said outlet, a series of rollers on the floor of said passage, whereby articles introduced at said inlet will travel through said passage by gravity to said outlet, locks or vestibules controlling access to said inlet and outlet respectively, and escapement devices for controlling the introduction of articles to said inlet and their discharge from said outlet.

2. In a drawing furnace, an oven having an inlet, a lock or vestibule adjacent said inlet and arranged to discharge articles thereinto by gravity, inner and outer doors for said lock or vestibule, operating means connecting said doors for opening them alternatively, and an escapement device for controlling discharge of articles from said lock or vestibule into said inlet.

3. In a drawing furnace, an oven having an outlet arranged to discharge articles therefrom by gravity, a lock or vestibule adjacent said outlet to receive articles therefrom and also arranged to discharge said articles by gravity, inner and outer doors for said lock or vestibule, operating means connecting said doors for opening them alternatively, and escapement mechanism for controlling the discharge of articles from said outlet into said lock or vestibule when said inner door is open and from said lock or vestibule when said outer door is open.

4. In a drawing furnace, an oven having an outlet arranged to discharge articles therefrom by gravity, a lock or vestibule adjacent said outlet to receive articles therefrom and also arranged to discharge said articles by gravity, stops adapted to be projected into the path of movement of said articles and to be withdrawn therefrom, said stops being located respectively in said lock or vestibule, at the outlet of said oven, and at a spaced point within said oven, and operating mechanism connecting said stops for projecting said first and last named stops while withdrawing said second named stop and for withdrawing said first and last named stops while projecting said second named stop.

5. In a drawing furnace, an oven inclined to discharge therefrom by gravity containers having front and rear abutments, a transfer chamber communicating with the outlet end of the oven, a pair of longitudinally spaced stops located within said outlet end, a stop located within said chamber, and a common means for operating all of said stops and including means for operating said pair of stops in opposite directions to alternately cooperate with the front and rear abutments of the containers.

6. A drawing furnace comprising an oven having loading and unloading platforms, a

passage intermediate said platforms having vestibules at its ends equipped with doors arranged to communicate alternately with said passage and said respective platforms, baskets having foraminous walls for carrying articles through said passage, a supply of heated gases, means for circulating said gases through said passage in a direction opposite to the movement of said baskets, and means for collecting the gases which escape from said vestibules and for discharging them through a stack.

In testimony whereof we affix our signatures.

RALPH Z. HOPKINS.
ALBERT E. FELLERS.
HARLEY D. RAYMOND.