May 6, 1924. 1,493,140

R. E. ZIMMERMAN

METHOD OF AND APPARATUS FOR HEAT TREATING SHEETS AND PLATES

Filed June 25, 1923 4 Sheets-Sheet 1

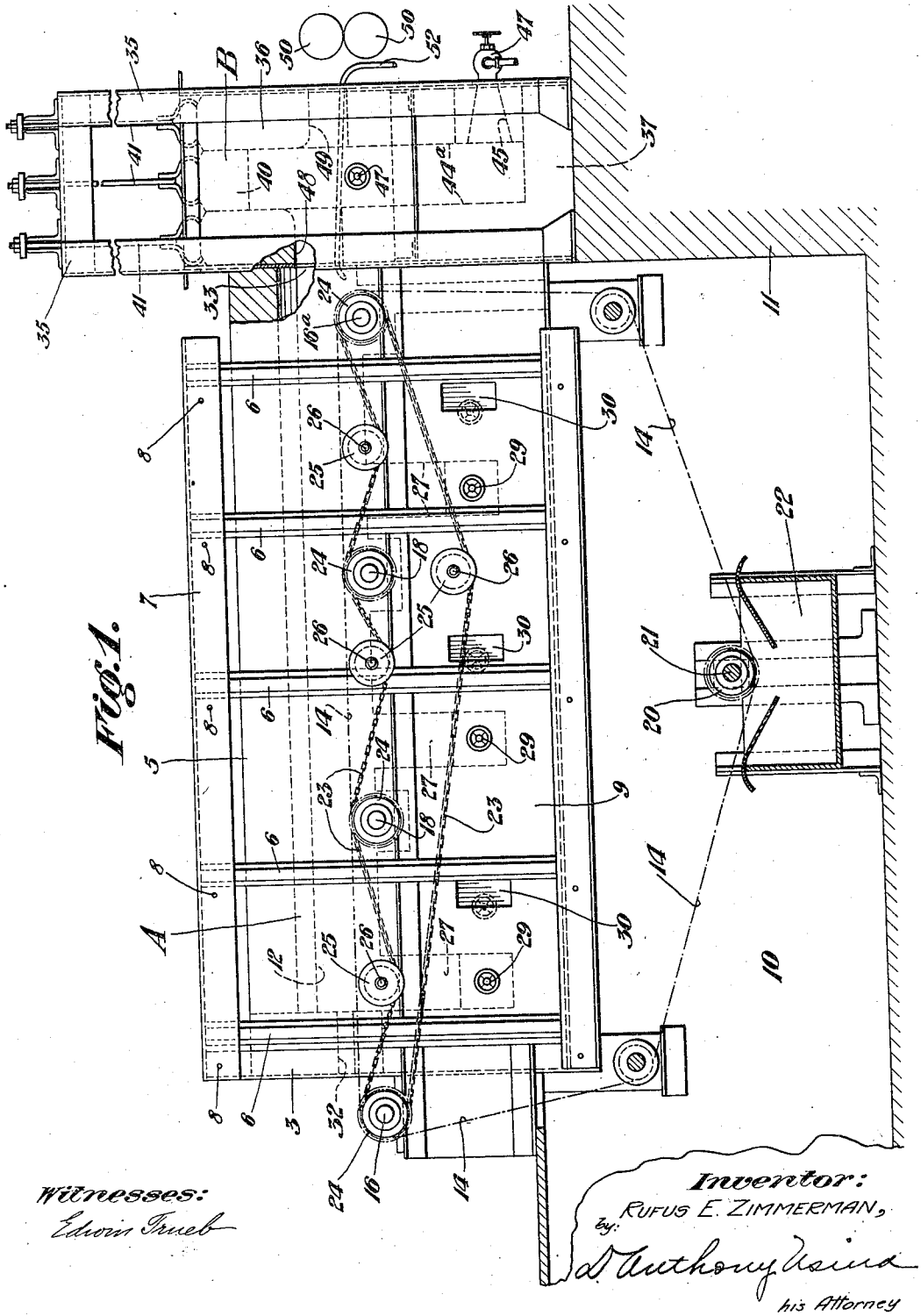

Fig. 1.

Witnesses:
Edwin Trueb

Inventor:
RUFUS E. ZIMMERMAN,
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METHOD OF AND APPARATUS FOR HEAT TREATING SHEETS AND PLATES

Filed June 25, 1923 4 Sheets-Sheet 2

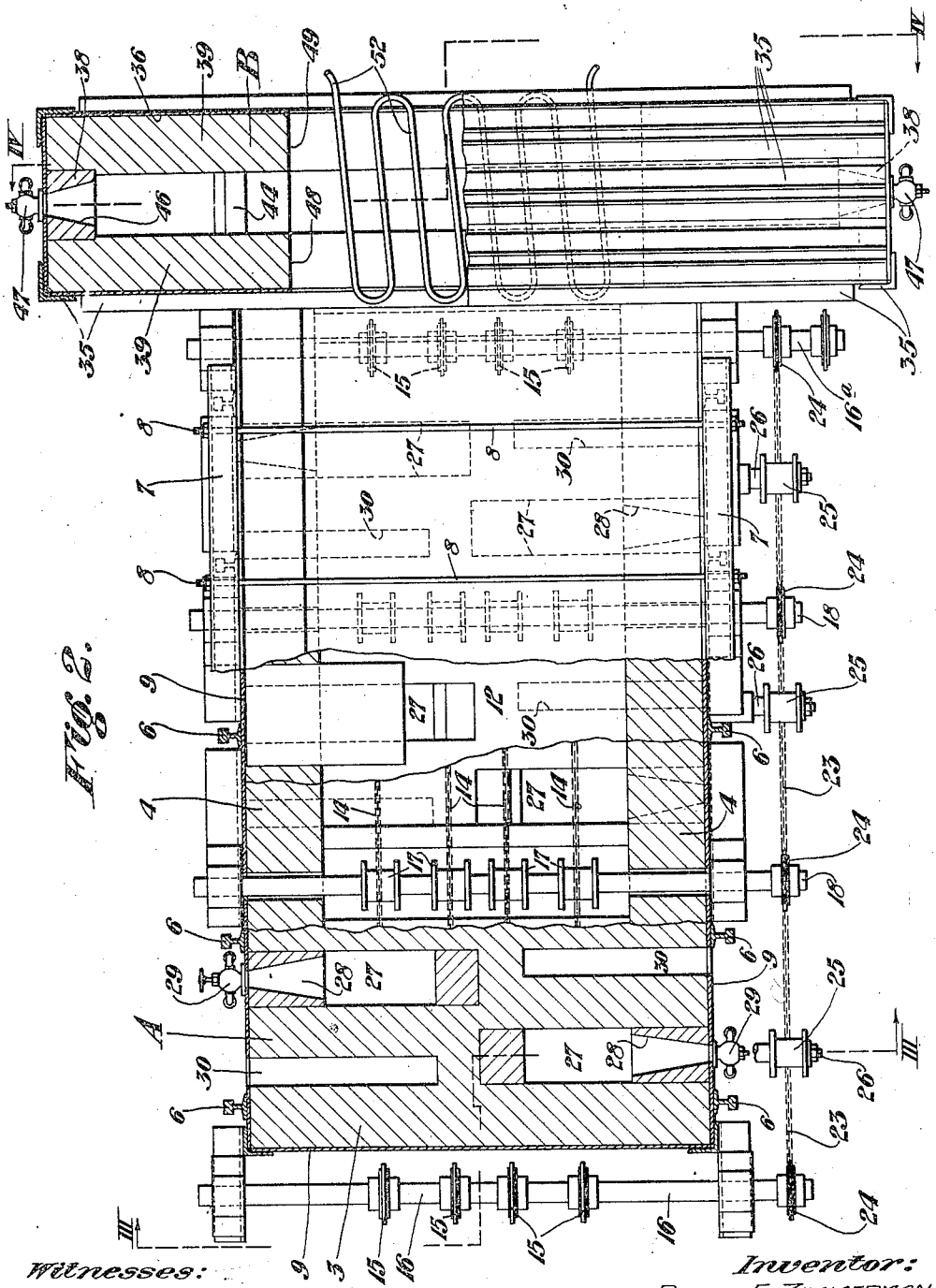

Fig. 2.

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METHOD OF AND APPARATUS FOR HEAT TREATING SHEETS AND PLATES

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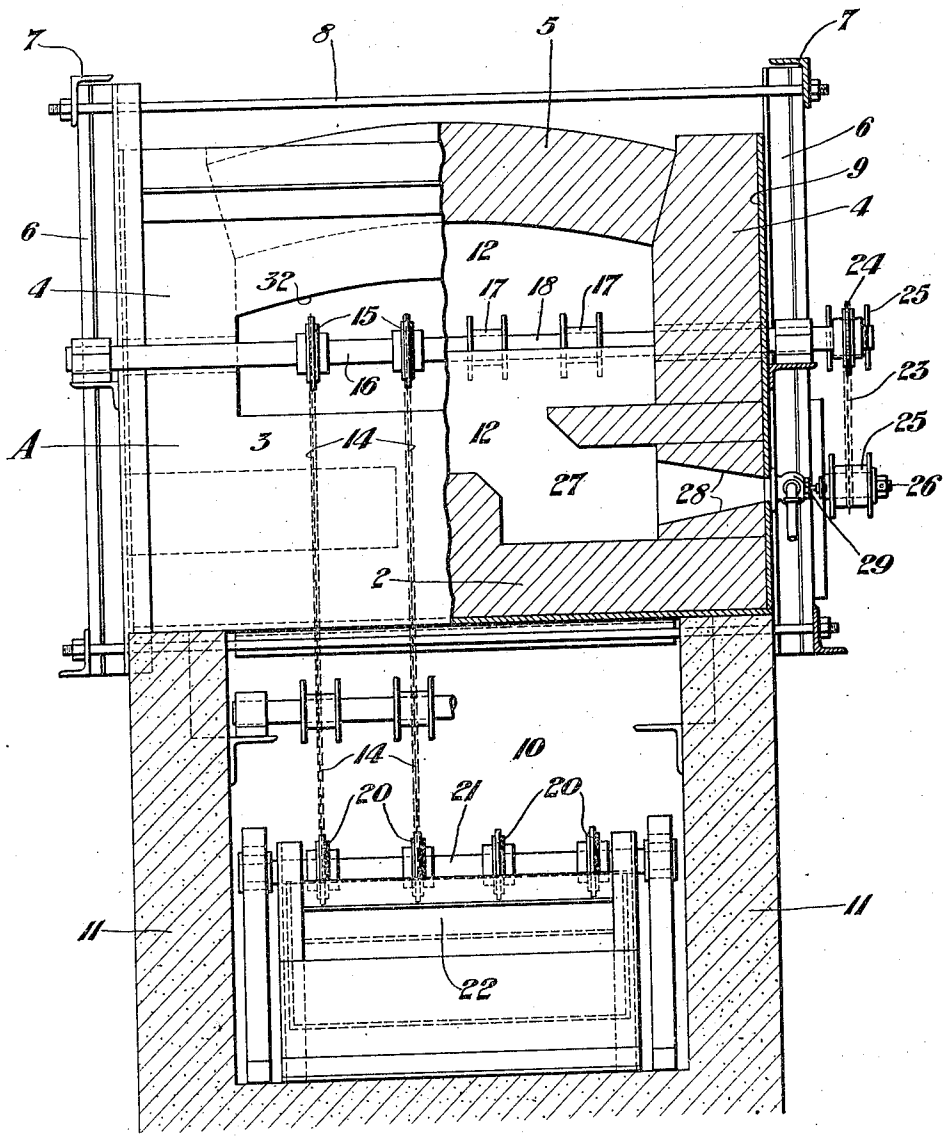
Fig. 3.



Witnesses:
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May 6, 1924. 1,493,140

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METHOD OF AND APPARATUS FOR HEAT TREATING SHEETS AND PLATES

Filed June 25, 1923 4 Sheets-Sheet 4

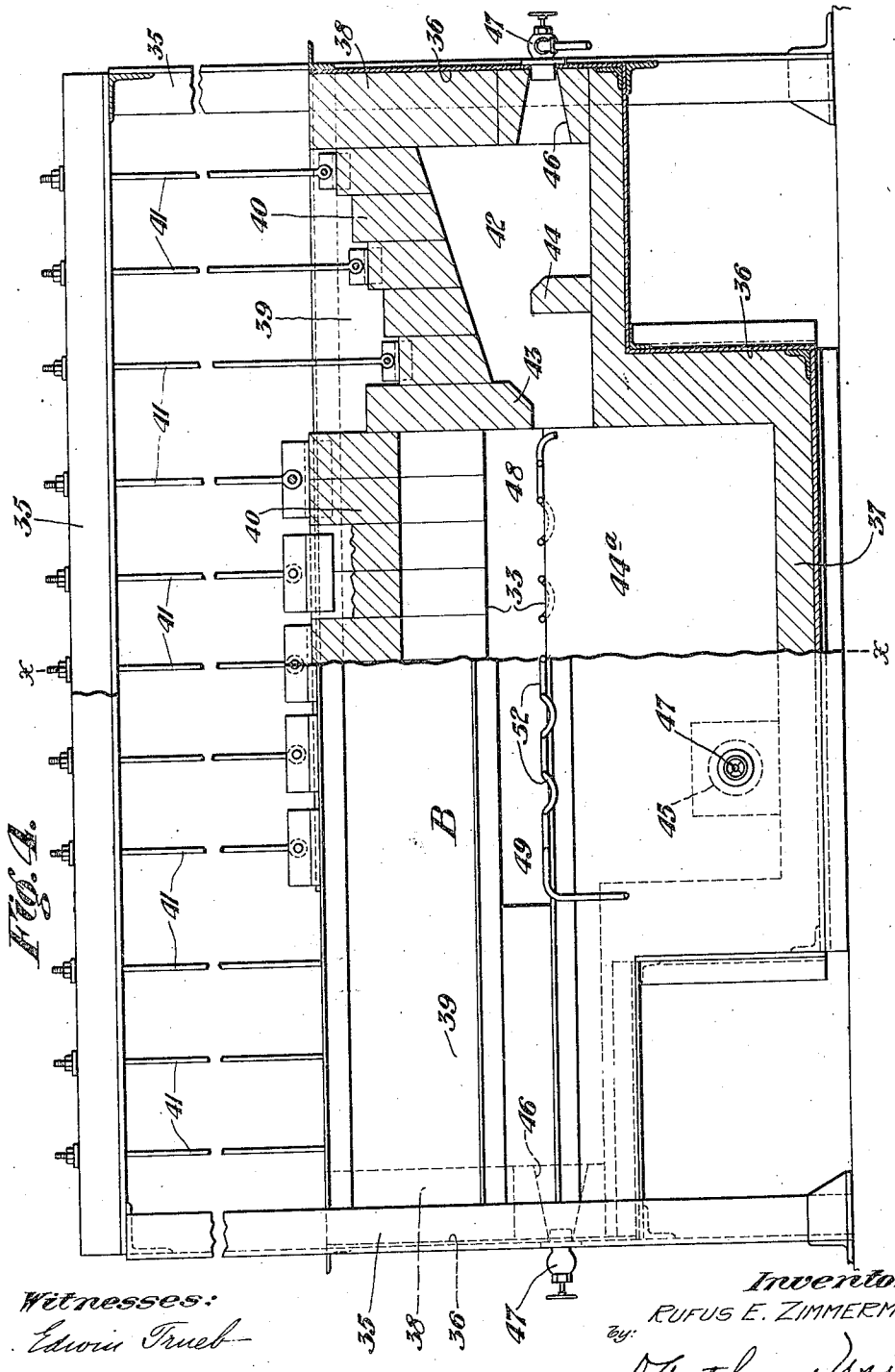

Fig. 4.

Witnesses:
Edwin Trueb

Inventor:
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Patented May 6, 1924. 1,493,140

UNITED STATES PATENT OFFICE.

RUFUS E. ZIMMERMAN, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO AMERICAN SHEET AND TIN PLATE COMPANY OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

METHOD OF AND APPARATUS FOR HEAT-TREATING SHEETS AND PLATES.

Application filed June 25, 1923. Serial No. 647,576.

To all whom it may concern:

Be it known that I, RUFUS E. ZIMMERMAN, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in a Method of and Apparatus for Heat-Treating Sheets and Plates, of which the following is a specification.

This invention relates to an improved method of and apparatus for heat treating rolled steel sheets and plates, and is an improvement over the method described in the patent to George A. White, No. 1,144,884, dated June 29, 1915.

As described in the White patent and as practiced, the method heretofore consisted in passing cold plates into a heat treating furnace having a relatively narrow heating chamber so that but a small part of the sheet or plate is heated at a time. That is, successive, constantly changing portions of the sheets or plates are passed through the heating zone of the furnace and heated to a temperature of from 1600 degrees to 2200 degrees Fahrenheit and then cooled.

The White method has proved a success in every way with the exception that movement of the plates was very slow, since they had to remain over the heating zone of the furnace for a sufficient length of time to become heated to the high temperature required to anneal them.

In open annealing as usually conducted, in which all portions of a plate are heated simultaneously to an annealing temperature, a high elastic limit and high ultimate strength with low ductility is obtained, while in box annealing sheets a low elastic limit and low ultimate strength with high ductility is obtained. White discovered that by heating only small portions of the plates, successively, to an annealing temperature and allowing them to cool, a plate is obtained having the high ductility attained in box annealing without materially reducing the elastic limit and ultimate strength characteristic of open annealed sheets or plates.

The present applicant has discovered that the White method may be materially improved by preheating the plates to a point below the critical range of temperature, that is, below approximately 1250 degrees F. and then passing them directly into the heat treating or annealing furnace for heating the successive sections of the plates to a temperature of from 1600 to 2200 degrees F. for annealing them.

The result of the present invention is to materially increase the speed at which plates can be annealed by the White method. In fact, tests show that the number of plates treated in a given time can be more than doubled, without in any way reducing the quality of the plates.

The apparatus for carrying out the present method is illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of heating and treating furnaces constructed to carry out the present invention.

Figure 2 is a plan partly in section of the furnaces of Figure 1.

Figure 3 is a sectional end elevation on the line III—III of Figure 2.

Figure 4 is an end elevation, partly in section, taken on the line IV—IV of Figure 2.

Referring more particularly to the drawings, the letter A designates the heating furnace for preheating the plates and the letter B designates the heat treating furnace for heat treating or annealing the preheated sheets or plates.

The furnace A is longer than it is wide and comprises a bottom wall 2, end wall 3, side walls 4 and an arched top wall 5 made of bricks or other refractory material. A suitable metal reinforcing framework, consisting of buckstays 6, longitudinal girders 7, tie rods 8, and metal shell 9, is provided to support and strengthen the refractory walls as is common in furnace constructions.

The furnace A is supported over a pit 10, having a concrete or other similar surrounding wall 11.

The space between the bottom and top walls 2 and 5, respectively, forms a heating chamber 12 through which the plates are passed by a plurality of conveyer chains 14, which are trained over suitable sprockets 15 on the drive shafts 16 and 16ª at the forward and rear ends of the furnace, respectively, and over sheaves 17 on driven supporting shafts 18 spaced along the length of the furnace, then returned through the

pit 10 under the furnace where they pass over suitable sprockets 20 on a shaft 21 in a cooling pan 22.

The shaft 16ª is driven by any suitable prime mover (not shown) and is connected to each of the shafts 18 and shaft 16 by a suitable endless drive chain 23 which is trained over sprockets 24 on the shafts 16, 16ª and 18, respectively, and under idler sheaves 25 mounted on stub shafts 26. One of the sheaves 25 is arranged below the sprockets 24 intermediate the ends of the furnace and the others are arranged alternately with the sprockets 24 and on a line therewith.

A plurality of combustion chambers 27 are formed in the bottom wall 2 and extend inwardly from the side walls toward the center thereof, the inner ends opening upwardly into the heating chamber 12. The outer ends of the chambers 27 are contracted to form burner ports 28 in which gaseous or liquid fuel burners 29 are mounted. When desired, powdered coal or other fuel may be employed in operating the furnace.

The combustion chambers 27 on one side of the furnace are staggered with relation to the chambers on the other side, and alternately arranged with respect to the chambers 27 are air circulation chambers 30 which extend into the bottom wall 2 from the side walls of the furnace and have their outer ends open to the atmosphere, forming means whereby the brickwork is cooled and the temperature equalized.

The ends of the furnace A are open to form inlet and outlet ports 32 and 33, respectively, the outlet port opening directly into the heat treating furnace B.

The heat treating furnace B is arranged across the outlet port 33 of the furnace A and is of materially greater length transversely than it is longitudinally of the furnace A.

The furnace B comprises the usual metal reinforcing framework 35 and metal shell 36, and brick bottom wall 37, end walls 38, side walls 39, and top wall 40. The top wall 40 is suspended from the framework 35 by suspension rods 41.

The side walls 39 are spaced a relatively small distance apart, forming a narrow chamber, and the top wall is inclined downwardly from each end toward the center of the furnace for an appreciable distance while the bottom wall is elevated adjacent each end to form combustion chambers 42, which chambers are provided with baffles 43 and 44 adjacent their inner ends. The portion of the chamber or space between the combustion chambers 42 forms a heating chamber 44ª in which the successive portions of the plates are heated to an annealing temperature. Suitable burner ports 45 are formed in the lower portion of the front side wall of the furnace opening into the chamber 44ª, and other burner ports 46 are formed in the end walls 38 opening into the combustion chambers 42. Gaseous or fluid burners 47 are mounted in each of the burner ports 45 and 46. It will be understood that the furnace B is symmetrical about the center line X—X.

The side walls 39 are provided with inlet and outlet ports 48 and 49, respectively, the inlet port 48 communicating directly with the outlet port 33 of the furnace A.

The forward ends of the plates to be treated are adapted to be moved through the furnace and into the bite of pinch rollers 50 by the conveyer chains 14. The pinch rollers 50 are arranged forward of the furnace B and are adapted to draw the plates through this furnace and feed them onto a cooling table (not shown).

A suitable rack 52 is arranged across the heating chamber 44ª from the inlet port 48 to the outlet port 49 for supporting the plates as they pass through the furnace. The rack 52 is preferably of tubular construction to permit water being passed therethrough for the purpose of cooling it.

In carrying out the method of this application the cold plates are first passed onto the conveyer chains 14 at the inlet 32 of the furnace A and are conveyed through the heating chamber 12 of this furnace wherein their entire area is heated up to a point slightly below the lower critical temperature of the metal. The plates are then passed out of the furnace A and into the furnace B, which is heated to from 1600 degrees to 2200 degrees F. by a flame from the burners 47. As the plates are passed into the furnace B they are successively passed through from one side to the other, into and through the heating chamber 44ª and pass out through the outlet or discharge opening 49. The heating chamber 44ª is made very narrow so as to expose very narrow portions of the plate or sheet being heat treated to the action of the heat at one time, and the narrower the section of the plate which is exposed to the heating action the better the result obtained. The plates are cooled as they pass out of the furnace. That is, the successive sections are cooled in the same order that they are heated.

The present method will produce plates having all the improved characteristics of the plates produced by the White method, and is distinguished from the White method by the preheating operation which permits the plates to be finally annealed in about half the time required by the White method.

I claim—

1. The combination with an elongated heating furnace for sheets and plates, having means for moving plates continuously therethrough and adapted to heat the

whole plate to approximately an even temperature, of a heat treating furnace arranged across the discharge end of said heating furnace and adapted to receive the heated plates from said heating furnace, said heat treating furnace being provided with a relatively narrow heating chamber over which the plates must pass, whereby successively different sections of said previously heated plates are heated and cooled.

2. The combination with an elongated heating furnace adapted to heat the whole area of a plate to approximately an even temperature, of a heat treating furnace arranged immediately forward of said heating furnace and adapted to receive the plates from said heating furnace, said heat treating furnace being provided with a relatively narrow transversely arranged heating chamber adapted to heat successively different narrow sections of said previously heated plates to a materially higher temperature.

3. A heat treating apparatus for sheets and plates, comprising in combination, an elongated heating furnace having a heating chamber of materially greater size than the plates to be heated and inlet and outlet ports at opposite ends of said chamber, a continuous conveyer arranged to move the plates through said heating chamber, and a heat treating furnace arranged across the outlet port of said heating furnace and adapted to receive the plates therefrom, said treating furnace being provided with a relatively narrow heating chamber over which the plates pass, whereby successively different sections of the previously heated plates are heated to a temperature of at least 1600 degrees Fahrenheit, which is a materially greater temperature than maintained in said heating furnace.

4. A heat treating apparatus for sheets and plates, comprising in combination, an elongated heating furnace having a heating chamber of materially greater size than the plates to be heated and inlet and outlet ports at opposite ends of said chamber, a plurality of combustion chambers below said heating chamber, said combustion chambers extending inwardly from the opposite sides of said furnace and being alternated with air circulation chambers, the combustion chambers extending from one side of the furnace being arranged in staggered relation with the combustion chambers extending from the other side of the furnace, and being opposite one of said air circulation chambers, a continuous conveyer arranged to move plates through said heating chamber, and a heat treating furnace arranged across the outlet port of said heating furnace and adapted to receive the plates therefrom, said treating furnace being provided with a relatively narrow heating chamber over which the plates pass, whereby successively different sections of the previously heated plates are heated to a temperature of at least 1600 degrees Fahrenheit, and means for causing such intense heat in the heating chamber of said treating furnace.

5. The method of heat treating rolled steel sheets and plates which consists in heating the whole plate to a temperature below the lower critical temperature of the metal, then heating successively different sections of the preheated sheets to a temperature materially above the lower critical temperature of the metal, and cooling the sections of the sheets or plates in the order in which they are heated.

6. The method of heat treating rolled steel sheets and plates which consists in heating substantially the whole plate to a temperature below the lower critical temperature of the metal, then heating successively different sections of the preheated sheets and plates to a temperature of at least 1600 degrees Fahrenheit, and cooling the heated sections successively in the order in which they are heated.

7. The method of heat treating rolled steel sheets and plates which consists in heating the plate to a temperature below 1250 degrees Fahrenheit, then heating successively different sections of the preheated sheets and plates to a temperature of approximately 1600 to 2200 degrees Fahrenheit and cooling the heated sections successively in the order in which they are heated.

In testimony whereof I have hereunto signed my name.

RUFUS E. ZIMMERMAN.