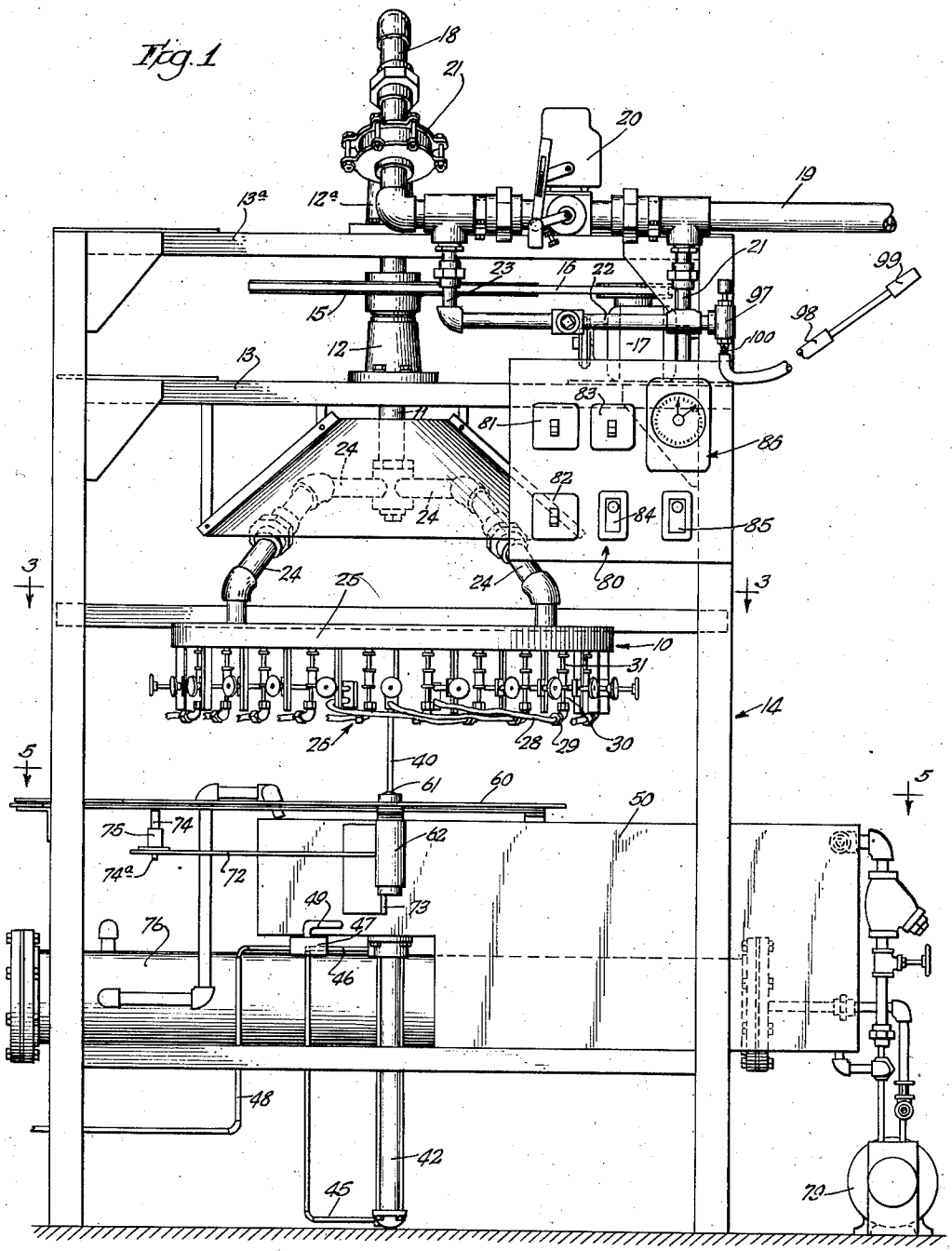
Sept. 10, 1946. E. A. FURKERT 2,407,230

HEAT TREATING APPARATUS

Filed Oct. 27, 1941 6 Sheets-Sheet 1

Fig. 1



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Filed Oct. 27, 1941 6 Sheets-Sheet 2

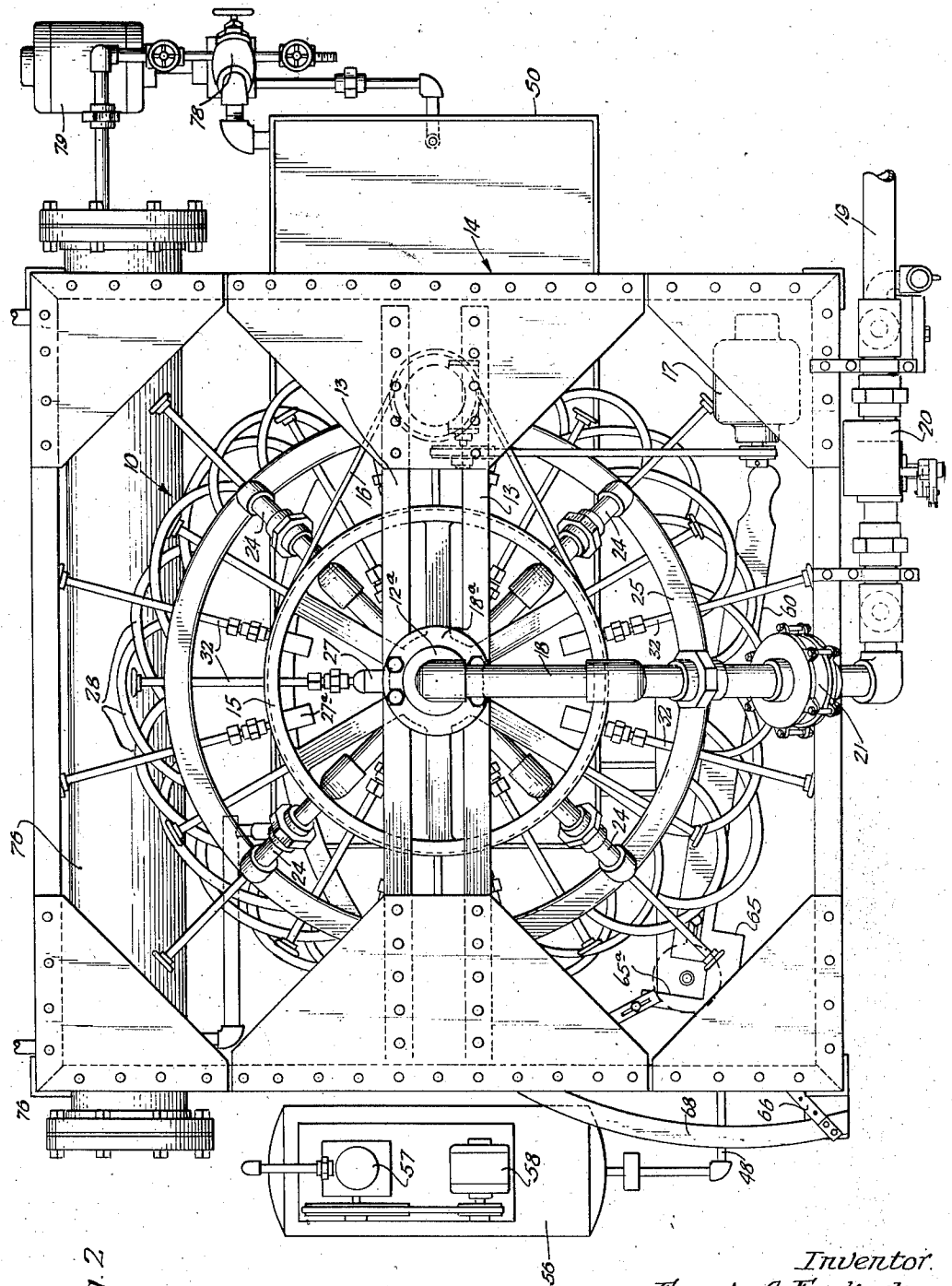


Fig. 2

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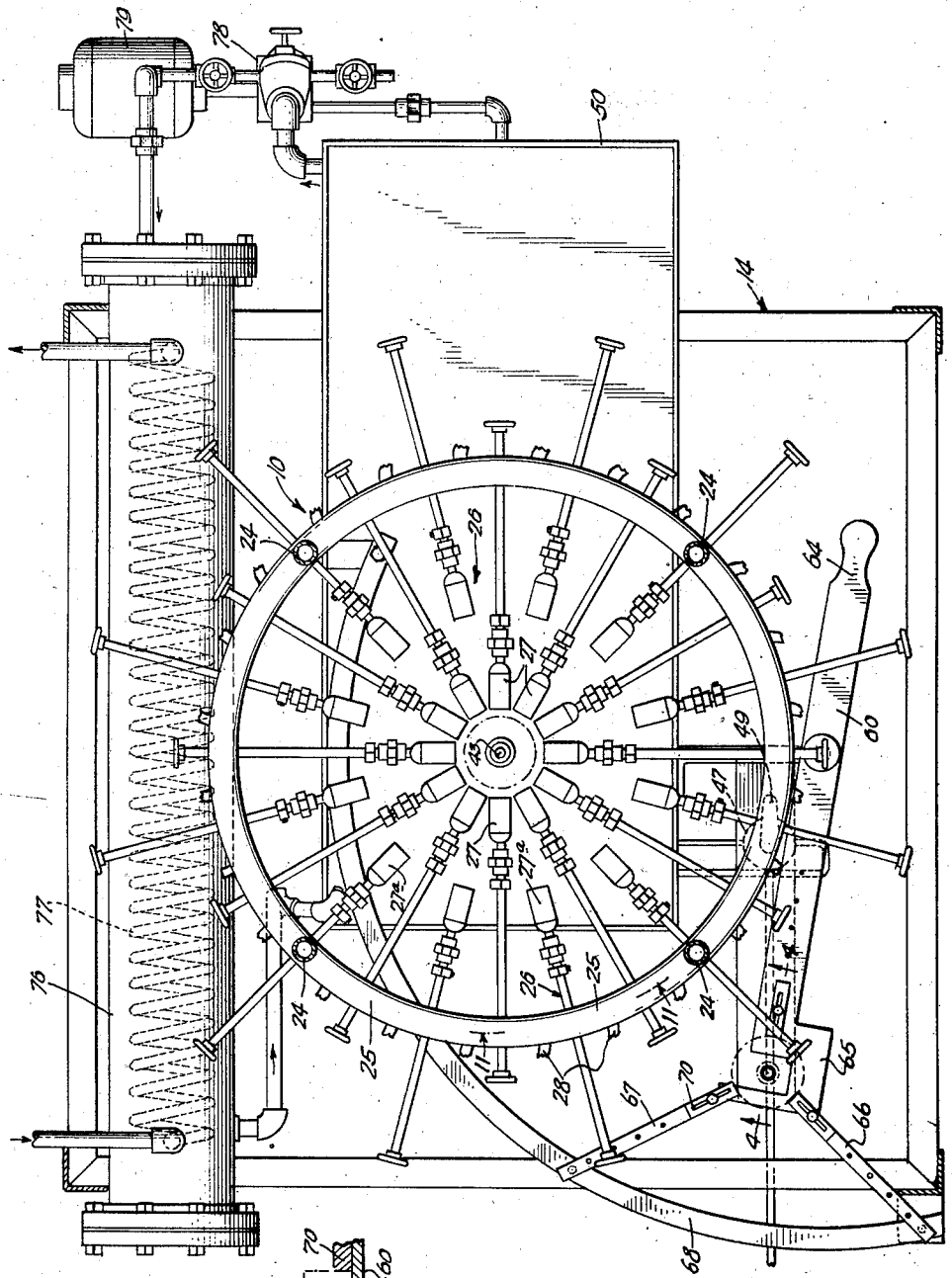


Fig. 3

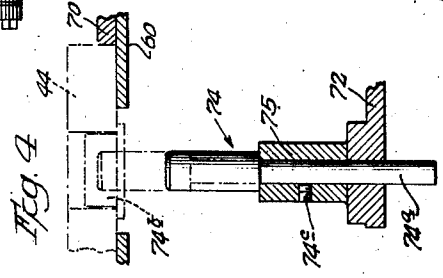


Fig. 4

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HEAT TREATING APPARATUS

Filed Oct. 27, 1941 6 Sheets-Sheet 4

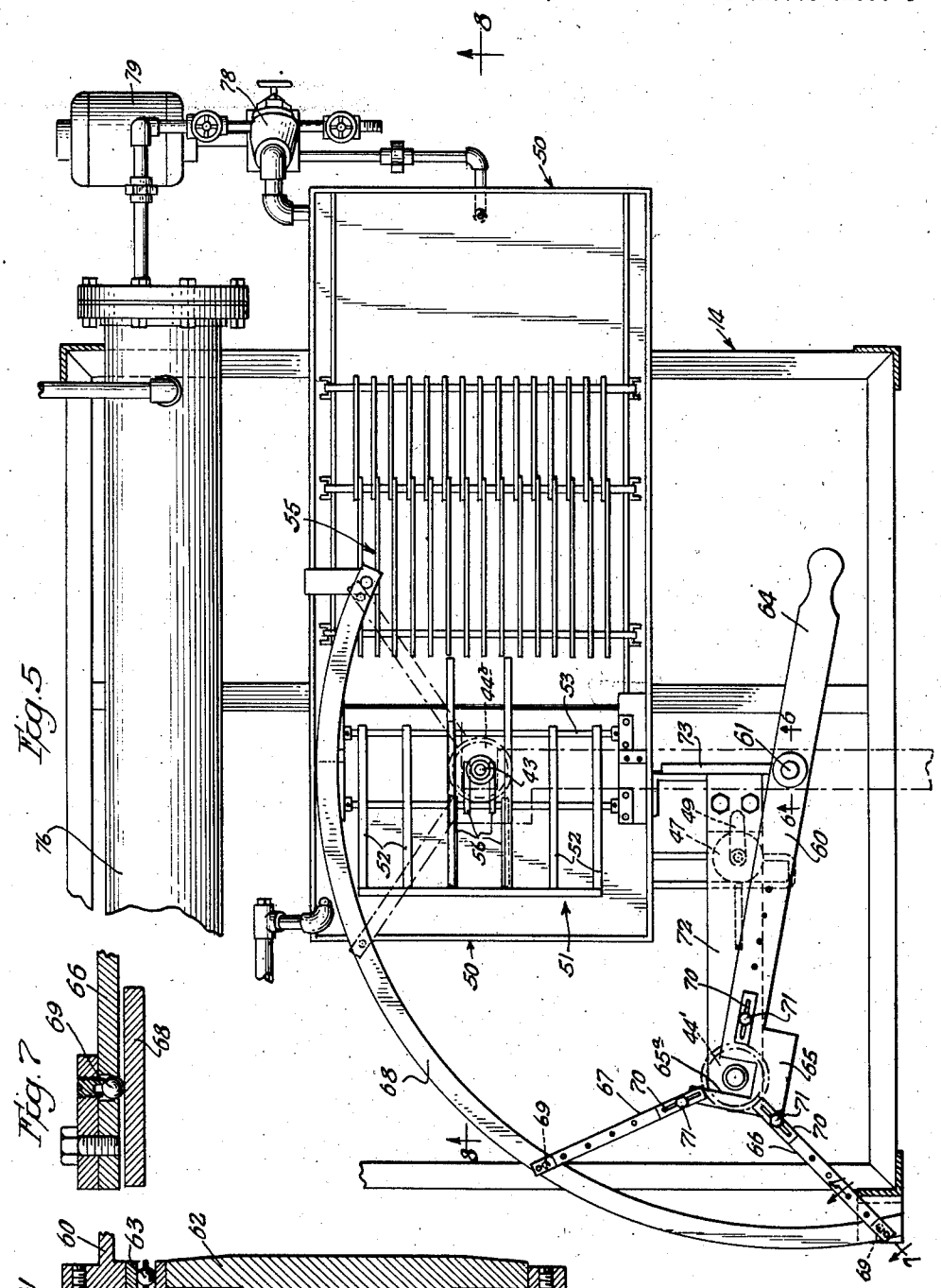


Fig. 5

Fig. 7

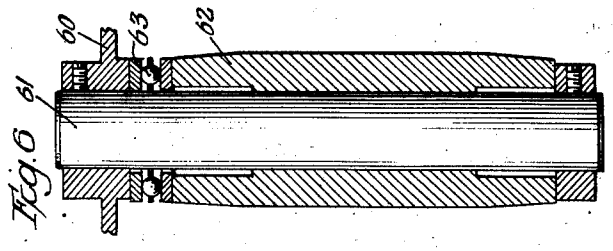


Fig. 6

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Filed Oct. 27, 1941 6 Sheets-Sheet 5

Fig. 8

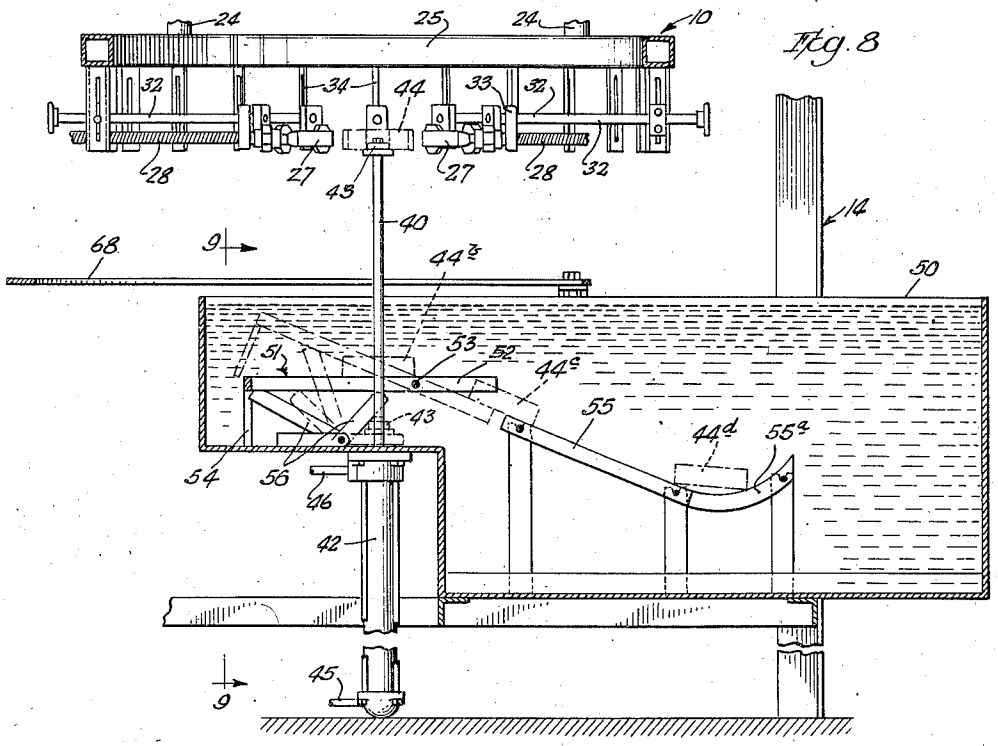
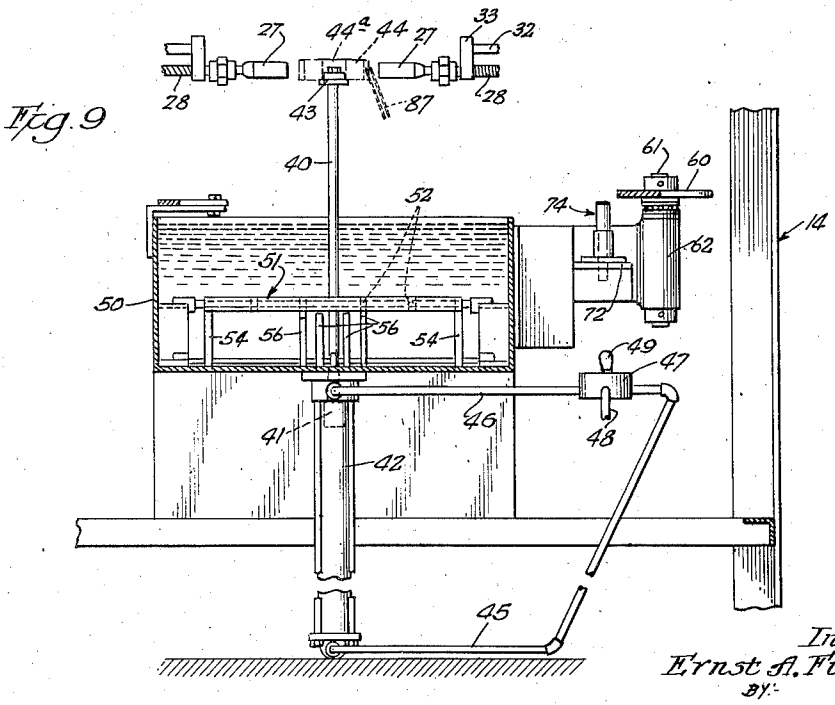


Fig. 9



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HEAT TREATING APPARATUS

Filed Oct. 27, 1941 6 Sheets-Sheet 6

Fig. 10

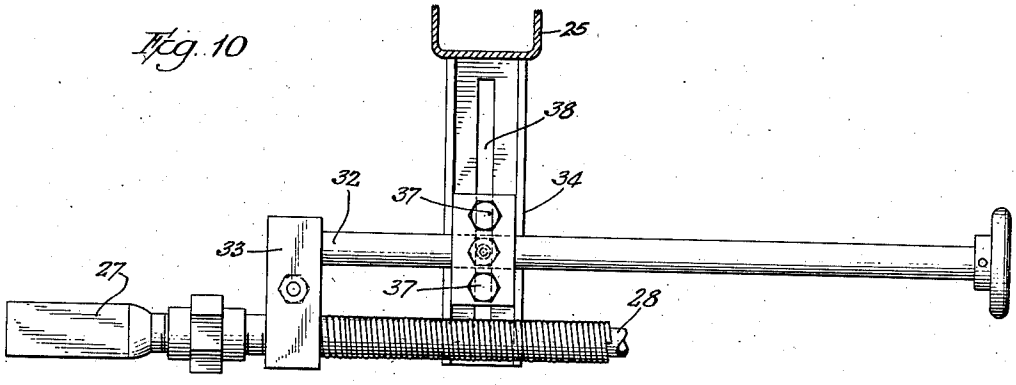


Fig. 11

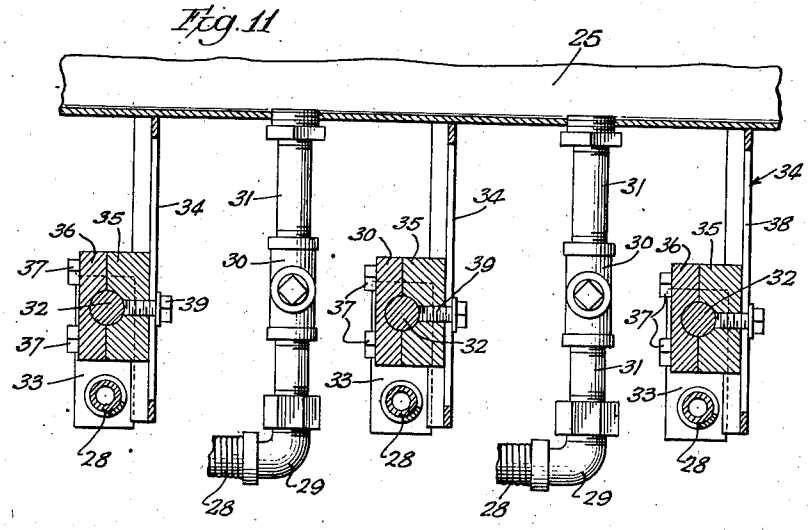
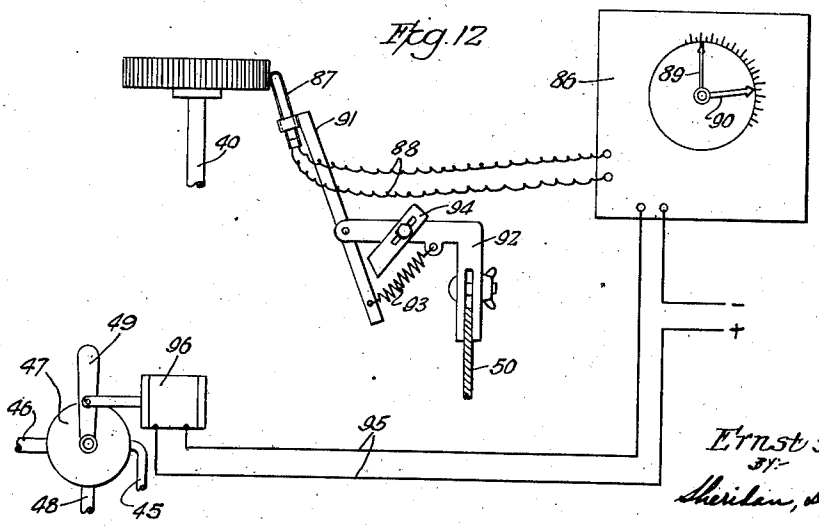


Fig. 12



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UNITED STATES PATENT OFFICE

2,407,230

HEAT-TREATING APPARATUS

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Application October 27, 1941, Serial No. 416,613

3 Claims. (Cl. 266—4)

1

This invention relates to improvements in heat treating apparatus.

One object of the invention is to provide improved heat treating apparatus adapted for use in heat treating metal articles with desired uniformity during hardening operations.

Another object of the invention is to provide rotary heating apparatus for uniformly heating to the required temperatures stationary metal articles to be hardened.

An additional object of the invention is to provide improved means for immersing heated articles in a suitable bath automatically when the articles have been heated to a predetermined temperature.

Additional objects of the invention relate to various features of construction and arrangement of parts which enable the improvements to be utilized advantageously in heating articles of different dimensions and sizes, in positioning the articles accurately in predetermined heating position, and in moving the heated articles expeditiously to the cooling bath, as well as moving the immersed articles within the bath, all of which objects and others will be apparent from a consideration of the accompanying drawings, wherein

Figure 1 is a side elevation of apparatus embodying the present improvements;

Fig. 2 is a top plan view of the apparatus shown in Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a broken sectional view taken on line 5—5 of Fig. 1;

Fig. 6 is an enlarged sectional view taken on line 6—6 of Fig. 5;

Fig. 7 is an enlarged sectional view taken on line 7—7 of Fig. 5;

Fig. 8 is a sectional view taken on line 8—8 of Fig. 5;

Fig. 9 is a section taken on line 9—9 of Fig. 8;

Fig. 10 is an enlarged top plan view of one of the burners or torches which supply heat to the article to be heated;

Fig. 11 is an enlarged sectional view taken on line 11—11 of Fig. 3; and

Fig. 12 is an elevation, partially diagrammatic, illustrating temperature responsive means for effecting the quenching of heated articles automatically.

In the illustrative embodiment of the invention shown in the drawings, rotary heat applying mechanism is provided which is indicated generally by the numeral 10. The mechanism comprises a rotary vertical shaft 11 which is suitably journaled in bearings 12, 12a which are supported by transverse frame members 13, 13a (see Fig. 2)

2

forming a part of the supporting frame structure of the machine and indicated generally by the numeral 14. Mounted on the shaft 11, which is tubular, is a pulley 15 driven by a belt 16 which is operable by a motor 17 which may be attached to the supporting frame structure of the machine. A gaseous fuel is supplied to the tubular shaft 11 by means of any appropriate pipe element such as the stationary pipe 18 having a gas tight coupling 18a which connects the same to the upper end of shaft 11, and other elements constituting a gas line by means of which the gas from a suitable source is conducted to the hollow shaft. The present improvements are designed for utilizing either natural or artificial illuminating gas suitably mixed with air in a mixing apparatus, not shown in the drawings, from which it is conducted as by the pipe 19 to a motor valve 20, to a fire check 21, and thence to the pipe 18 referred to above. When the machine is in operation, the motor valve 20 will be open to admit the fuel to the heating apparatus, but when the motor valve is closed by a switch hereinafter referred to, a reduced quantity of gas is by-passed around the valve through pipes 21, 22 and 23 to maintain a flame at the burners hereinafter described.

The lower end of the shaft 11 is provided with a plurality of branches 24, four being shown in Fig. 2, which branches communicate with an annular manifold 25 which constitutes a part of the rotary structure of the machine. From the manifold the gas flows into a plurality of burners or torches indicated generally by the numeral 26. The torches which are directed radially inwardly of the rotary structure are provided with nozzles 27 at their inner ends which communicate with flexible tubes 28. The tubes 28 in turn communicate with the manifolds by means of suitable pipe connections as shown in Fig. 11 comprising elbow 29, regulating valve 30 and conduit sections 31. It will thus be seen that gas from the manifold may flow to the burner nozzles while the manifold and burners are rotating.

Each of the nozzles, as shown in Fig. 10, is attached to a horizontal rod or arm 32 by means of a suitable clamp 33. The rod 32 is adjustably secured to a bracket 34 which is secured to and depends from the manifold 25, in the form of the nozzle support shown in Figs. 10 and 11. Each of the rods 32 is carried between a pair of cooperating clamp plates 35 and 36 which are adjustably secured together by means of screws 37. Upon loosening the screws 37, the rod can be slid forwardly or rearwardly or turned angularly about the axis of the rod and reclamped in the desired position by tightening the screws. The brackets 34 are shown as provided with slots 38 through each of which projects a tightening screw 39 for securing the plates 35 and 36 in ver-

tically adjusted position to the bracket 34. Hence, the nozzles can be adjusted arcuately about the axis of the respective rods 32; they can be moved inwardly or outwardly by the sliding movement of the rod mentioned above, and they can be moved vertically by sliding the clamp plates 34 and 36 along the brackets 34; the flexible ducts 28 permitting such adjustments.

As illustrated in the drawings, the nozzles are directed radially inwardly of the rotary structure for directing flames upon an article to be heated which is located in a position disposed along the axis of rotation of the rotary structure. While the improvements herein disclosed are adapted for heat treating articles of various shapes, they will, for illustrative purposes, be described in conjunction with the treatment of gears.

For the purpose of supporting a gear in a heating position, as illustrated in Fig. 9 for example, suitable reciprocating mechanism has been provided. Such mechanism comprises a vertical shaft 40 which, at its lower end, is secured to a piston 41 arranged to operate in a cylinder 42. The upper end of the shaft 40 is provided with a removable gear supporting member 43 of a size to enter the axial opening 44^a of a gear 44 to be treated as shown in Fig. 9. Where gears having different size openings are to be treated, appropriate supporting members 43 fitting such openings are employed.

In the embodiment of the invention illustrated, the piston 41 is designed to be operated by compressed air, and for this purpose, a conduit 45 is shown extending to the bottom of the cylinder 42, while a conduit 46 extends to the upper end of the cylinder. A suitable valve 47 is provided whereby air delivered thereto by a conduit 48 may be directed to the conduit 45 for elevating the piston, the rod 40 and a gear thereon, or the air may be directed through conduit 46 for lowering the piston, the rod 40 and the gear thereon. The valve may be of any suitable type and is shown as being provided with a manually operable handle 49 for controlling the operation of the piston, although as described hereinafter additional means preferably are provided for operating the valve in controlling the descent of the piston. The cylinder 42, as shown in Figs. 8 and 9, is located beneath an end portion of a tank 50 which is supplied with oil or other appropriate cooling liquid into which a heated gear is immersed for hardening the same.

The shaft 40 extends upwardly through a suitably packed opening in the tank 50 and through the liquid, as shown in Figs. 8 and 9, and projects at its upper end substantially into the horizontal plane of the nozzles 27 for supporting a gear 44 in heating position when the piston is in the uppermost position, as illustrated in the above-mentioned figures. Upon descent of the piston to its lowermost position, a gear 44 carried by the shaft 40 is drawn downwardly into the cooling bath. When the piston has been retracted to its lowermost position, the gear supporting member 43 is disposed in the dotted line position shown in Fig. 8. The shaft 40 extends through a gear receiving member which is positioned within the tank 50. Such a receiving member is indicated generally by the numeral 51, and in the form illustrated is of grid-like formation constructed of bars 52. The member 51 is pivotally supported adjacent the forward portion thereof on a rockshaft or the like 53 whereby it can be tilted clockwise to the dotted line position shown in Fig. 8. Normally, the gear receiving member 51 is in the horizontal position shown in full lines in Fig. 8, and is supported in that horizontal position by legs 54 which contact the bottom portion of the tank. The bars 52 are located sufficiently close together to arrest the downward descent of a gear as the latter is lowered by the piston and thus remove it from the gear support member 43. Such a removed gear is indicated at 44^b in Fig. 8.

Suitable means are provided for tilting the gear receiving member 51 to cause the same to slide therefrom onto an inclined rack 55 also located in the tank, as shown in Fig. 8. Such tilting means may be in the form of a structure comprising a pair of bell-crank levers 56 each having a short arm located adjacent the shaft 40 for engagement by the gear supporting member 43 as the latter moves downwardly through the member 51 to the dotted line position shown in Fig. 8. As the member 43 engages the ends of the short arms of the levers 56, the longer arms thereof are moved clockwise to the dotted line position shown in Fig. 8, and in so moving, engage a pair of bars 52 of member 51 and tilt the latter to the dotted line position shown in Fig. 8 and thus cause an arrested gear in the position indicated at 44^b to slide from the member 51 onto and downwardly along the inclined rack 55 to the lower upturned portion 55^a thereof where it is arrested and remains until removed from the bath. As indicated by the positions 44^c and 44^d of the gear, it will thus be seen that when a gear has been heated to the proper temperature, operation of the valve 47 will admit air under pressure through conduit 46 to the cylinder 42 above the piston, and the gear will be moved quickly into the bath and will be freed from the gear carrying member 43 by reason of the descent of the latter to a position beneath the gear receiving member 51, whereupon, due to the tilting action of the member 51, the gear will be moved by gravity laterally or to the right, as shown in Fig. 8, to the lowermost portion of the rack 55. Hence a hot gear, by reason of its movement within the bath, is cooled quickly since it does not remain in its original arrested position in the cooling liquid and comes to rest within the liquid adjacent an end of the tank from which it can be removed by an attendant.

Air under pressure may be supplied to conduit 48 from any suitable source, but in the drawings the duct 48 is shown as being connected to air pressure tank 56 having mounted thereon an air pump 57 operable by a motor 58 which maintains the desired pressure in the tank for the purposes mentioned.

To facilitate the positioning of gears to be treated upon the gear carrying member 43, as for example, where a number of similar gears are to be hardened, a suitable gear loading member is provided which in the form illustrated comprises a lever 60 pivotally supported on a vertical shaft 61, which in turn may be journaled in a bearing 62 and provided with anti-friction bearings as shown in Fig. 6. The lever 60 is provided with a manually operable handle 64 whereby the lever may be swung from the full-line position shown in Fig. 5 to the dotted line position and vice versa. The forward end of the lever 60 is provided with a gear supporting head 65 having a recess 65^a of sufficient size to permit passage therethrough of gear carrier members 43. The recess, it will be noted, is open at one side whereby when a gear positioned on the head has been swung clockwise to a position over a cylinder 42, and has been removed therefrom by the upward move-

ment of the gear carrier **43**, the lever **60** can be returned from the dotted line gear delivering position shown in Fig. 5 to the full line or gear loading position thereof.

Two arms, **66** and **67**, project radially from the head **65** over the upper surface of an arcuate track **68** which is concentric with reference to the pivotal axis **61** of the lever **60**. The forward ends of the members **66** and **67** preferably are provided with anti-friction members **69** which contact the upper surface of the track **69** for reducing friction during the swinging movements of the lever **60**. Such an anti-friction member is illustrated in Fig. 7 of the drawings.

The head **65** and the adjacent portions of the supporting arms **66** and **67** are provided with adjustable gear centering members **70** in the form of slotted bars which may be secured in properly adjusted positions by screws **71**. The inner ends of the bars **70** can be adjusted about a central point whereby when a gear, such as the gear indicated by the numeral **44'** in Fig. 5, is in the position illustrated, and the lever **60** is swung to the dotted line position of said figure, the gear will be engaged by the gear supporting member **43** when the piston **41** is moved upwardly as above described. When gears of larger or smaller diameter than the gears shown in Fig. 5 are to be treated, the gear locating bars **70** are adjusted outwardly or inwardly proper radial distances. It will, therefore, be seen that the distance from the axis **61** of the lever **60** to the center of gear **44'** is the same as the distance from the axis **61** to the vertical center line of the gear supporting member **43**.

Suitable means are provided for assuring a proper adjustment of the bars **70** with reference to a vertical axis which will coincide with the axis of the member **43** when the lever **60** has been swung to the gear delivering position shown in dotted lines in Fig. 5. In the present embodiment of the invention such means is shown as comprising a bracket or arm **72** extending horizontally from a supporting arm **73** which supports the bearing of shaft **61** and provided at its outer end with means for slidably supporting a centering pin **74** (see Figs. 1, 4 and 9). Means for slidably supporting the pin **74** may comprise a tubular support **75** into which a reduced lower end **74a** of a pin can be inserted. On the upper end of the pin **74** in Fig. 4 is shown a member **74b**, corresponding in diameter to the gear opening and similar to the supporting member **43**.

The vertical axis of the member **75** is spaced from the axis **61** a distance corresponding to the distance from the axis **61** to the axis of the gear holder **43**. By sliding the pin **74** upwardly by means of the lower projecting end **74a** thereof to the dotted line position shown in Fig. 4, the member **74b** will project into the area of the slot **65a** of the arm **60** when the latter is in the loading or full line position shown in Fig. 5. A set-screw **74c** is shown for temporarily retaining the pin **74** in the elevated position. The gear or one of a group of similar gears to be treated can then be placed upon the member **74b** for the purpose of locating the same in the proper position, the bars **70** being thereupon adjusted into contact with the exterior of the gear for retaining it in such position. The pin **74** and member **74b** can then be lowered to a non-obstructing position beneath the arm **60** or can be removed from the member **75**. When the lever **60** is swung to the dotted line position, the center opening of the gear will register with the member **43** as the latter is moved upwardly by the piston into engagement with the gear, as shown in Fig. 9, for elevating the same into the heat zone of the apparatus. When the locating bars or stops **70** have once been properly positioned for handling gears of a given diameter, such subsequent gears when placed on the head **68** will be properly located for registration with the member **43** when the lever **60** is in the dotted line position of Fig. 5.

In Figs. 2 and 3 of the drawings a horizontally disposed tank **76** is shown provided with a tubular coil **77** therein which is connected to a source of cold water such as the city water supply for circulating water therethrough for reducing the temperature of the oil employed in the quenching tank of the apparatus. A pump **78**, operable by a motor **79**, draws the oil from the tank **50** and forces the same through the tank **76** where it is cooled by the coil and from which it is returned to the quenching tank **50**.

In Fig. 1 of the drawings a switch panel **80** is shown secured to the front of the machine and is provided with a switch **81** for controlling the operation of the pump **79** whereby the oil in the tank **50** may be maintained at a proper quenching temperature. A second switch **82** is shown for controlling the operation of the motor valve **20**. A switch **83** also mounted on the panel controls the operation of the motor **17**. The three switches referred to particularly are illustrated as of the toggle or snap on and off type. When the switch **83** is closed the motor **17** operates continuously until the switch is turned to the off position. A second switch for controlling the motor **17** is provided which is a spring-opening switch indicated by the numeral **84**. When the button of this switch is pressed inwardly, the motor circuit is closed, but when the button is released, the switch is automatically opened. This switch is of convenience in making adjustments of the torches or burner nozzles since by its use the rotary structure can be caused to move a few degrees of arc at a time for moving nozzles into a position at the front of the machine. The machine itself can be located with its rear against or close to a wall, or in a corner of a room since it is not necessary for an operator to work on all sides of the machine in effecting adjustments of the burners. An additional switch **85** is shown on the panel **80** for controlling the operation of the air compressor motor **58**. This switch may be of either type above referred to, but is shown as being of a type similar to the switch **84**.

Also positioned on the panel **12** is a temperature indicator designated generally by the numeral **86**. The indicator is of the controlling pyrometer type of known construction. The indicator comprises a thermocouple **87** adapted to be positioned against a gear in the heating position as illustrated in Fig. 12. Conductors **88** extend from the couple to the instrument for effecting actuation of a hand or pointer **89** which indicates the changing temperature of the gears during the heating operation. A temperature selector hand **90** can be adjusted to a position corresponding to the maximum temperature at which a gear or gears are to be heated. When the gear in the heating zone is at the selected temperature, as indicated by the hand **89**, it will be parallel with the hand **90**. In the present embodiment of the invention, the conductors **88** of the couple **87** extend downwardly from the indicator **86** on the exterior of the rotary structure, and the couple is held against the gear pe-

riphery in such a position as not to interfere with the rotation of the burners, nor with the lowering of the gear when the proper temperature has been reached. Any suitable means such as an adjustable arm 91 pivotally mounted on a bracket 92 may be employed for retaining the couple in contact with the gear during the heating operation. A spring 93 is shown for pressing the couple firmly in contact with the gear. An adjustable stop 94 limits the counterclockwise movement of the couple when the gear has been moved into the quenching fluid. When the next gear is moved into the heating zone, it will move the couple and arm 81 into the position shown in Fig. 12.

The indicator 86 constitutes means for effecting the automatic operation of the valve handle 49 in a direction to lower the gear into the quenching fluid. When the hand 89 moves into a position parallel with the adjustable temperature selector hand 90, the mechanism of the pyrometer, by known means not disclosed in the drawings, is arranged to close a circuit switch. In this instance the circuit includes conductors 95 and a solenoid 96. The solenoid is operatively connected to the valve handle 49 and hence moves the same to admit air into conduit 46 and thereby lower the gear into the quenching liquid.

Since an article while being heated in the improved apparatus remains stationary, it need not be firmly attached or clamped to supporting means as in prior apparatus where the articles are rotated and the heat sources are stationary. The article, heated by means of the present improvements, can, therefore, upon acquiring the desired maximum temperature, immediately be immersed in the quenching fluid without additional handling.

In Fig. 1 of the drawings a gas pilot 97 is shown connected to the conduit 21 forming part of the by-pass around the motor valve 20. The flame issuing from the upper end of the pilot member by its color gives an indication of the character of the admixture of the gas and air being delivered by the gas mixing machine not shown. To a gas port in the lower end of the pilot 97, a flexible tube 98 may be attached, the tube having a burner tip 99 at its outer end. By opening a pet-cock 100, gas will be delivered to the burner tip 99 which may be ignited by the flame issuing from the upper end of the pilot 97 and the tip used as a torch for igniting the burners of the rotary structure.

By means of the present improvements it has been found that articles can be heat treated satisfactorily and expeditiously by utilizing manufactured or natural gaseous fuels of relatively low flame temperatures and with less likelihood of overheating or burning the articles than where more expensive and high flame temperature fuel is employed, such as oxyacetylene gas which generally has been used in prior flame hardening apparatuses. A sufficient number of the burner or torch nozzles 27 can be adjusted to direct flames upon those surfaces of the article that are to be hardened to heat the same to the desired temperature, such burners as are not required in heating a relatively small article, for example, being moved radially outward to inoperative positions, such as the positions of the burners indicated by reference characters 27a in Fig. 3. It will also be seen that where several identical gears are to be hardened, the adjustment of the members 70 to center the gears with respect to the path of movement of the gear supporting member 43, when the loading lever 60 has been swung to the dotted line position of Fig. 5, facilitates the handling of the gears since, during the period that one gear is being heated, the attendant can place another gear in position on the member 65 and can swing that gear inwardly into alignment with the path of member 43 immediately following the quenching of the heated gear. The positioning of the gears in heating position by the means described, as well as the adjustment of the burners, can be effected without an attendant being required to reach into the heating or flame zone of the machine as will be seen.

While I have shown and described certain embodiments of my improvements for the purpose of illustration, it is obvious that various alterations may be made therein without departing from the spirit of the invention.

I claim:

1. Heat treating apparatus comprising a plurality of rotary burners arranged in positions for projecting flames into a zone located axially with respect to the orbit of the burners, means for rotating the burners, means for supplying fuel thereto during such rotation, vertically reciprocable means for supporting in said zone an article to be heated, means for reciprocating said supporting means between upper and lower positions, and article transferring means operable from a position remote from said supporting means for receiving an article to be heated and transferring the same into the path of movement of said supporting means intermediate said upper and lower positions thereof for delivery thereto upon movement of said supporting means from the lower to the upper position.

2. Heat treating apparatus comprising a plurality of horizontally rotatable burners arranged to project flames upon an article located in a zone disposed centrally of the orbit of the burners, means for rotating the burners, a reciprocable support for engaging an article and elevating the same into said zone, means for actuating said support from a lower position to a position for supporting an article in said zone, and means for delivering an article into the path of movement of said reciprocable support at a level above said lower position for engagement and elevation thereof to said upper position.

3. Heat treating apparatus comprising a vertically reciprocable shaft provided with an article supporting member on the upper end thereof, means for directing heat upon an article on said support when said shaft is in an elevated position, a horizontal swingable member provided with article holding means spaced from the pivotal axis thereof a distance corresponding to the distance from said axis to the path of movement of said shaft, said swingable member being located at an elevation lower than the uppermost position of said article supporting member and being swingable to a position for locating an article carried thereby coaxially above said article supporting member when the latter is in a lowered position, and means for moving said shaft and supporting member upwardly into engagement with an article in said coaxial position for elevating the latter into heating relation with respect to said heating means.

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