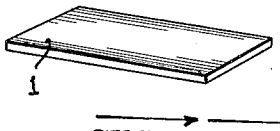
Aug. 6, 1929. H. T. GRAFTON 1,723,152

PRODUCTION OF DUCTILE IRON AND STEEL SHEETS

Filed Feb. 10, 1928

Fig.1.



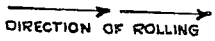


Fig.2.

Fig.3.



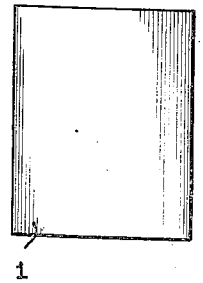


Fig.4.

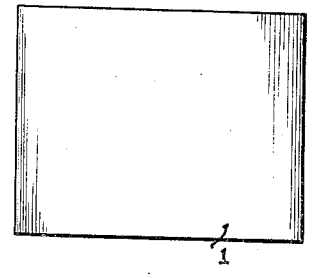


Fig.5.

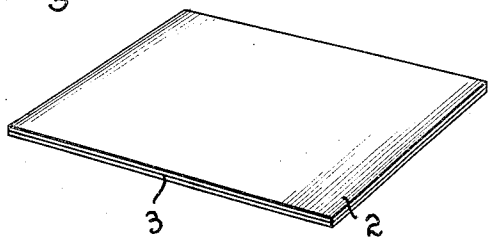


Fig.6.

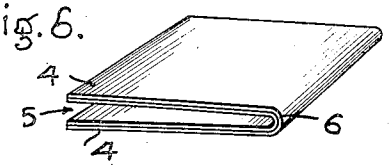


Fig.7.

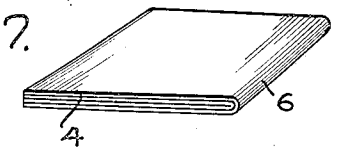


Fig.8.

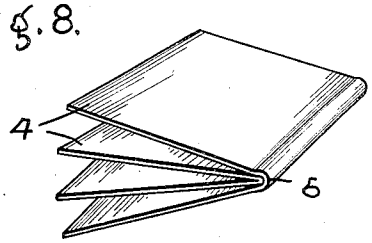
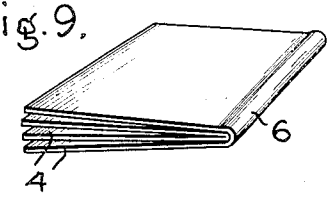


Fig.9.



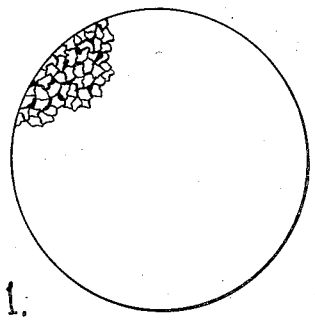


Fig.10.

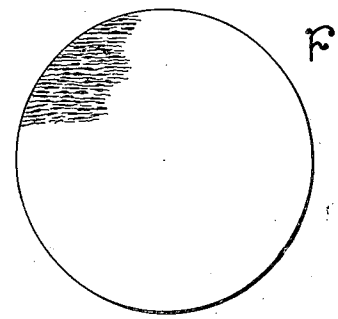


Fig.11.

INVENTOR,

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BY Joan P. Jackoff

ATTORNEY.

Patented Aug. 6, 1929. 1,723,152

UNITED STATES PATENT OFFICE.

HOWARD T. GRAFTON, OF BRISTOLVILLE, OHIO, ASSIGNOR OF ONE-THIRD TO WILLIAM RAYMOND GRIMSLEY AND ONE-THIRD TO JAY SILVESTER IRVIN, BOTH OF WARREN, OHIO.

PRODUCTION OF DUCTILE IRON AND STEEL SHEETS.

Application filed February 10, 1928. Serial No. 253,500.

My invention relates to the annealing or normalizing, in packs, of iron or sheet steel.

In the production of iron or steel sheets, sheet bar, or the raw material as it is delivered to the hot mills is usually of a standard width and varies in thickness, dependent on the length of the sheet desired. The length of the sheet depends on the width of a finished sheet as the subsequent rolling of the bar is crosswise or at right angles to the direction of the original rolling. The resultant sheets are formed into packs as will be clear from the drawings, in which:

Figure 1 is a perspective view of a sheet bar prior to rolling;

Figures 2 to 4, inclusive, are plan views, showing the steps in the elongation of the bar as it passes through the hot mills;

Figure 5 is a perspective view of two matched sheets after elongation;

Figure 6 is a perspective view of two sheets folded to form a pack;

Figure 7 is a perspective view of a completely folded pack;

Figure 8 is a perspective view of a pack open to the fold;

Figure 9 is a perspective view of a pack of sheets which fall together after opening; and

Figures 10 and 11 are reproductions of microscopic sections.

In producing sheets from bar, the bar 1 is given several passes through the hot mills and necessarily assumes the shapes shown in Figures 2, 3 and 4. Another bar is similarly rolled, the two sheets thereafter matched, and then passed together through the hot mill until a predetermined length has been reached, as shown in Figure 5, original sheet 1 being denoted by the numeral 2 and its matching sheet by the numeral 3. Thereafter the matched sheets are doubled or folded as shown in Figure 6 to form packs 4 having an open end 5 and a closed or folded end 6.

In the drawing, a pack of four is shown formed from the original bars after they have been rolled, matched, rerolled and then doubled.

As far as I am aware, it has been the customary practice, after packs have been formed to shear, then separate the sheets thereof and anneal in boxes. More specifically, the method of treatment and sequence of operation now in use is to shear to size, open the packs, pickle, box anneal, cold roll, if required, and reanneal.

It has been proposed to pass the opened sheets, after they have been sheared, singly through the normalizing furnace. However, when this is done excessive oxidation occurs, which is undesirable. Further, only a small tonnage can be treated, making the cost excessive and the procedure commercially impractical. Instead of running the sheets through the normalizing furnace singly they are frequently run through two at a time, depending on the gauge of the sheets. When annealing a number of sheets at the same time, that is, annealing in mass formation, such as box annealing, it is impossible to apply the same degree of heat to each of the sheets, and considering each sheet, it is further impossible to apply the same degree of heat thereto. This results in irregularities in the grain structure of the sheet, making the production of uniformly ductile sheets impossible. Consequently, the drawing qualities of the sheet are of a low order.

The difficulties and disadvantages above referred to apply to both heavy gauge and light gauge sheets but are especially true of lighter gauge sheet ranging, for example, from 24 to 38 gauge, the latter identifying sheets about .006″ thick. It is desired to also point out that in normalizing light gauge sheet as it is now carried out in a continuous normalizing furnace, it is necessary to provide carrier sheets heavy enough to support the steel sheets being annealed when the latter are hot.

My invention relates to and has for its object, the normalizing of iron and steel sheets, especially those of lighter gauge in such a manner as to substantially eliminate the disadvantages above referred to.

More specifically, one of the objects of my invention is to produce a superior sheet having a uniform ductility adapting it for drawing and stamping operations and permitting the production of light tin plate in shorter time. Preferably, the sequence of operations are in the following order: After hot rolling, open or separate the individual sheets of the pack to the curled or doubled end either before or after shearing the sides, pass the sheets through the normalizing or

annealing furnace in open packs, shear, pickle, dry, cold roll and reanneal only if desirable. Proceeding as set forth, not only will superior sheets be produced, but the time required to manufacture the same will be materially reduced, thereby effecting a substantial saving in inventory and reducing the sheets damaged, lost or spoiled to a minimum.

According to my invention, I propose to anneal or normalize iron and steel sheets and especially those of lighter gauge in packs as rolled on the hot mills before shearing the curl or doubled ends of the sheets. My specific procedure will be described in connection with Figures 7 and 8. The former figure shows a pack of four. In the preferred form of my invention, before the pack, as shown in Figure 7, is passed through a normalizing furnace, the sheets of the pack are loosened or opened up to the fold 6, as indicated in Figure 8. The loosened pack of sheets, as shown in Figure 9, is then passed through the normalizing furnace. The sheets, after loosening, are allowed to fall together again as the leaves in a closed book. I do not desire to be limited as to the amount of loosening as this will vary according to the kind and character of the sheets being treated. All that is necessary is that the sheets of the packs be sufficiently loosened from one another so that they do not stick together as they pass through the normalizing furnace.

My invention further consists in feeding the opened pack of sheets into a normalizing furnace without a carrier sheet. Since the curled or doubled end of the pack is not sheared until after the pack has passed through the annealing or normalizing furnace, the pack, and this is especially true of a pack of light guage steel, has sufficient body to carry itself through the furnace by entering the doubled end of the pack into the furnace foremost.

My process of treating iron and steel sheets whereby the individual sheets of the pack are separated prior to passing the same through the normalizing furnace subjects each sheet to the same and uniform degree of heat whereby the grain structure is greatly refined, producing a sheet which possesses a uniform ductility, enabling it to be used for the production of drawn and stamped articles superior to articles heretofore manufactured.

Sheets of steel normalized according to my process, have a uniform equiax structure as indicated in Figure 11 and I believe that I am the first to commercially produce a light gauge sheet of this character. Figure 10 shows the structure of a specimen annealed in accordance with standard practice. It has a streaky and non-uniform texture. More specifically, I believe I am the first to produce light gauge sheets having a uniform equiax structure, suitable for the manufacture of tin plate and especially for the production of cans for food containers.

In practicing my invention, the normalizing furnace is held at a temperature varying from about 1675° to 1725° F. although the range may be considerably varied. What is desired is that the temperature be above the critical range of the steel being annealed. The atmosphere of the normalizing furnace is, preferably, neutral or non-oxidizing. By normalizing in open packs, as set forth, the additional advantage is obtained that the inner sheets of the pack are protected to a large extent from any oxidation after emerging from the furnace. Normalizing under the above conditions and in open packs, as set forth, a fine equiax and uniform grain is produced which is particularly desirable in finished tin plate. Relative to the ductility of the sheets, it may be stated that specimens of 30 gauge (.012″ thick) ordinary box annealed sheets show an average Erichsen, ductility test of from 7.00 to 7.50 m. m. in depth of draw, while sheets of the same quality of steel, but normalized by my method, have shown depth and reading of 8.50 to 9.80 m. m.

In manufacturing tin plate, after the normalizing operation, the material is sheared to proper size, pickled as usual, given two or three passes through cold rolls, again lightly pickled, lightly annealed, if desirable, or immediately coated. Tin plate produced as described is superior to that manufactured by the standard methods now in use.

Sheets produced in accordance with my invention may be vitreous enameled or used to manufacture various types of expanded metal lath.

I do not desire to limit my invention to a pack having any particular number of sheets. The packs of four sheets have been used merely to illustrate the invention. A pack of eight produced in the standard manner from the pack of four sheets may be treated in accordance with my invention, and packs of various sizes may be normalized as set forth.

While in the specific illustration given, I have shown the pack opened at one end and substantially closed at the other, and this is accomplished by folded sheets so that they are opened at one end and closed at the folded end, it is, of course, obvious that equivalent means may be used to produce such an opened pack of iron or steel sheets. The point is here made that the basic idea of my invention is to anneal the pack in an opened condition, so that each sheet will have substantially the same degree of heat applied thereto, thereby making possible the production of uniformly ductile sheets. It

is to be noted that in annealing an open pack, the sheets do not stick together when passing through the normalizing furnace. It is further desired to point out that my invention has the additional advantage that the inner sheets of the pack are protected, to a large extent, from oxidation after the pack emerges from the normalizing furnace. This further acts to prevent irregularities in the grain structure which is, of course, eminently desirable. In the more specific aspect of the invention, the method comprises annealing iron or steel sheets after hot rolling, and assembling in pack formation to produce sheets having a uniform grain and high ductility. This is accomplished by passing through a normalizing furnace a pack opened sufficiently to prevent the respective sheets of the pack from sticking together during the annealing step, allowing each sheet of the pack to be subjected to substantially the same degree of heat, and removing the pack from the normalizing furnace in said opened condition, whereby the inner sheets of the pack are protected from oxidation.

I claim:

1. The method of annealing iron and steel sheets after hot rolling and assemply in pack formation to produce sheets having a uniform grain and high ductility comprising passing an opened pack through an annealing or normalizing furnace maintained at a temperature adapted to refine the grain structure of the sheets.

2. The method of annealing iron and steel sheets after hot rolling and assembly in pack formation to produce sheets having a uniform grain structure and high ductility comprising separating the individual sheets of the pack to the folded end thereof, and passing said open pack through an annealing furnace maintained above the critical range of the iron and steel sheets.

3. The method of treating iron and steel sheets after hot rolling, in assembled pack formation comprising separating the individual sheets of the pack to the folded end thereof, passing the open pack through an annealing or normalizing furnace, shearing the pack, separating the individual sheets thereof, pickling the sheared and separated sheets, drying, and cold rolling whereby there is produced sheets of uniform grain structure and high ductility.

4. The method of treating iron and steel sheets after hot rolling, in assembled pack formation comprising separating the individual sheets of the pack to the folded end thereof, passing the open pack through an annealing or normalizing furnace, shearing the pack, separating the individual sheets thereof, pickling the sheared and separated sheets, drying, cold rolling and light annealing whereby there is produced sheets of uniform grain structure and high ductility.

5. The method of annealing iron and steel sheets after hot rolling and assembly in pack formation to produce sheets having a uniform grain and high ductility, comprising passing through a normalizing furnace a pack opened sufficiently to prevent the respective sheets of the pack from sticking together during the annealing step, simultaneously allowing each sheet of the pack to be subjected to substantially the same degree of heat, and removing the pack from the normalizing furnace in said opened condition, whereby the inner sheets of the pack are protected from oxidation.

6. As a new article of manufacture, a pack of iron or steel sheets opened at one end, and substantially closed at the other end, which has been passed through a normalizing furnace, and is characterized by a structure resulting from normalizing the pack in said opened condition.

7. As a new article of manufacture, a heat treated opened pack of iron or steel sheets folded at one end and characterized by a structure resulting from normalizing such a pack after it has been opened.

In testimony whereof I hereunto affix my signature.

HOWARD TOLAN GRAFTON.