

July 16, 1929.

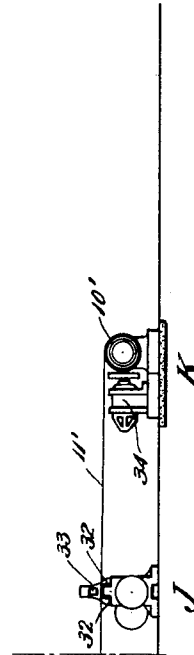
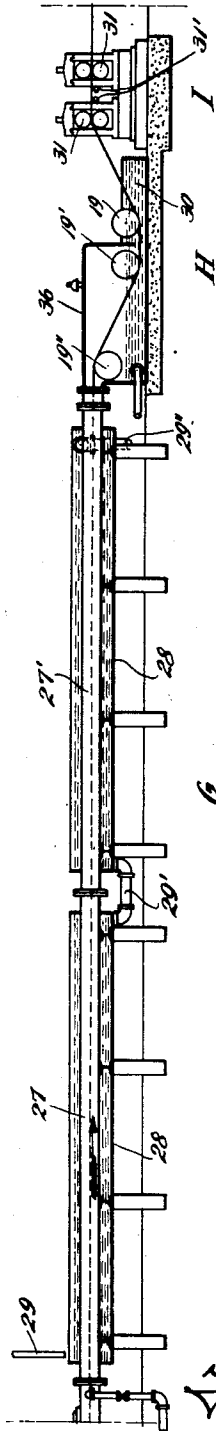
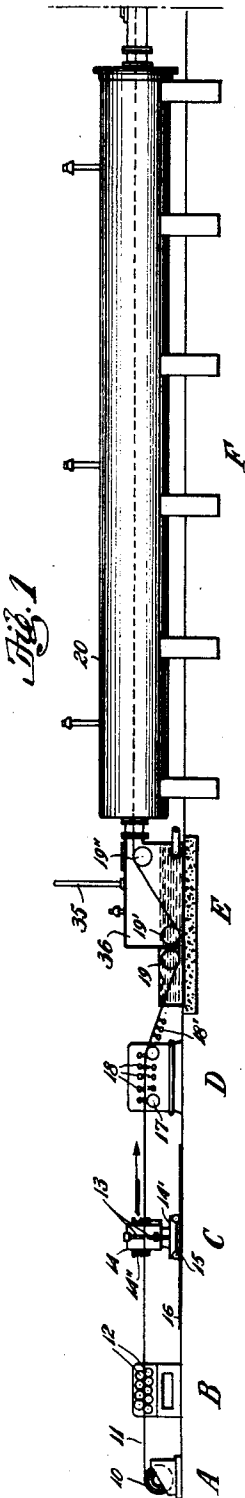
H. M. NAUGLE ET AL

1,721,350

CONTINUOUS ANNEALING APPARATUS

Filed Nov. 17, 1924

3 Sheets-Sheet 1



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CONTINUOUS ANNEALING APPARATUS

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3 Sheets-Sheet 2



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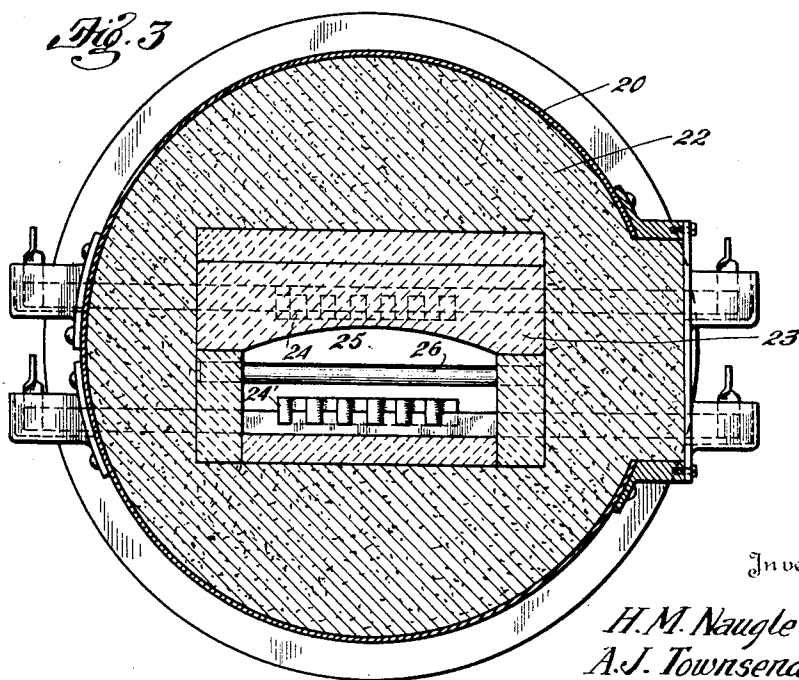
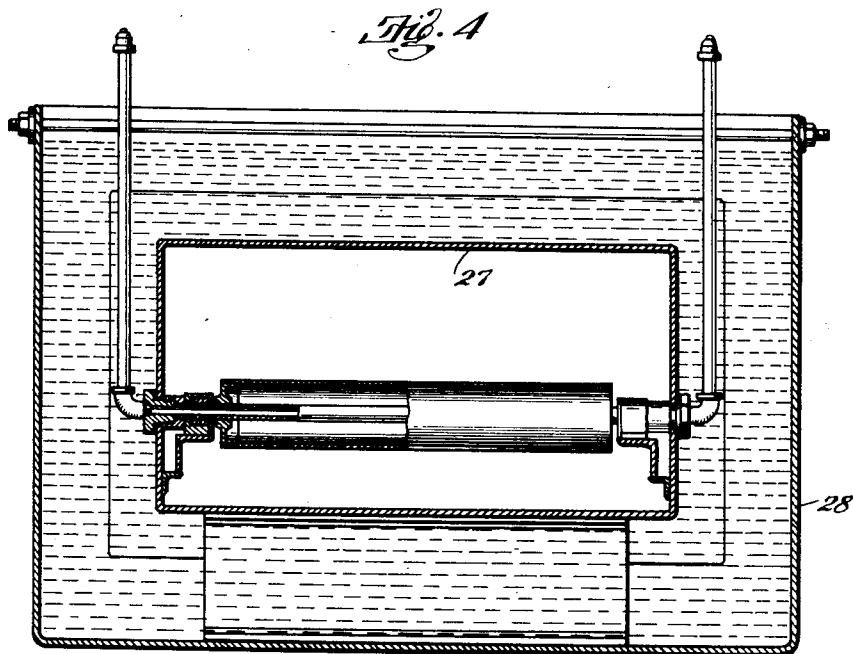
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UNITED STATES PATENT OFFICE.

HARRY M. NAUGLE AND ARTHUR J. TOWNSEND, OF CANTON, OHIO, ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE AMERICAN ROLLING MILL COMPANY, OF MIDDLETOWN, OHIO, A CORPORATION OF OHIO.

CONTINUOUS ANNEALING APPARATUS.

Application filed November 17, 1924. Serial No. 750,269.

The invention relates to apparatus which may be used for carrying out the continuous quick annealing of a strip sheet of metal, referred to in our application for method of making strip sheets, filed August 22, 1922, Serial No. 583,612, matured in patent No. 1,536,028, dated April 28, 1925, and reissued June 14, 1927, Reissue No. 16,652; and for carrying out the continuous annealing processes set forth in our application for patent filed April 4, 1924, Serial No. 704,157; and the object of the improvement is to anneal the metal in a manner that will give the product the uniform ductile and other structural characteristics which are necessary for deep drawing and forming or stamping operations.

A readjustment of the grains of metal to relieve them of the strains produced by a rolling operation, and more particularly by a rapid cold rolling reduction, cannot be accomplished by the ordinary box annealing of a mass or coil of material, for the reason that the longer period of time required for properly heating the inner portions of the mass or coil, not only results in the overannealing of the outer portion thereof, but in the production of a grain growth in a considerable portion of the mass or coil, which destroys the ductility and uniformity, and also decreases the strength of the material in the outer portion of the mass or coil.

The present improvement is particularly concerned with the annealing of steel having a carbon content of less than .20% for the reason that such a low carbon steel is best suited for deep drawing and forming or stamping operations; and for properly annealing the same, the metal must be uniformly heated to a temperature of from 1300° to 1600° F. As a grain growth, sometimes known as "Stead's brittleness", may occur at a temperature less than 1400° F., if the same is maintained long enough; one object of the present improvement is to uniformly heat the metal to an annealing temperature, to maintain or continue that temperature only long enough, say from one to three minutes, to correct the micro-structure of the steel which has been critically stressed by previous rolling processes, and then to quickly cool the metal uniformly

and gradually without, however, quenching the same to harden its structure.

This general object of the improvement may be attained by annealing the strip by the direct action of electric resistors while moving continuously through a heating chamber, in which the resistors are transversely located adjacent to and parallel with the strip, by which the same may be uniformly heated and the degree of heat definitely controlled at all points in the heating furnace; and then to promptly cool the strip by moving it continuously through a tubular duct surrounded by a moving body of water or other heat absorbing liquid, by which the strip may be quickly and gradually reduced to a non-oxidizing temperature when exposed to the air.

Other objects of the improvement relate to the combination in series of strip leveling, spot welding and solution washer means in front of the heating and cooling apparatus, and of conveyer rolls, strip shearing and strip coiling apparatus in rear of the same; for continuously carrying on the annealing process upon a series of successive strips, without stopping the movement of the strip which is passing through the heating and cooling apparatus.

The improved apparatus is illustrated, more or less conventionally, in the accompanying drawings forming part hereof, in which—

Figure 1 is a side elevation, showing some parts in section, of the entire series of combined apparatus;

Fig. 2, an enlarged side elevation, mostly in longitudinal section, showing interior details of the heating and cooling chambers;

Fig. 3, a cross section on line 3—3, Fig. 2; and

Fig. 4 a cross section on line 4—4, Fig. 2. Similar numerals refer to similar parts throughout the drawings.

The apparatus may include a coil box A, a strip leveler B, a traveling spot welder C, a solution washer D, an entering seal E, an electric heating furnace F, a water cooling duct G, an exit seal H, conveyer rolls I, a double end shear J and a strip coiler K arranged in series as shown in Fig. 1.

The coil box A may be of any ordinary construction for holding a coil 10 of a strip

11 of steel or the like, and permitting the same to unwind for a continuous annealing; and the strip leveler B may include two sets of rolls 12 of any well known construction and operation for flattening the sheet and removing uneven fullness or buckles which may have been caused by reducing rolls or other apparatus used in producing the strip.

The spot welder C may include a set of electrodes 13 mounted in a frame 14 supported on a carriage 14', provided with wheels 15 riding on a track 16, together with gripping devices 14'' on the front and rear side of the frame, for clamping and holding successive strips with their ends overlapped, in position between the electrodes for a spot welding operation while the carriage is traveling forward on the track.

The solution washer D may include supporting rolls 17 and transverse tubes 18 suitably apertured for spraying a hot soda solution upon the strip to remove grease and grit therefrom, and like tubes 18' may also be provided for air drying the strip in rear of the cleaner.

The entering seal E may be of the liquid type provided with guide rolls 19, 19' and 19'' as described in detail in said application Serial No. 704,157.

The heating furnace F may include a cylindric steel shell 20 mounted on supports 21, lined with a thick body of heat insulating material 22, within which is provided a lining of fire brick 23 or other refractory material, forming a support for transverse electric resistors 24 and 24' parallelly positioned above and below and forming between them a longitudinal heating chamber 25, in which are provided a series of transverse skids 26 for supporting a strip 11 as it is moved endwise through the chamber from the entering seal E at its port and to the cooling duct G at its rear end.

By these means, the strip may be heated directly by the action of the electric resistors, in a uniform manner from end to end of the furnace; and the degree and continuity of heat can be readily controlled at all points in the heating duct.

The cooling duct G may be a series of end connected iron tubes 27 and 27' extending rearward from the rear end of the furnace, and the sections of the same may be surrounded by tanks or troughs 28 containing water for cooling the conduit and the strip moving through the same.

The cooling troughs may be provided with a water inlet pipe 29, a water connecting pipe 29' and an over-flow pipe 29'' so as to cause a continuous flow of cooling water from the forward toward the rear end of each trough.

The exit seal H may be of the same type as the entering seal E, and may likewise be provided with reversely arranged rolls 19,

19' and 19'' for guiding the strip through the seal. Each sealing box is provided with an inlet pipe for supplying the same with sealing water or other liquid 30.

The conveyer rolls I may include two stands of pinch rolls 31 arranged for drawing a strip through the apparatus and conveying it rearward to the double end shear J, and between these rolls may be provided transverse pipes 31' suitably apertured for hot air drying the strips.

The shear J is provided with a shearing die 32 on its front and rear sides, and a shearing punch 33 operating between them, for shearing the joint of two strips in front and in rear of their overlapped ends, so as to neatly disconnect them after the annealing process is completed.

The strip coiler K may be of any well known construction for winding the annealed strip 11' into a coil 10', and it is preferably provided with an independent motor 34 for this purpose.

During the operation of the apparatus the heating and cooling chambers are completely filled, to the exclusion of air, with a neutral or a reducing gas, for preventing an oxidation of the surface of the strip or to remove any oxidation there may be thereon; and this gas may be introduced through a pressure inlet pipe 35 into one of the water sealed boxes 36, each one of which is preferably provided with an outlet pressure valve to permit a renewal of the gas in the duct.

In the operation of the apparatus, a strip sheet, which has been flattened by the leveler B, joined to another strip by the spot welder C, and acted upon by the spray cleaner D, is moved continuously endwise through the heating chamber 25, and cooling duct G, wherein it is heated rapidly and uniformly by the electric resistors to an annealing temperature, which temperature is maintained and continued only for the brief period necessary for a proper annealing of the metal, which may not exceed one minute, whereupon it is promptly cooled gradually by the heat absorbing water surrounding the tubular duct.

In this manner a continuous quick annealing is accomplished, and the brief period during which the annealing temperature is maintained and continued, prevents the production of an objectionable grain growth or "Stead's brittleness", so that the annealed strip thus produced is characterized by a uniformly fine grained structure and a highly ductile quality, which adapts it for deep drawing operations.

By the improved apparatus strip sheets of different gauges and of more than ordinary widths can be continuously annealed without developing any objectionable grain growth. In actual practice any given portion of a strip sheet, one-sixteenth of an

inch in thickness may be heated to a temperature of 1600°, maintained at that temperature for about one minute, and then cooled to a nonoxidizing temperature, all within a period of about three minutes. This operation can be carried on continuously with respect to all portions of each strip, and of successive strips which have been joined together, without stopping the movement of the strip which is passing through the heating chamber and cooling duct.

We claim:—

1. Apparatus for annealing steel strips and the like, including strip flattening rolls, a heating chamber, a cooling duct, all arranged in series for flattening and continuously annealing a moving strip, and means for continuously moving the strip through the apparatus for controlling the degree and continuity of annealing throughout the strip.

2. Apparatus for annealing steel strips and the like, including a travelling spot welder, a heating chamber, a cooling duct, all arranged in series for connecting the ends of successive moving strips and continuously annealing the same, and means for continuously moving the strip through the apparatus for controlling the degree and continuity of annealing throughout the strip.

3. Apparatus for annealing steel strips and the like, including a travelling spot welder, a heating chamber, a cooling duct, a

double end shear, all arranged in series for connecting, continuously annealing and disconnecting successive moving strips, and means for moving the strip through the apparatus for controlling the degree and continuity of annealing throughout the strip.

4. Apparatus for annealing steel strips and the like, including a cleaning solution washer, a heating chamber, a cooling duct, all arranged in series for continuously cleaning and annealing a moving strip, and means for moving the strip through the apparatus for controlling the degree and continuity of cleaning and annealing throughout the strip.

5. Apparatus for annealing steel strips and the like, including a heating chamber with transverse electric resistors opposing each other in parallel relation, and a cooling duct extending endwise from the heating chamber surrounded by heat absorbing liquid, there being intake and exit openings for a strip at the remote ends of the chamber and duct, liquid seals for the openings, means for filling the chamber and duct with a reducing gas, and means for continuously drawing the strip through the apparatus for controlling the degree and continuity of annealing throughout the strip.

In testimony that we claim the above, we have hereunto subscribed our names.

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ARTHUR J. TOWNSEND.