July 20, 1926. 1,593,351

A. E. PAIGE

ANNEALING FURNACE

Filed August 13, 1925 3 Sheets-Sheet 1

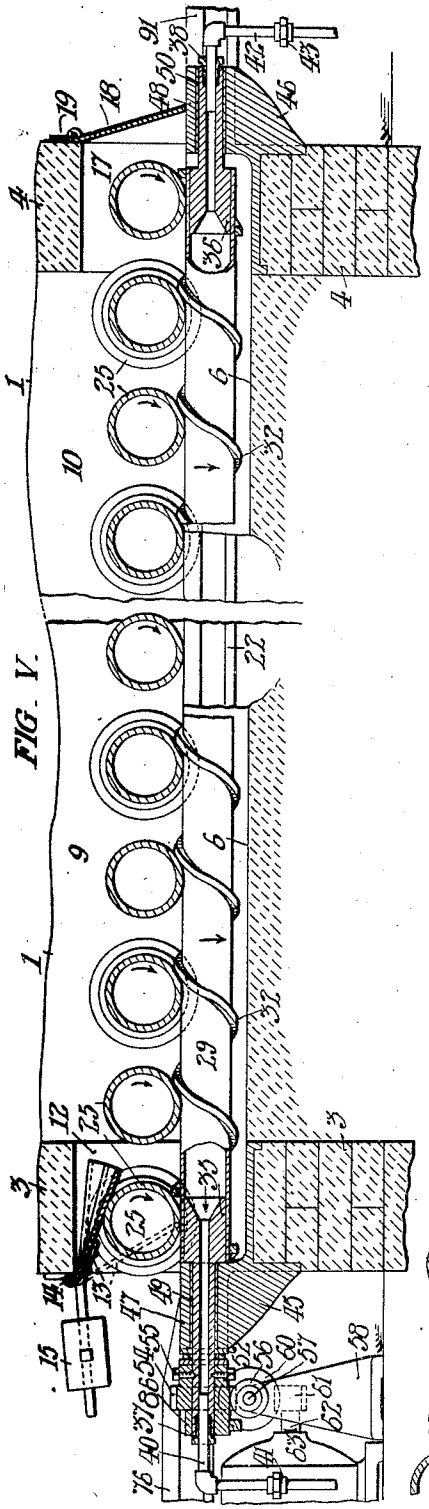


FIG. V.

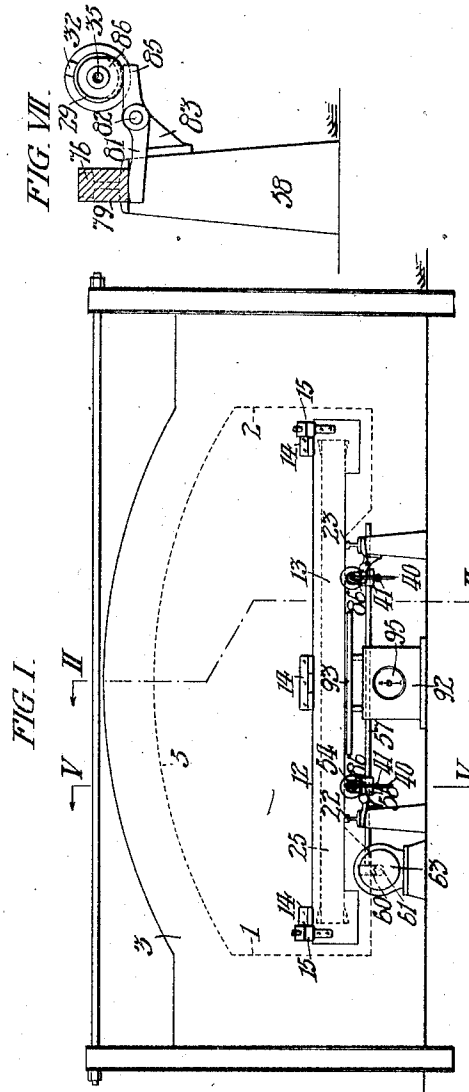


FIG. I.

FIG. VIII.

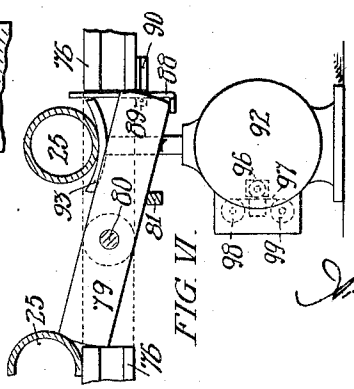


FIG. VI.

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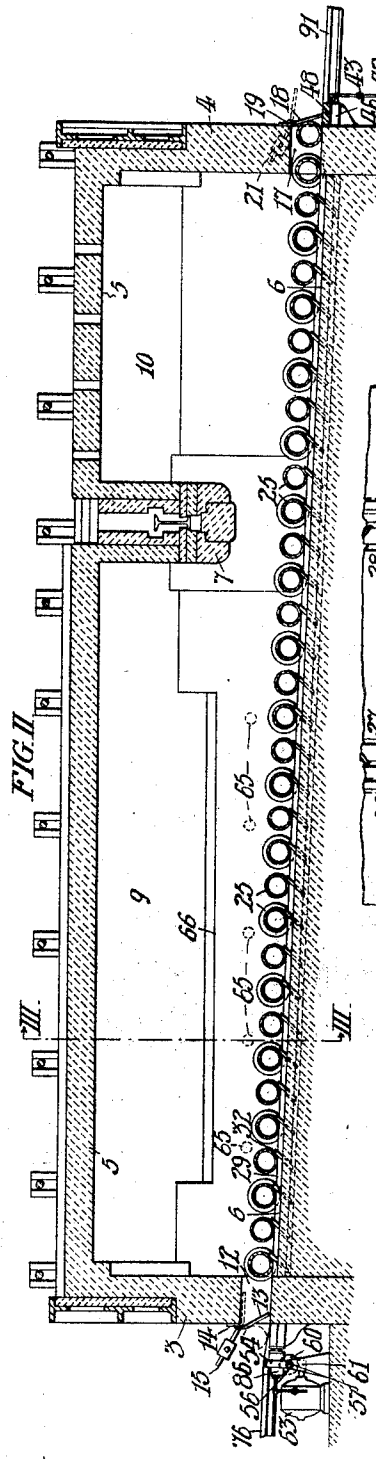


FIG. II

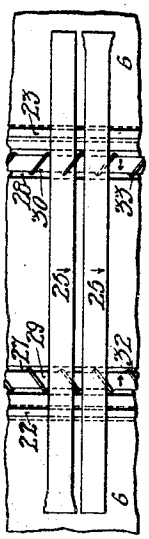


FIG. IV

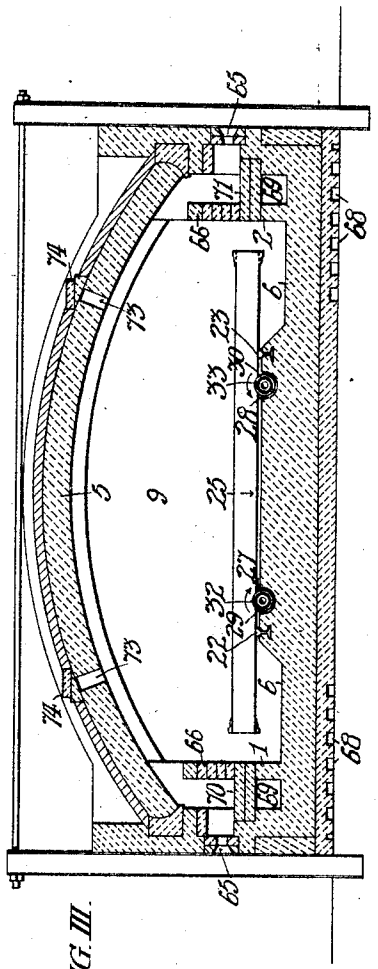


FIG. III

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July 20, 1926. 1,593,351

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ANNEALING FURNACE

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FIG. VIII.

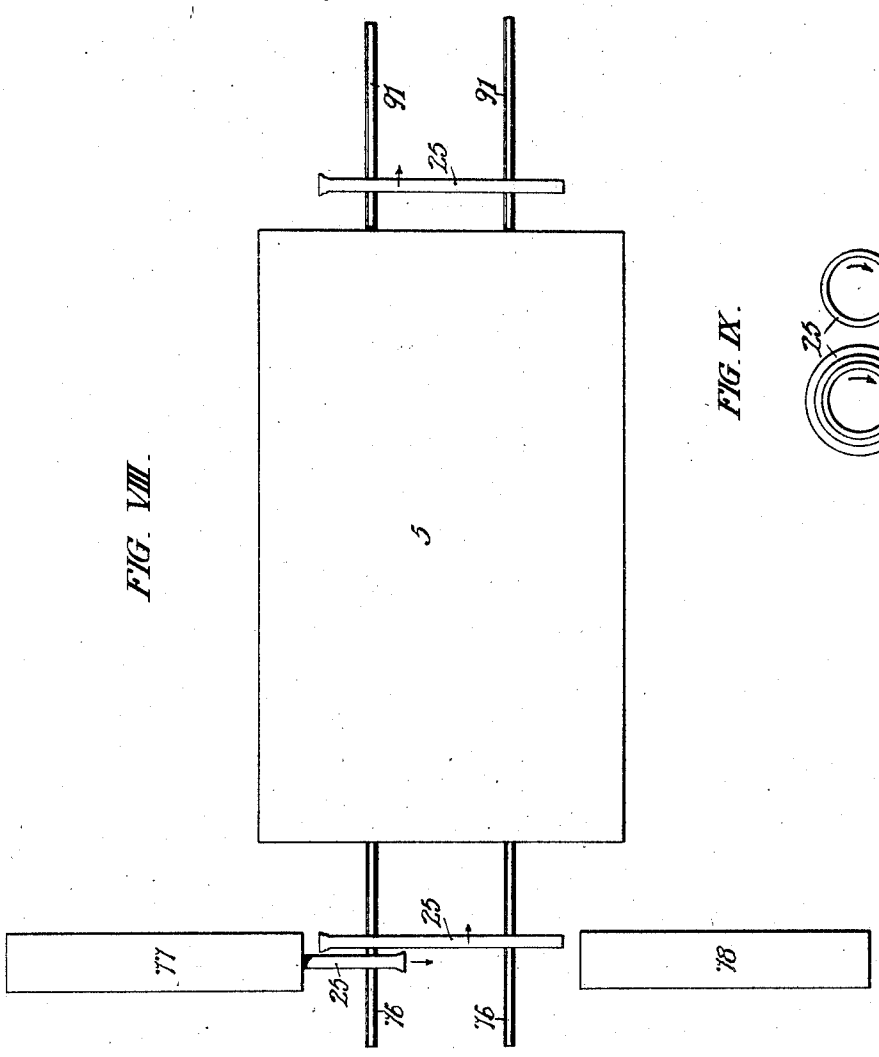
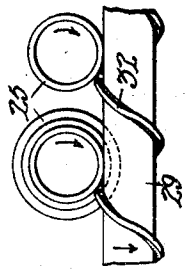


FIG. IX.



INVENTOR:

Albert E. Paige

Patented July 20, 1926. 1,593,351

UNITED STATES PATENT OFFICE.

ARTHUR E. PAIGE, OF PHILADELPHIA, PENNSYLVANIA.

ANNEALING FURNACE.

Application filed August 13, 1925. Serial No. 49,993.

My invention is particularly adapted for annealing centrifugally cast iron pipe, and designed to cooperate with such centrifugal casting mechanism as described and claimed in Letters Patent of the United States No. 1,538,585 granted to me May 19, 1925; the pipes produced by that mechanism being of what are known as the bell and spigot type. However, I do not desire to limit myself to that specific use.

Owing to the high temperature to which such pipes are necessarily subjected to completely anneal them; they would deform and collapse if permitted to remain in one position continuously throughout the annealing operation, which may require more than twenty minutes. Therefore, an object and effect of my invention is to keep each pipe continuously in motion throughout the annealing operation; such motion including rotation of each pipe upon its own axis and progression of the latter from the entrance to the exit of the furnace chamber; so that the gravitative effect of the mass of each pipe, tending to deform it, is constantly changed in direction, with the result that the pipe retains its original symmetrical configuration throughout the annealing operation.

In the form of my invention hereinafter described; a furnace chamber, of such dimensions as to inclose a series of more than thirty of such pipes, of standard dimensions, is provided with a pair of rails, imbedded in the floor thereof and inclined downwardly from the inlet to the outlet of the furnace so that said series of pipe roll down the same, of their own weight, when free to do so; but such rolling movement is limited and controlled by a pair of screw shafts having threads against which each pipe is stopped; means being provided to turn said shafts simultaneously at any desired rate, which may be predetermined in accordance with the length of time it is desired to retain each pipe in the furnace. The mechanism for rotating said screw shafts is co-operatively connected with means for feeding pipes into said furnace at intervals predetermined by the rotation of said shafts and such feeding mechanism is co-operatively related with means for weighing each pipe before it is released for entrance into the furnace.

In furnaces of the prior art for the same general purpose; the pipe entrance and exit of the furnace chambers are controlled by vertically reciprocatory doors which are necessarily open a large part of the time to permit the ingress and egress of the pipes. Such construction and arrangement very materially reduce the thermal efficiency of the furnace by the practically continuous communication thus established between the interior of the furnace chamber and the outer atmosphere, permitting the inrush of cold air induced by the draught of the products of combustion from the furnace. Therefore, an important adjunct of my invention aforesaid is the provision of means to maintain the furnace chamber substantially continually closed during its operation. Such closure is effected by doors which are hinged at their upper edges and which are swung open only by contact of the successive pipes therewith, as the latter are progressed from the entrance to the exit of the furance; each pipe co-operating with the door which it is moving to maintain the doorway substantially closed while the pipe is passing through the same.

My invention includes the various novel features of construction and arrangement hereinafter more definitely specified.

In said drawings: Fig. I is a front elevation of a furnace and its appurtenances, conveniently embodying my invention.

Fig. II is a longitudinal vertical sectional view of said furnace, taken on the line II, II in Fig. I.

Fig. III is a transverse vertical sectional view of said furnace, taken on the line III, III in Fig. II, in the direction of the arrows on said line.

Fig. IV is a fragmentary plan view of the furnace floor with said rails and screw shafts, and two pipes thereon.

Fig. V is a fragmentary longitudinal vertical sectional view, taken on the line V, V in Fig. I, in the direction of the arrows on said line; but on a larger scale.

Fig. VI is a fragmentary side elevation of the pipe feeding and weighing mechanism aforesaid, on the same scale as Fig. V,

Fig. VII is a fragmentary transverse sectional view of the portion of said feeding mechanism indicated at the left hand side of Fig. I, and in Fig. V.

Fig. VIII is a diagrammatic plan view of a convenient embodiment of my invention in coordinated relation with centrifugal casting mechanisms.

Fig. IX is a fragmentary longitudinal sectional view, showing a modified form of my invention.

In said figures; the annealing furnace includes opposite side walls 1 and 2, end walls 3 and 4, ceiling 5 and floor 6, and the space inclosed thereby is preferably divided by the partition 7, to form the combustion chamber 9 and cooling chamber 10. Said end wall 3, is provided with the pipe entrance doorway 12, which is normally closed by the door 13. Said door is hung upon hinges 14 at its upper edge and preferably provided with the counterweight 15, and so constructed and arranged that said door is only slightly underbalanced, so that it will close to the position shown in full lines in Fig. II when released.

Said end wall 4, is provided with the pipe exit doorway 17 which is normally closed by the door 18, hung upon hinges 19 at its upper edge and preferably provided with the counterweight 21, so constructed and arranged that said door is only slightly underbalanced, so that it will close to the position shown in full lines in Fig. II when released.

Said floor 6, has a pair of rails 22 and 23 imbedded therein, as indicated in Fig. III, and arranged to support a series of pipes 25 in parallel relation with each other and with their axes extending transversely, at right angles, to said rails. Said floor and rails are inclined, so that said pipes would rapidly roll from said entrance to said exit, of their own weight, if free to do so. However, I provide said floor 6, with two longitudinal channels 27 and 28 in which I mount the respective rotary screw shafts 29 and 30. Said shafts are hollow and each as 29 shown in Fig. V; formed of a single piece of wrought iron or steel tubing, having respective screw threads 32 and 33 formed of bars welded thereon, but oppositely inclined upon the respective shafts as indicated in Fig. IV. Such opposite inclination prevents rotary movement of said shafts from causing said pipes to move transversely with respect to said tracks, as would be the case if they were both inclined in the same direction. In the form shown; the frictional engagement of each balances the other.

Each of said shafts is provided at its opposite ends with respective hollow trunnions 35 and 36 provided with packing boxes 37 and 38 adapted to make water tight joints. The interior of each of said screw shafts 29 and 30 is supplied with water through respective pipes 40 which are stationary and held in water tight relation therewith by said stuffing boxes 37. Each pipe 40 is conveniently provided with a union 41 so that they may be readily removed and replaced to permit said screw shafts to be removed and replaced.

Water thus supplied within said screw shafts 29 and 30 is arranged to be withdrawn therefrom through the respective pipes 42 which are stationary and held in water tight relation therewith by said stuffing boxes 38. Said pipes 42 are provided with unions 43 to permit their removal and replacement.

Water may be thus directed through said screw shafts 29 and 30 at such a rate as to regulate the temperature thereof to any desired degree. However, it is advantageous to maintain them as hot as is possible without interference with their operation, so as to avoid unnecessary loss of heat from the furnace chamber and pipes 25 therein.

Said trunnions 35 and 36 are respectively journaled in bearings 45 and 46, conveniently formed in respective cast plates forming the respective sills of said entrance and exit doorways, and said journals are respectively provided with cap plates 47 and 48 bolted thereto so as to adjustably secure antifriction bearing bushings 49 and 50 which are indicated in Fig. V; which may be renewed when required.

Each of said trunnions 35 is encircled by a ball thrust bearing for instance as indicated at 52 in Fig. V; which abuts against the adjacent face of the journal 45 to sustain the endwise thrust on said shafts 29 and 30 incident to their inclination aforesaid; each of said trunnions 35 being provided with a worm gear 54 rigidly secured thereon, conveniently by set screws 55, and having its hub against the outer hard steel ring of said ball bearing 52; as shown in Fig. V.

Said gears 54 are respectively engaged by oppositely inclined worms 56 which are rigidly connected with the shaft 57 which is supported in suitable bearings 58. As shown in Figs. I and II; said shaft 57 carries, at the outer end thereof, the worm gear 60 which is engaged by the worm 61 on the armature shaft 62 of the electric motor 63; whereby said screw shafts 29 and 30 may be simultaneously rotated in opposite directions as indicated in Fig. IV. Such rotation permits said pipes 25 to roll through said furnace upon said rails 22 and 23 at a rate which may be predetermined and controlled either by controlling the speed of said motor, or by varying the ratio of the gearing connecting said motor with said screw shafts 29 and 30. As above indicated; it is possible to adequately anneal such pipes 25 to a commercially acceptable state in twenty minutes. However, it is preferable to re-

tain them in said furnace for a longer time, if convenient.

Although said furnace may be heated by any suitable means; I prefer to heat it by two series of blast burners 65, indicated in Figs. II and III, respectively disposed upon opposite sides of said combustion chamber 9. The flames from said burners are upwardly deflected by the baffle walls 66 so as to enter said chamber 9 adjacent to said ceiling 5 from which they are deflected upon said pipes 25. Said burners 65 may be adapted to consume gas, oil or powdered coal, and to facilitate the combustion of such fuel and conserve some of the heat from said furnace which would otherwise be wasted. I prefer to take compressed air to said burners through passageways 68 extending through tiles beneath said floor 6, and through conduits 69 which extend longitudinally through said side walls 1 and 2, beneath the hearths 70 and 71, shown in Fig. III. As shown in Fig. III; I find it convenient to provide vent openings 73 in said ceiling 5, which may be closed by tiles 74.

In order to feed said pipes 25 into said furnace in the regular order indicated in Figs. II, IV and V; I provide tracks 76, indicated in Figs. II, V and VI extending exterior to said furnace in alinement with said furnace rails 22 and 23; and mount centrifugal casting machines 77 and 78, upon respectively opposite sides thereof, with their axes extending transversely, at right angles thereto, as indicated in Fig. VIII. Such machines are each adapted to discharge the pipes cast therein with their bell ends toward said tracks, and are arranged to be operated in alternation so as to dispose the pipes 25 with their bell ends alternately upon opposite sides of said tracks 76, as indicated in Fig. IV.

Said tracks 76 are preferably inclined so that said pipes 25 roll toward the furnace above described. However, in order to properly time the introduction of each pipe to said combustion chamber 9; I connect said tracks 76 with said rails 22 and 23 by the tiltable trap including rails 79 which are coupled by means including the rock shaft 80; so that they may tilt together, from alinement with said tracks 76 as indicated in dotted lines in Fig. VI to the inclined position indicated in full lines in that figure. Said rock shaft 80 is so located that the ends of said trap rails 79 extend to a greater radius therefrom toward said furnace than in the other direction, and tend to gravitate to the position shown in full lines in Fig. VI, whenever they are free to do so. However, said coupled tiltable trap rails 79 are normally upheld in alinement with said tracks 76 and furnace rails 22 and 23 by two levers 81 which, as indicated in Fig. VII, are fulcrumed at 82 in respective stationary brackets 83, and extend beneath the respective rails 79. Said levers 81 have arms 85 respectively presented beneath cams 86, conveniently of the configuration shown in Fig. VII, which are respectively rigidly connected with said screw shafts 29 and 30, and conveniently by being made in respectively unitary relation with said worm gears 54, as indicated in Fig. V.

The construction and arrangement of the pipe feeding mechanism above described is such that said tiltable trap rails 79 are permitted to fall into the position shown in Fig. VI at each revolution of said screw shafts 29 and 30, with a pipe 25 trapped and detained at the entrance end of said rails 22 and 23. Although under normal conditions such a pipe would be detained by encountering the adjacent ends of said rails 22 and 23; I prefer to provide a pair of detent levers 88 respectively adjacent to said rails 22 and 23 and fulcrumed at 89 on respective bearing 90 in rigid relation with said tracks, as indicated in Fig. VI; so that when said tiltable trap tracks 79 drop to the position shown in Fig. VI said detent levers 88 are upturned above said rails 22 and 23 to detain the trapped pipe 25 from passing on to said rails until released by the feeding mechanism. Of course, such release is effected by the said cams 86; which restore said levers 81 to the position shown in Fig. VII and thus raise said trap tracks 79 to their normal horizontal position, as indicated in dotted lines in Fig. VI, and simultaneously permit said detent levers 81 to drop below the upper level of said rails 22 and 23 so that each pipe 25, is thus freed at the proper instant to roll into the furnace chamber 9 of its own weight; each pipe rolling against said entrance door 13 and swinging the latter from the position shown in full lines, to the position shown in dotted lines, in Fig. II, without opening the furnace to the outer atmosphere. Similarly, each pipe 25 ultimately rolls against the exit door 18 and swings the latter from the position shown in full lines in Fig. II, to the position shown in dotted lines in said figure, without opening the latter to the outer atmosphere, and rolls on down the discharge tracks 91.

I find it convenient to coordinate with said cast pipe feeding mechanism above described, means for weighing each such pipe before it is released for entrance into the furnace. As indicated in Figs. I and VI; such weighing means conveniently includes a scale 92 having a vertically reciprocatory platform 93 which is adapted to receive the detained pipe 25 when the trap tracks 79 drop to the position shown in Fig. VI. The weight of the pipe then resting upon said platform is conveniently indicated by the dial 95. Moreover, as indicated in Fig. VI;

I prefer to coordinate with the mechanism of said scale 92 a printing mechanism 96, which is adapted to automatically print upon a web of paper 97 extending between the rolls 98 and 99, a record of the weight of each pipe deposited upon said scale platform 93.

Although, in the form of my invention above described, I prefer to utilize the screw shafts 29 and 30 merely to limit and control the rate at which the cast pipes 25 roll down the inclined rails 22 and 23 by their own weight; it is obvious that said rails 22 and 23 may extend in horizontal position, so that said pipes 25 have no tendency to roll thereon of their own weight, and, in that case, I use said screw shafts 29 and 30 to transversely push, and thus roll, said pipes 25, as indicated in Fig. IX; to progress them through said furnace.

Although the structures above described may be conveniently employed in annealing centrifugally cast pipes 25; it is obvious that they may be used to automatically turn or progress or weigh or trap and intermittently feed other articles.

Therefore, I do not desire to limit myself to the precise details of construction or arrangement or method of procedure herein set forth, as it is obvious that various modifications may be made therein without departing from the essential features of my invention as defined in the appended claims.

I claim:

1. In annealing apparatus; the combination with a furnace inclosure; of tracks in said inclosure arranged to support a series of pipes to roll thereon from one end of the furnace to the other; and means controlling the movement of said pipes on said tracks including a screw shaft extending parallel with said tracks and having a thread engaging said pipes; wherein the tracks are inclined so that the pipes tend to roll thereon in said inclosure, of their own weight, and said screw shaft merely limits the rate of such gravitative movement of the pipes.

2. In annealing apparatus; the combination with a furnace inclosure; of means arranged to limit the movement of articles through said inclosure, including a rotary screw shaft extending in the direction of travel of the articles through said inclosure; wherein the screw shaft is hollow and cooperatively connected with means for directing a refrigerant therethrough.

3. In annealing apparatus; the combination with a furnace inclosure having an entrance at one end and an exit at the other; of doors hinged at their upper edges respectively at said entrance and exit; and means arranged to direct the articles to be annealed through said entrance and exit in such position as to form temporary closures for the same; whereby said doors are automatically opened by the movement of such articles against them, and the introduction and removal of such articles effected with such articles co-acting with said doors to substantially exclude the outer atmosphere from said inclosure during the passing of such articles through the doorways.

4. In annealing apparatus; the combination with a furnace inclosure; of means arranged to control the rate of movement of articles through said furnace, including a rotary shaft; and means arranged to intermittently trap and release such articles for entrance to said furnace, including a tiltable support for such articles and a cam operatively connected with said shaft arranged to tilt said trapping means.

5. In annealing apparatus such as defined in claim 6; the combination with said trapping means; of means arranged to automatically weigh each article in succession, including a scale, to which each article is delivered and from which each article is removed by said trapping means.

6. In annealing apparatus; the combination with a furnace inclosure; of means arranged to control the rate of movement of articles through said furnace, including a rotary shaft; and means arranged to intermittently trap and release such articles for entrance to said furnace, including a tiltable support for such articles, and means operatively connected with said shaft arranged to tilt said trapping means; and weighing means including a vertically reciprocatory member beneath said tiltable trap, arranged to receive and weigh articles released by said trap.

7. The combination with a pair of tracks; of means arranged to discharge pipes on to said tracks; a pipe trap in alinement with said tracks, arranged to oscillate and tending to tilt downwardly; an annealing furnace having a pipe entrance doorway and a pipe exit doorway at respectively opposite ends thereof; a pair of stationary furnace rails in alinement with said trap and extending downwardly inclined from said entrance to said exit in said furnace; whereby said pipes discharged from said machine upon said tracks are caused to roll through said furnace; means arranged to regulate the progression of said pipes through said furnace, including a pair of screw shafts extending in said furnace parallel with said furnace rails and having respectively oppositely inclined threads arranged to engage with said pipes; means arranged to simultaneously turn said screw shafts and thereby control the rate of progress of said pipes through said furnace, including worm gears on the respective shafts, worms engaging said gears, a shaft for said worms, and an electric motor connected with said worm shaft; a cam on said screw shaft; and a

lever connecting said cam with said trap; whereby the latter is raised and lowered during each revolution of said screw shafts to temporarily detain each pipe and then release it for entrance into said furnace.

8. The combination with a pair of tracks; of means arranged to discharge pipes on to said tracks; a pipe trap in alinement with said tracks, arranged to oscillate and tending to tilt downwardly; an annealing furnace having a pipe entrance doorway and a pipe exit doorway at respectively opposite ends thereof; a pair of stationary furnace rails in alinement with said trap and extending downwardly inclined from said entrance to said exit in said furnace; an entrance door for said furnace and an exit door for said furnace; said entrance door being adapted to swing inwardly and said exit door being adapted to swing outwardly with respect to said furnace; whereby pipes discharged from said machines upon said tracks are caused to roll through said furnace; means arranged to regulate the progression of said pipes through said furnace, including a pair of screw shafts extending in said furnace parallel with said furnace rails and having respectively oppositely inclined threads arranged to engage with said pipes; means arranged to simultaneously turn said screw shafts and thereby control the rate of progress of said pipes through said furnace, including worm gears on the respective shafts, worms engaging said gears, a shaft for said worms, and an electric motor connected with said worm shaft; a cam on said screw shaft; and a lever connecting said cam with said trap; whereby the latter is raised and lowered during each revolution of said screw shafts to temporarily detain each pipe and then release it for entrance into said furnace.

9. The combination with a pair of inclined tracks; of means arranged to discharge pipes on to said tracks; a pipe trap in alinement with said tracks, arranged to oscillate and tending to tilt downwardly; means for weighing each pipe which traverses said tracks, including a scale having a vertically reciprocatory platform arranged to receive a pipe deposited thereon by the downward tilting movement of said trap; a detent lever arranged to be operated by the downward movement of said trap to upturn said detent lever in position to stop each pipe in its trapped position and prevent its accidental escape from said scale platform; an annealing furnace having a pipe entrance doorway and a pipe exit doorway at respectively opposite ends thereof; a pair of stationary furnace rails in alinement with said tracks and extending downwardly inclined from said entrance to said exit in said furnace; an entrance door for said furnace and an exit door for said furnace; said entrance door being adapted to swing inwardly and said exit door being adapted to swing outwardly with respect to said furnace; whereby pipes discharged from said machine upon said tracks are caused to roll through said furnace, and automatically open said doors by their own weight; means arranged to regulate the progression of said pipes through said furnace, including a screw shaft extending in said furnace parallel with said furnace rails and having threads arranged to engage with said pipes; means arranged to turn said screw shaft and thereby control the rate of progress of said pipes through said furnace, including a worm gear on said shaft, a worm engaging said gear, a shaft for said worm, and an electric motor connected with said worm shaft; a cam on said screw shaft; and a lever connecting said cam with said trap; whereby the latter is raised and lowered during each revolution of said screw shaft to temporarily detain each pipe while it is being weighed and then release it for entrance into said furnace.

10. The combination with a pair of inclined tracks; of a pair of trap rails respectively in alinement with said tracks, rigidly connected, arranged to oscillate, and tending to tilt downwardly; means for weighing each article which traverses said tracks and rails, including a scale having a vertically reciprocatory platform arranged to receive an article deposited thereon by the downward tilting movement of said trap; a detent lever arranged to be operated by the downward movement of said trap to upturn said detent lever in position to stop each article in its trapped position and prevent its accidental escape from said scale; and an annealing furnace having an entrance doorway in cooperative relation with said tracks and trap; whereby, each article is temporarily detained, weighed, and released to enter said furnace.

11. The combination with a pair of inclined tracks; of a pair of trap rails respectively in alinement with said tracks, rigidly connected, arranged to oscillate, and tending to tilt downwardly; means for weighing each article which traverses said tracks and rails, including a scale having a vertically reciprocatory platform arranged to receive an article deposited thereon by the downward tilting movement of said trap; and an annealing furnace having an entrance doorway in cooperative relation with said tracks and trap; whereby, each article is temporarily detained, weighed, and released to enter said furnace.

12. The combination with a pair of inclined tracks; of a pair of trap rails respectively in alinement with said tracks, rigidly connected, arranged to oscillate, and tending to tilt downwardly; means for weighing

each article which traverses said tracks and rails, including a scale arranged to receive an article deposited thereon by the downward tilting movement of said trap; and an annealing furnace having an entrance doorway in cooperative relation with said tracks and trap; whereby, each article is temporarily detained, weighed, and released to enter said furnace.

13. The combination with a pair of tracks; of a trap adjoining said tracks, arranged to oscillate and tending to tilt downwardly; means for weighing each article which traverses said tracks and trap, including a scale arranged to receive an article deposited thereon by the downward tilting movement of said trap; a detent arranged to be operated by the downward movement of said trap rails to upturn in position to stop each pipe in its trapped position and prevent its accidental escape from said scale; and a motor arranged to automatically tilt said trap.

14. The combination with a pair of tracks; of a trap adjoining said tracks, arranged to oscillate and tending to tilt downwardly; means for weighing each article which traverses said tracks and trap, including a scale arranged to receive an article deposited thereon by the downward tilting movement of said trap; and a motor arranged to automatically tilt said trap.

15. Apparatus as defined in claim 17; wherein the scale mechanism is inclosed in a casing and said casing includes means arranged to print a record of the weight of each article.

In testimony whereof, I hereunto sign my name at Philadelphia, Pennsylvania, this eleventh day of August, 1925.

ARTHUR E. PAIGE.