March 8, 1932. J. L. McFARLAND 1,848,898

HEAT TREATING APPARATUS

Filed June 6, 1928 2 Sheets-Sheet 1

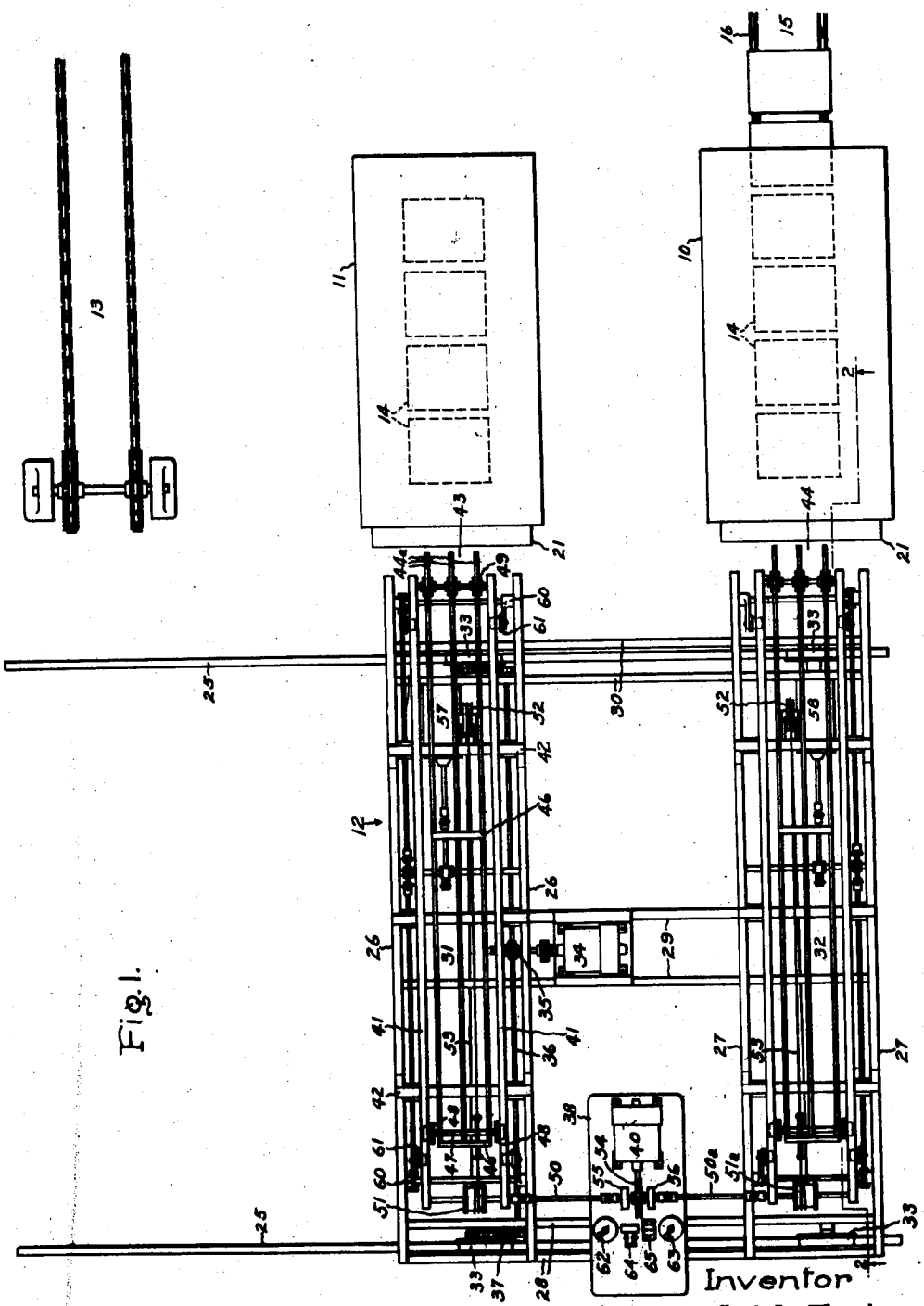


Fig. 1.

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HEAT TREATING APPARATUS

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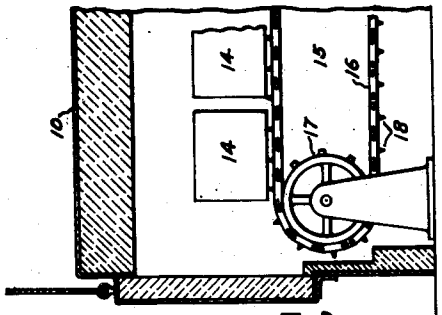


Fig. 2.

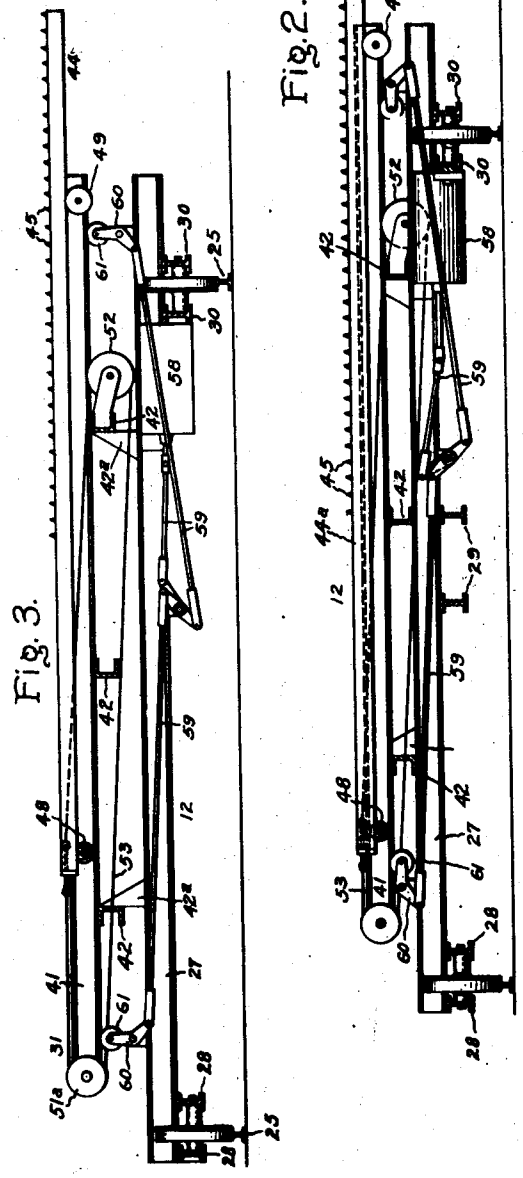


Fig. 3.

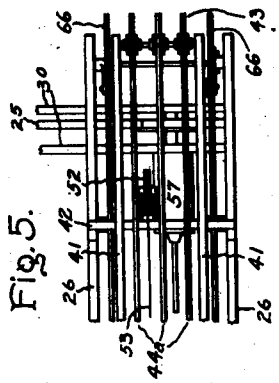


Fig. 5.

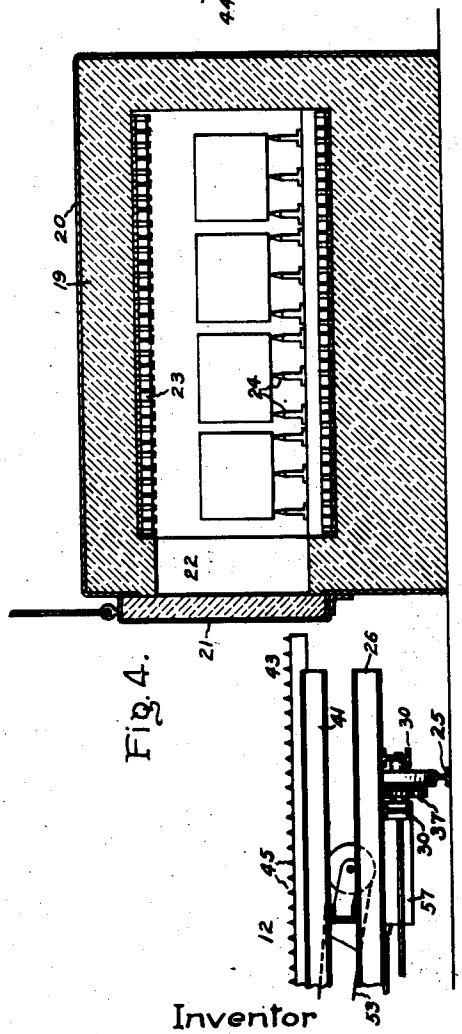


Fig. 4.

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UNITED STATES PATENT OFFICE

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HEAT TREATING APPARATUS

Application filed June 6, 1928. Serial No. 283,329.

This invention relates to heat treating apparatus, and the like, and has for its object the provision of improved means for carrying out a predetermined succession of treating operations.

Although my invention may be used in the charging of furnaces, ovens and the like, in general, it has particular application to vitreous enameling installations wherein a plurality of furnaces or ovens are used to carry out the process of enameling. In certain vitreous enameling processes, the articles to be enameled, after being dipped or sprayed with the enameling solution are placed in a preheating or drying furnace or oven, of relatively low temperature in which the liquid binder used in the enamel is evaporated. The articles are then withdrawn from this drying furnace and conveyed into a second furnace which may be termed a firing furnace and which is maintained at a higher temperature, wherein the heating operation is completed, the constituents of the enamel being fused onto the article being coated. After the completion of the heating operation in the second furnace, the articles are removed and allowed to cool after which they may be given a second application of liquid enamel, which is then successively dried and fired in the furnaces. The articles are often given several applications of enamel in order to obtain a coating of the desired thickness and quality. The drying and firing operations are of but short duration, in some instances a period of but a few minutes being required for each operation. It is advantageous therefore to operate the furnaces continuously and remove the charge while hot at the end of each operation, a fresh charge being immediately inserted.

My invention has special reference to means for facilitating the insertion and removal of the charge from the furnace or furnaces in carrying out the enameling or other process and the transfer of the charge as desired, such as from one furnace to another where a plurality of furnaces are used, or from a furnace to a suitable cooling rack. In carrying out my invention in one form I provide a carriage, and a frame on the carriage which may be raised and lowered, together with a fork mounted on the frame so as to be movable into a furnace chamber to deposit or receive a charge. In connection with an enameling installation in which both drying and firing furnaces are used I provide apparatus for withdrawing a charge from the drying furnace and concurrently therewith withdrawing a charge from the firing furnace, and then, concurrently depositing the first charge in the firing furnace and the second charge on a suitable support. My entire apparatus can easily be controlled and operated by one person.

For a more complete understanding of my invention reference may be had to the accompanying drawings wherein Fig. 1 is a plan view of a complete installation; Fig. 2 is a sectional elevation on the lines 2—2 of Fig. 1 looking in the direction of the arrows; Fig. 3 is a view similar to Fig. 2 but with the charging forks in the elevated position; Fig. 4 is an elevation partly in section through one of the furnaces while Fig. 5 illustrates a slight modification.

Referring to Fig. 1 of the drawings, I have illustrated my invention in one form as applied in an installation for vitreous enameling comprising a drying furnace 10 and a firing furnace 11. In carrying out my invention I provide a charging device comprising a carriage 12 by means of which the heated articles 14 are carried from the furnace 10 to the furnace 11, and from the furnace 11 to the conveyor 13. While I have shown the articles 14 as substantially cubic boxes it is to be understood that my apparatus is capable of being used with articles of any other shape, such as flat plates, for example. The furnaces 10 and 11 may be maintained at equal temperatures but it is preferred that while being used in the process of vitreous enameling, the furnace 10 will serve as a preheating or evaporating furnace, and thus will be maintained at a lower temperature than furnace 11. A chain conveyor 15 is provided on which the articles 14 are placed, after having been dipped or sprayed with the vitreous solution, and carried into the furnace 10. I have shown the conveyor 15 as comprising

an endless chain 16 passing around sprockets 17, one only of which is shown in Fig. 2. The links of the chain 16 are provided with projections 18 which serve to support the articles 14 while they are being heated in the furnace 10. After the articles 14 have been dried in furnace 10 they are conveyed to the firing furnace 11 where the constituents of the enamel coating are fused. After being fired, the articles are removed from furnace 11 and deposited on the conveyor 13. The conveyor or support 13, as shown in Fig. 1, may be similar to the conveyor 15 and is provided to carry the articles 14 to a position where they may receive another coat of enamel. It is to be understood that the articles 14 need not be placed directly on the conveyors 15 but may be placed on separate supporting members, not shown, which in turn would be supported directly on the conveyors. The use of separate supporting members would be especially applicable where the articles 14 to be heated are small, as the danger that the articles might slip off of or through the conveyors would thus be avoided.

As illustrated more clearly in Fig. 4, the furnace 11 comprises refractory walls 19 surrounded by sheet metal shells 20. Vertically movable doors 21 are adapted to close openings 22 through which the articles 14 are inserted into and removed from the furnaces. Heating resistors 23 are provided in the top and bottom of the furnace 11 and refractory, pointed supports 24 for the articles 14 are mounted above the lower heating resistor 23. The furnace 10 is similar to the furnace 11 as indicated in Fig. 2 with the exception that the conveyor chain 16 serves to support the articles 14. Heating means, not shown, is also provided for furnace 10 but it is not necessary that the heating means for furnace 10 have as great heat generating capacity as the heating means used in furnace 11, since the function of the furnace 10 is merely to preheat the articles 14 and to cause evaporation of the liquid binder in the solution which has been sprayed on the articles 14, previous to their entrance into the furnace 10. The back or right-hand end of the furnace 10 may be open at all times as is illustrated in Fig. 1.

Extending substantially at right angles to the longitudinal axes of the furnaces 10 and 11 are tracks 25, and movably mounted on these tracks is the charging device comprising a carriage 12 of substantially rectangular shape, formed of two pair of longitudinal channel beams 26 and 27 connected by pairs of cross bars 28, 29 and 30. The longitudinal beams 26 and 27 are held in proper spaced relation by the cross bars 28, 29 and 30. The carriage 12 is supported on the tracks 25 by means of four wheels 33. A reversible motor 34 mounted on the cross bars 29 is connected to two of the wheels 33 by means of worm and pinion 35, shaft 36 and gearing 37. By energizing motor 34 the carriage 13 may thus be moved on the tracks 25. Mounted on the cross bars 28 is a platform 38 and on this platform 38 are mounted control instruments and a reversible motor 40, the purpose of which will be explained hereinafter.

Supported by the beams 26 and 27 are two track frames 31 and 32, each track frame comprising a pair of track bars 41 and a plurality of short channel beams 42, and as shown more clearly in Fig. 2, these channel beams 42 are adapted to rest upon the longitudinal channel beams 26, 27. Angle irons 42—*a* are secured to the longitudinal beams 26, 27 and serve to prevent longitudinal movement of track bars 41 while still allowing vertical movement thereof. The track frames 31, 32 serve to support charging forks 43 and 44. The charging forks 43, 44 are each shown as comprising three rods or tines 44*a* and on the upper surface of each tine is a plurality of short projections 45. The tines are secured together at one end and at a point substantially at the middle by cross bars 46, and it will be observed that this arrangement leaves the tines projecting for about half their length so that they can pass freely into and out of the furnaces between the chains 16 in the case of furnace 10 and between longitudinal rows of the refractory supports 24 in the case of furnace 11. Secured to the left-hand end of the forks 43, 44, as viewing Figs. 1, 2 and 3, are shafts 47 and attached to the ends of these shafts and mounted within the channels of track bars 41 are rollers 48. The rollers 48 are slightly smaller in diameter than the width of the channel in track bars 41 and the left-hand ends of the forks 43 and 44 are thus mounted for movement lengthwise of the track bars 41. At the opposite or right-hand end of track bars 41 are mounted short shafts provided with rollers 49 on which the right-hand ends of tines 44*a* rest so as to be supported thereby.

I have provided means for moving the forks 43, 44 lengthwise of the track frames 31, 32 and this means comprises shafts 50 and 50*a* driven by motor 40 and secured to drums 51 and 51*a* mounted at the left-hand ends of the track frames. Idler pulleys 52 are supported by the track frames 31, 32 and passing around these idler pulleys, drums 51 51*a* and secured to the left-hand ends of forks 43, 44 are flexible members 53, preferably made of heat resistant wire or cable. The motor 40 is connected to shafts 50, 50*a* by means of a worm and pinion 54 and the clutches 55 and 56. It will be seen that by operating the motor 40 the drums 51 and 51*a* will be rotated and by means of the flexible members 53 will cause forks 43, 44 to move lengthwise relatively to the track frames 31, 32. The clutches 55, 56 are preferably of the magnetic type, having control means, not shown, on the control platform 38. By means

of the clutches 55, 56 the operator can disconnect the motor 40 from either shaft 50 or 50*a* and either one of the forks can thus be used while the other remains idle.

I have also provided means for raising and lowering the track frames 31, 32 and consequently therewith the forks 43, 44 vertically relatively to the carriage 12, and this means comprises reciprocating piston motors 57 and 58 which may be of a hydraulic or pneumatic type, linkage 59 and a pair of bell cranks 60. Attached to the upper arms of bell cranks 60 are anti-friction rollers 61 which serve to engage the lower surfaces of track bars 41 and act as supports therefor. It will be observed that by causing the pistons of the motors 57, 58 to move to the right, the arms of the bell cranks to which the rollers 61 are secured, will be raised from the position shown in Fig. 2 and the linkage 59, track frames 31, 32 and forks 43, 44 will then be in the position shown in Fig. 3. As will be observed with reference to Figs. 2, 3 and 4, when the track frames 31, 32 and forks 43, 44 are in the lower position (Figs. 2 and 4) the upper surfaces of the forks 43, 44 will be slightly lower than the upper surface of the conveyor 15 of furnace 10 and the upper extremities of the pointed refractory supports 24 of furnace 11.

An important feature of my invention is the simplicity with which my entire apparatus may be operated and controlled by one person. An operator standing on the platform 38, by manipulating the controllers 62 and 63 causes the motors 34 and 40 to be energized and thus governs both the lateral movement of the carriage 12 and the longitudinal movement of the forks 43 and 44. By moving the levers 64, either one or both of the pneumatic motors 57, 58 may be operated to raise and lower the track frames 31, 32. Three pair of push buttons 65 serve to control respectively the upward and downward movement of the furnace doors 21 and the movement of the conveyor 15.

In explaining the operation of my apparatus let us assume that a number of the articles 14, having been coated with enameling solution, are resting on the conveyor 15 in the furnace 10 and that a number of the articles are also resting on the refractory supports 24 in furnace 11, as shown in the drawings. With the carriage 12 in the position shown in Fig. 1 and with the track frames 31, 32 and forks 43, 44 in the lower position, as shown in Fig. 2, the operator causes doors 21 to be raised and causes motor 40 to be energized in the proper direction to move the tines of the forks 43, 44 into the furnaces 10 and 11 immediately underneath the articles 14. It will be understood that the tines of the forks move between the supports for the articles in the furnaces. For example, in furnace 10 the tines will move between the chains of the conveyor 15, while in the furnace 11 the articles will be supported on relatively narrow spaced supports extending lengthwise of the furnace, and between which the tines of the fork are free to move under the articles. The motors 57, 58 are now operated and raise the track frames 31, 32 and forks 43, 44 to the upper position and the tines of the forks 43, 44 will thereby lift the articles 14 vertically from the supports in the furnaces 10 and 11. While the forks are maintained in this raised position the motor 40 is operated in a reverse direction and the forks 43, 44 and articles 14 will thus be withdrawn from the furnaces. The doors 21 are then closed by the operator on platform 38. The motor 34 is then energized and because of the driving connection between this motor and one pair of the wheels 33 the entire carriage 12 will be moved toward the conveyor 13. When the track frames 31 and 32 are in alignment, respectively, with the conveyor 13 and furnace 11, the movement of the carriage is stopped, the door 21 of furnace 11 is raised, and the motor 40 being energized in the proper direction causes the forks 43, 44 to move the articles 14 carried thereby to positions directly over conveyor 13 and directly over the refractory supports 24. By operating motors 57, 58 in the reverse direction the track frames 31, 32 and forks 43, 44 are vertically lowered and the articles 14, carried by the forks will be deposited on the conveyor 13 and on the refractory supports 24 in furnace 11. The articles on the conveyor 13 may then be moved to a position where they may receive a second coat of enamel. The motor 40 is now energized in a direction to move the forks 43, 44 to the left and then the motor 34 is energized in a reverse direction whereby the carriage 12 is moved back to its former position, as shown in Fig. 1, and the entire operation may then be repeated. It is to be understood that when a charge of articles 14 is withdrawn from furnace 10 by fork 44, additional articles will be moved into the furnace 10 on the conveyor 15.

Should the operator wish to move but one of the forks 43 or 44 he has but to disconnect the opposite clutch 55 or 56, suitable means, not shown, being provided for the purpose, and the operation of the apparatus will then be the same as described heretofore, with the exception that but one of the forks 43 or 44 will be in use.

In the enameling of flat plates and other articles which have but little stiffness it sometimes happens that these articles will be warped while resting on the tines 44*a* of forks 43, 44 due to sagging of those portions of the articles overlapping the tines, and for the purpose of preventing this I have provided, as shown in Fig. 5, a slight modification in which an additional pair of forks 66 are mounted in fixed relation to the longi-

tudinal bars 26 or 27 and at a height corresponding to the height of tines 44*a* when in the position shown in Fig. 2. These stationary forks 66 may have at their upper surface a plurality of projections similar to the projections 45, shown in Fig. 3. The operation of the modification illustrated in Fig. 5 is substantially the same as that described heretofore, the only exception being that on the withdrawal of the forks 43, 44 from the furnaces 10 and 11 the operator causes the forks to be lowered to the position shown in Fig. 2. The flat plates or articles will then be supported not only on the tines 44*a* but also on the stationary forks 66. Should the articles remain on the forks outside of the furnace for an appreciable time warpage of the plates or articles will be prevented since the edges of the articles overlapping the tines 44*a* will be supported on the stationary forks 66.

While I have described my invention as embodied in concrete form and operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Charging means for a plurality of furnaces, comprising a carriage, a plurality of charge carrying devices mounted on said carriage, said devices each being arranged to lift and carry a charge for said furnaces, driving means for moving said carriage to bring said charge carrying devices concurrently into registering relation with said furnaces, driving means for moving said charge carrying devices into and out of said furnaces, driving means for raising, lowering said charge carrying devices and means for controlling said driving means and auxiliary means for charging one of said furnaces independently of said charging devices.

2. The combination with a plurality of furnaces arranged in parallel relation, charge carrying means therefor comprising a plurality of vertically movable frames arranged substantially in parallel with each other and with said furnaces, said frames having substantially the same spacing as said furnaces, charge carrying and lifting devices supported by said frame, driving means for moving said charging devices into and out of said furnaces, driving means for raising and lowering said frames to raise and lower the charge and means for selectively controlling said driving means.

3. The combination with a pair of furnaces arranged substantially in parallel relation, of charging apparatus for said furnaces comprising a track mounted substantially at right angles to said furnaces, a pair of elongated vertically movable frames supported by said track and separated a distance equal to the distance between said furnaces, charging forks supported by said frames and mounted for horizontal movement relative to said frames, driving means for raising and lowering said frames, driving means for moving said forks on said frames into and out of said furnaces, means for controlling said driving means, one of said furnaces being provided with a rearward charging opening and conveyor means for charging said furnace through said opening.

4. The combination with a pair of furnaces and a conveyor, said furnaces and conveyor being arranged substantially in parallel relation and spaced apart equally, of charging apparatus for said furnaces comprising a track mounted laterally of said furnaces, a carriage movably mounted on said track, horizontal track bars supported by said carriage, said track bars having substantially the same spacing as said furnaces and conveyor, longitudinally movable charge carrying forks mounted on said track bars, driving means for moving said forks into and out of said furnaces, driving means for raising and lowering said track bars relatively to said carriage whereby said forks are raised and lowered, driving means for moving said carriage on said track substantially at right angles to said furnaces and means for selectively controlling said driving means.

5. The combination with a pair of furnaces and a conveyor, said furnaces and conveyor being arranged substantially in parallel relation and spaced apart equal distances, of charging apparatus for said furnaces comprising a track mounted substantially at right angles to the longitudinal axes of said furnaces, a carriage movably mounted on said track, horizontal track bars supported by said carriage arranged in parallel and separated a distance equal to the distance between said furnaces, longitudinally movable forks mounted on said track bars, driving means for moving said forks into and out of said furnaces, driving means for vertically raising and lowering said track bars relative to said carriage and driving means for moving said carriage on said track and means for selectively controlling said driving means.

6. In apparatus for carrying out successive heat treating operations, the combination of a pair of furnaces and a support constituting treating devices, said devices being equally spaced, one of said furnaces being provided with a rearward charging opening, conveyor means for charging said furnaces through said opening, a carriage movable back and forth in front of said treating devices, and a pair of charging devices mounted on said carriage, said charging devices having the same spacing as said treating devices so that

said carriage is movable to bring one of said charging devices into successive cooperating relation with said furnaces while at the same time the other charging device is moved into successive cooperating relation with one of said furnaces and said support, driving means for said carriage and said charging devices, and means for controlling said driving means.

In witness whereof, I have hereunto set my hand this 5th day of June, 1928.

JAMES L. McFARLAND.

CERTIFICATE OF CORRECTION.

Patent No. 1,848,898. Granted March 8, 1932, to

JAMES L. McFARLAND.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 43, strike out the comma after the word "raising" and insert the word and, and line 44, strike out the word "and" and insert a comma; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of May, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)