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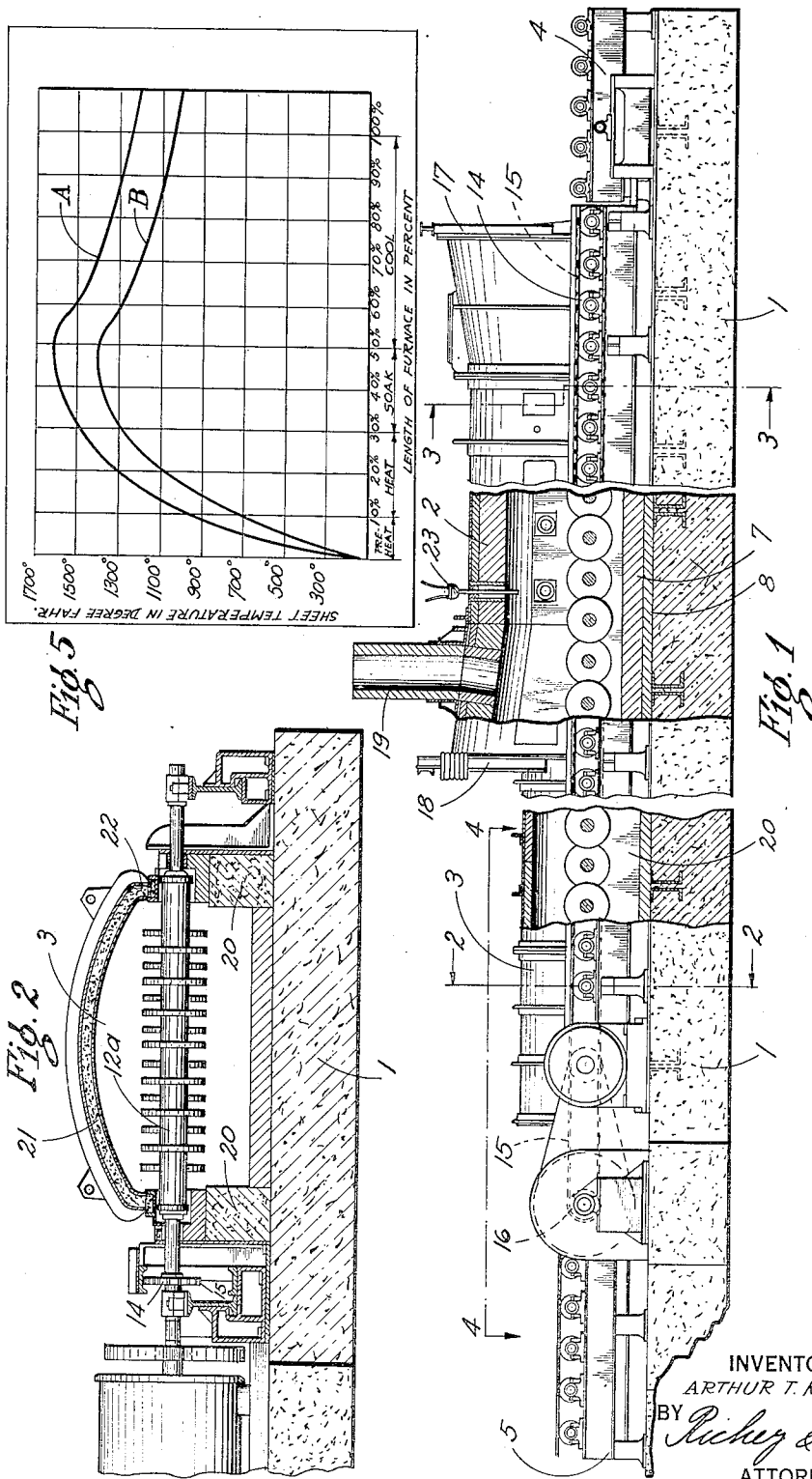
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METHOD OF OPEN ANNEALING SHEET METAL

Filed July 19, 1929

2 Sheets-Sheet 1



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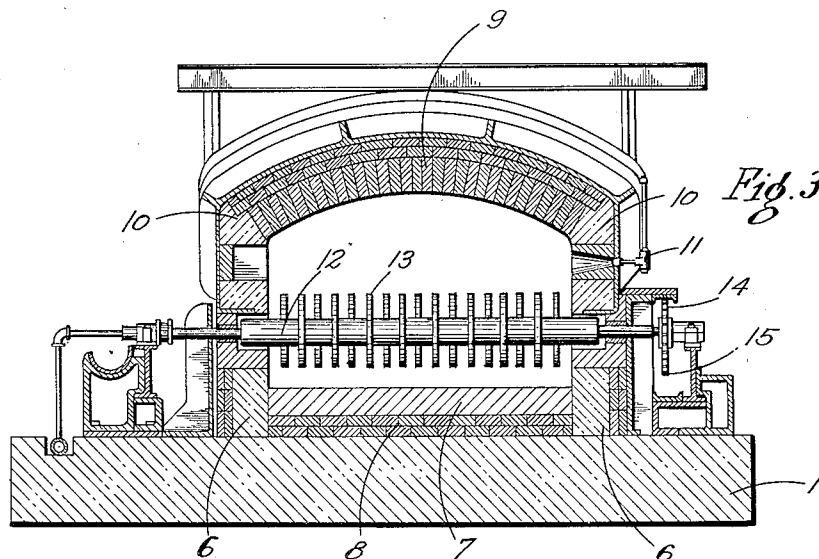
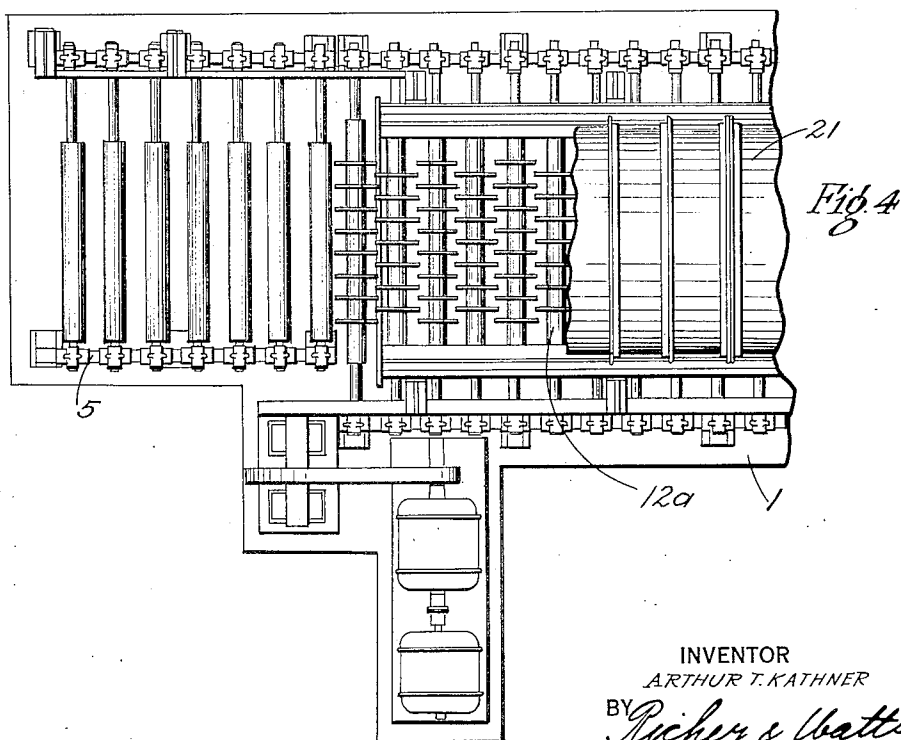
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METHOD OF OPEN ANNEALING SHEET METAL

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2 Sheets-Sheet 2



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METHOD OF OPEN ANNEALING SHEET METAL

Application filed July 19, 1929. Serial No. 379,451.

This invention relates to the art of heat treating metal sheets and is particularly concerned with a new and improved method of annealing relatively thin gauge sheet metal preferably to be subsequently coated.

Heretofore, the methods of heat treating metal sheets which are to be provided with oxidation-preventing-coatings such, for example, as tin or terne plate, galvanized or enamelled coatings, have included the steps of one or more box annealings. That is, the sheets were annealed by being slowly heated and cooled while enclosed in substantially air tight boxes to prevent undesired oxidation of the surfaces and at the same time relieving rolling strains and equiaxing the original grain structure.

So far as I am aware, it has never been proposed or commercially attempted to continuously open anneal thin gauge sheets, subsequently to be coated, in a continuous furnace. This is based on the fact that the prior art open ended furnaces would produce a scaling or bluing of the surfaces of the sheets. With relatively thin gauge metal, the sheets oxidized heavily during annealing and the scale loss in the pickling bath was so excessively high that the method was impractical commercially. With such sheets having blued surfaces the bluing, which consisted of the formation of a complex oxide adhering tightly or closely to the base metal, constituted a film on the sheet which prevented such contact of the coating material with the base metal as was necessary for practically all coating materials. The blued, oxidized surfaces cannot be readily altered by pickling or other means, so far as I am aware, to allow a subsequently applied coating to adhere satisfactorily.

I have discovered that relatively thin sheet steels, such as U. S. S. 22 gage or thinner, to be subsequently coated, can be continuously annealed in an open furnace, by heating and then cooling the sheet all in a substantially non-oxidizing atmosphere and to below a substantially non-oxidizing temperature. The resultant sheet may then be pickled with little or no loss in weight, and

coating material will adhere closely to its clean non-oxidized surface.

Where only one box annealing step was heretofore used, the present method eliminates that step, and where two box annealing steps were used heretofore, only one need be used with this present method. Due to the excellence of the product obtained by this present method, even the second box annealing step may be eliminated in many cases as thin gauge sheets of this class require for the most part very little deep drawing or stamping properties.

It will be understood that I do not limit myself to the annealing of metal to be coated but that my invention contemplates also the annealing of metal which is not to be coated, such as the gages mentioned above or heavier gage metal.

This improved method is thus extremely economical as to equipment and floor space required, is rapid in operation and is much cheaper than the prior art methods.

In practicing my invention I may employ a furnace constructed substantially as shown in my copending application Serial No. 270,637, filed April 17, 1928, and described briefly hereinafter with reference to the drawings accompanying and forming a part of this specification and in which

Fig. 1 is a side elevation partly in section and partly broken away of a furnace in which the present method may be carried out;

Figure 2 is a transverse sectional view taken on line 2—2 of Figure 1;

Figure 3 is a transverse sectional view taken on line 3—3 of Figure 1;

Figure 4 is a top plan view with certain roof parts broken away taken substantially on line 4—4 of Figure 1 and

Figure 5 shows by means of curves the temperatures of sheets at various points in the furnace.

In the figures the furnace comprises a base 1 upon which is supported the structure constituting heating and cooling chambers 2 and 3 respectively and roller tables 4 and 5 for feeding material into the heating chamber and receiving it after it emerges from the cooling chamber. The heating chamber 2

consists of upright side walls 6 and a hearth 7 which may be supported on insulating material 8. The upright walls 6 support crown sections composed of an arch 9 and depending side walls 10 adapted to rest on side walls 6. These crown sections are preferably removable and are lined with suitable insulating material and are also provided with burners 11 through which combustible gases may be delivered into the heating chamber 2. Article conveyor means are provided in the heating chamber in the form of rotatable shafts 12 carrying spaced discs 13, the shafts projecting through the side walls of the heating chamber and preferably being located in open topped notches in the side walls 6. The shafts 12 are suitably journaled outside of the furnace walls and are provided with sprocket wheels 14 over which a driven chain 15 (see Figure 1) passes upon a suitable drive 16.

The entering end of the cooling chamber 2 is provided with a suitable elevatable door 17 and the exit end of the chamber 2 has a movable door 18 which may be raised or lowered. The chamber 2 is provided at the end near the door 18 with a vent or bleeder stack 19 which may be kept closed by a valve (not shown) when desired. Ordinarily this stack is kept closed except during lighting of the furnace and to bring it to its desired temperature.

The cooling chamber 3 is in continuously open communication with the heating chamber 2 and is aligned therewith and is disposed at the exit end of the heating chamber 2 where a restriction preferably formed by a bridge wall (not shown) which depends from the roof of the heating chamber 2 adjacent to the door 18.

The cooling chamber 3 consists of upright side walls 20 adapted to receive shafts 12 similar to the shafts 12 of chamber 2 and on the walls 20 crown sections consisting of arches 21 and short depending side walls 22 are disposed with the latter resting on the walls 20. Preferably the sections 21 are removable. The roof of the cooling chamber 3 is much lower than that of chamber 2.

Pyrometers 23 may be employed at various points in both chambers 2 and 3.

Preferably the furnace is operated with the doors 17 and 18 partly opened and with an opening at the exit end of chamber 3 which may be varied in size by a door similar to door 17 but not shown.

When the furnace is heated to operating temperatures the door 18 is open to the desired extent, the stack is preferably closed and the heated gases in the chamber 2 escape in part past the door 17 and in part pass into chamber 3 and out through the exit end thereof. The chamber 2 is usually divided into a preheating, a heating and a soaking zone by

the use of burners disposed approximately midway in the length of the chamber.

In Figure 5 curve A represents the temperatures to which sheet steel containing .005 percent of carbon is heated in the various parts of the furnace while curve B illustrates corresponding temperatures to which steel sheet containing .50 percent of carbon is heated in this furnace and corresponding to the present method.

My improved method is carried out as follows:

The sheets to be annealed are passed through the furnace in which they are heated in a non-oxidizing atmosphere to a temperature below its upper critical range thus relieving hot mill strains and equiaxing its original grain structure. It is then cooled by being passed thru the cooling chamber of the furnace in the presence of a non-oxidizing atmosphere which makes the cooling more nearly uniform and tends to prevent material surface oxidation such as scaling. Then it may be further treated as being pickled, cold rolled for flatness, and coated, although not necessarily in this sequence of steps.

The furnace temperature to which the sheet metal being annealed is subjected should be sufficiently high so that the temperature attained by the sheet metal will correspond to the temperatures attained by sheet metal in the box annealing methods.

The resulting physical properties of sheet metal annealed by this method surpass the best properties heretofore obtained by the box annealing method, so far as I am aware, due to the uniformity of heating and cooling throughout the sheet metal, a condition not present in commercial box annealing.

The annealing temperatures should never reach the upper critical range of the steel, but should be sufficiently high to produce an equiaxed grain structure. For example with steels having .50% of carbon the temperature in the steel should not exceed about 1400° F. while with a .005% carbon steel the temperature in the steel may reach 1620° F.

I prefer to pass two or more sheets in stacked arrangement thru the furnace but I may take folded sheets direct from the hot mill in the form of double or double-double iron and pass them thru previous to shearing and opening.

When extremely thin sheets are heat treated in such form according to this invention, I have found that they are separated more easily after annealing by my method than are the packs or folds made heretofore, which were sheared and opened or separated before the first box annealing step.

A tonnage can be annealed by this method in 3 to 4 hours which by box methods would take approximately the same number of days.

What is claimed is:

1. The method of open annealing sheet

steel which comprises passing unopened hot mill packs of sheet steel progressively through communicating heating and cooling zones while maintaining a substantially non-oxidizing atmosphere in the presence of the
5 said steel in the said zones, heating the steel in the heating zone to below its upper critical temperature range and cooling it in a cooling zone, all in a substantially non-oxidizing
10 atmosphere, delivering the steel from the cooling zone at a substantially non-oxidizing temperature and then shearing and opening the packs.

2. The method of annealing sheet steel, which consists in passing the sheets in the
15 form of unopened hot mill packs continuously through an open-ended furnace, heating the sheets to a temperature the maximum of which is below the upper critical temperature range of the steel being treated, cooling
20 the packs and opening same after discharge from the furnace.

3. The method of annealing sheet steel, which consists in passing the sheets in the
25 form of unopened hot mill packs continuously through an open-ended furnace, heating the unopened packs to a temperature below the upper critical temperature range of the steel and then subjecting the packs to a
30 cooling temperature over a period of time approximating the heating time, and opening the heat-treated packs after discharge from the furnace.

In testimony whereof I hereunto affix my
35 signature this 18th day of July, 1929.

ARTHUR T. KATHNER.

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