

J. E. CARNAHAN & A. J. MASKREY.  
 METHOD OF OXIDIZING STEEL OR IRON SHEETS.  
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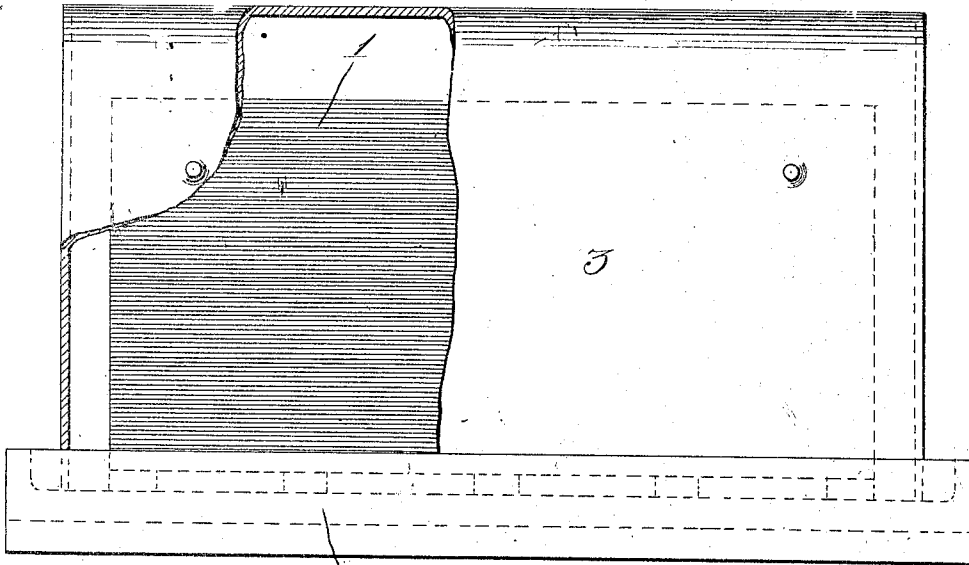


Fig. 1.

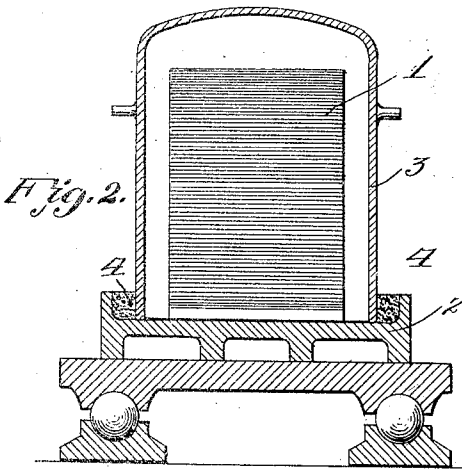


Fig. 2.

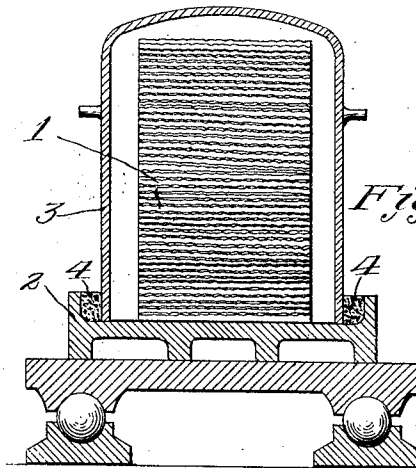


Fig. 3.

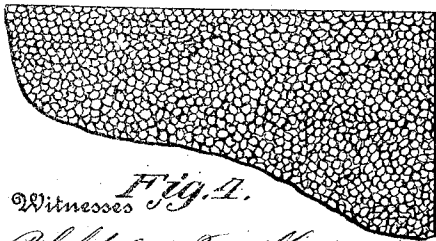


Fig. 4.

Witnesses

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Fig. 5.

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# UNITED STATES PATENT OFFICE

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## METHOD OF OXIDIZING STEEL OR IRON SHEETS.

1,056,627.

Specification of Letters Patent. Patented Mar. 18, 1913.

Application filed November 8, 1912. Serial No. 730,126.

To all whom it may concern:

Be it known that we, JOHN E. CARNAHAN and ARTHUR J. MASKREY, both citizens of the United States, and both residing at Canton, in the county of Stark and State of Ohio, have invented a new and useful Method of Oxidizing Steel or Iron Sheets, of which the following is a specification.

The invention relates to the oxidation of the surfaces of steel or iron sheets, for the purpose of giving them a uniform bluish color, and especially to that method of bluing whereby the sheets are heated in an annealing box and wherein steam is employed as an oxidizing agent.

A well known method of oxidizing a very cheap grade of steel sheets, as for use in making ordinary stove pipes, is to heat them in an annealing box and blue them by a bath of steam immediately after the sheets come from the reducing rolls, and before the sheets have been pickled or otherwise cleansed, and then to subsequently anneal the sheets and finish them between cold rolls; but it is obvious that the unclean condition of the sheets before they are pickled and the presence thereon of patches of oxid of iron, prevents an oxidation to a uniform depth upon the surfaces which causes a variation in the color in different parts of the sheets.

An alternate prevailing method of oxidizing sheets by a bath of steam, is to pickle, anneal and cold roll the sheets, and then to heat them in an annealing box and blue them with a bath of steam; but it is obvious that the smoothing and polishing of the surface by the pressure of the cold rolls, and the close contact of the surfaces of the finished sheets when packed for annealing, prevents the development of a deep and uniform oxidation on the surfaces, and does not give the rich color which is much desired. These difficulties are overcome by the present invention, in the practice of which the black sheets are first pickled and then packed in a pile and annealed in the usual manner; and then cooled and separated and repacked and reheated in an annealing box, and then oxidized by steam when partially cooled, after which they are cold rolled for finishing, and again heated for softening and steamed for preserving the uniform color, after which they may be again cold rolled for certain special uses.

The invention thus set forth in general terms is preferably practised by the use of

an ordinary annealing pan and box, as illustrated in the accompanying drawing forming part hereof, in which—

Figure 1, is a side elevation of an annealing pan and box, with part of the box broken away to show a pile of sheets packed therein; Fig. 2, a cross section of the annealing pan and box, on a track and roller truck, showing a pile of annealed sheets packed therein; Fig. 3, a similar section showing a pile of sheets loosely repacked therein, for the improved bluing process. Fig. 4, a fragmentary view of the surface of a pickled unfinished sheet showing the comparatively rough and convoluted condition thereof; and Fig. 5, a fragmentary exaggerated section of a pile of repacked unfinished annealed sheets, showing the slight interval between the rough and convoluted surfaces thereof.

Similar numerals refer to similar parts throughout the drawings.

For the purposes of the present process, when the black sheets have been reduced by rolling, they are first pickled in sulfuric or muriatic acid and then washed in clear water in the usual manner, for completely cleaning the surfaces thereof, which then presents a roughened and somewhat porous condition, as illustrated in Fig. 4. The sheets are then packed in a pile 1, on an annealing pan 2 and then covered with an annealing box 3, the rim of which is luted with sand 4 in the usual manner, to seal the box. The sheets are then annealed by heating them in a furnace to some 1500° F., for a substantial period, and are then cooled by withdrawing them from the furnace, while covered by the box, in the usual manner.

The high heat of the annealing process and the softening influence thereof, causes the sheets of the pile to subside and to pack and stick so closely together as to substantially exclude the entrance of air or steam between them. This adhesion of the sheets together is so tenacious, that it requires considerable force to separate one sheet from another, and is no doubt the principal reason why sheets have not heretofore been oxidized immediately after being pickled and annealed.

When the sheets are cooled after being annealed, the box is removed and the sheets are first separated and then repacked one by one, the order of the sheets being preferably reversed to avoid a contacting of the

same sides in the repacked pile; and it is evident that the rough and porous condition of the unfinished surfaces of the sheets, together with the slight distortion in shape caused by their separation, prevents them from being repacked so closely together as to exclude air or steam from between them. In fact, it has been found that the separating and repacking of the sheets as described, will leave such a substantial interval between them as to permit a free entrance of steam between them and cause a complete and uniform oxidation of the adjacent surfaces. The sheets are again covered by an annealing box, the rim of which is luted by sand as before, and the repacked sheets are then heated in a furnace to a dull red heat or about 1000° F., after which they are withdrawn from the furnace and cooled while yet covered by the box, to a dark red heat; whereupon dry live steam is introduced into the box, which in practice is done by slightly elevating one end of the box and inserting thereunder a nozzle through which steam is discharged into the box, the luting sand being packed around the nozzle. The bath of steam is preferably maintained until the sheets are so cooled that the steam will not be further decomposed, after which the box is removed and the sheets are smoothed or polished by passing them a sufficient number of times between the cold rolls to produce the finish desired.

It has been found that by separating and repacking the previously pickled annealed sheets, and bluing them by a bath of steam before they have been smoothed or polished by cold rolling, a very deep, and substantially complete and uniform oxidation of the surface is attained: which is no doubt caused by the fact that the separation and repacking of the sheets, permits the steam to enter freely between them, and the roughness of the unfinished surfaces, permits the steam to penetrate more deeply into the body of the sheet than would be possible if the same had been previously smoothed. Furthermore the lower degree of heat required for the bluing, does not cause the sheets to pack so closely together as in the annealing process. The subsequent cold rolling of the sheets for finishing the surfaces, serves to impress the deep oxidation thus formed into the surface of the sheet, so that the oxidation is not merely a superficial film, but has a deep interengagement with the body of the sheet. It is preferred to give the sheets an odd number of passes between the cold rolls, thereby again reversing the order of the sheets in the pack for the subsequent step in the process.

The amount of cold rolling necessary for finishing the more highly polished sheets and impressing the oxidation therein, usually makes the sheets too hard for gen-

eral commercial purposes, and to overcome this effect, the sheets thus reversely arranged in a pack, are again heated and steamed in an annealing box, in the manner as described above; after which, if necessary, they may be given one or two final passes between cold rolls. It is evident that the reheating process serves to soften the sheets by a partial annealing, that the resteamer preserves the uniform oxidation and color which has been given to the sheets by the first steaming process, and finally that the comparatively soft condition of the sheets after the reheating permits a finer gloss to be obtained by the final cold rolling. Furthermore, the rearrangement of the pack to bring the sheets which were at the bottom of the pack for the first steaming process, to the top of the pack for the second steaming process, relieves these sheets from the superimposed weight of the pack, and permits the steam to flow more freely between them; and it is evident that if these sheets are not uniformly and deeply oxidized by the first steaming, they will be so oxidized by the second steaming. By these means, a deeper and more tenacious oxidation is produced on the surfaces of the sheets, and while it may not be possible to produce an absolutely uniform color from the middle portions to the edges of the sheets by any method of oxidizing them while cooling in packs, it is believed that a greater uniformity of color is attained by the method herein set forth, than by any other process of the same character. Whatever variation in color which may result from this method, is a gradual, uniform and undefined change from the middle portion to the edge portion, without showing any well defined or distinctive zones or bands of color on the surfaces of the sheets.

We claim:—

1. The method of oxidizing steel or iron sheets which consists in pickling and annealing them, then separating and repacking them in reverse order, then oxidizing them by heating and steaming them in an annealing box, then cold rolling them, then repacking them in reverse order and repeating the oxidizing process, and finally cold rolling the sheets.

2. The method of oxidizing steel or iron sheets which consists in pickling and annealing them, then separating and repacking them in reverse order, then oxidizing them by heating and steaming them in an annealing box, then cold rolling them, and then repacking them in reverse order and repeating the oxidizing process.

3. The method of oxidizing steel or iron sheets which consists in pickling and annealing them, then cooling, separating and repacking them one by one, then oxidizing them by heating and steaming in an anneal-

ing box, then cold rolling them, then repack-  
ing them and repeating the oxidizing proc-  
ess, and finally cold rolling the sheets.

4. The method of oxidizing steel or iron  
5 sheets which consists in pickling and anneal-  
ing them, then cooling, separating and re-  
packing them one by one, then oxidizing  
them by heating and steaming in an anneal-  
ing box, then cold rolling them and then re-  
10 packing them and repeating the oxidizing  
process.

5. The method of oxidizing steel or iron  
sheets which consists in pickling and anneal-  
ing them, then separating and repacking  
15 them in reverse order, then oxidizing them  
in an annealing box, then cold rolling them,  
then repacking them in reverse order and  
repeating the oxidizing process, and finally  
cold rolling the sheets.

6. The method of oxidizing steel or iron  
20 sheets which consists in pickling and anneal-  
ing them, then separating and repacking  
them in reverse order, then oxidizing them  
in an annealing box, then cold rolling them,  
25 and then repacking them in reverse order  
and repeating the oxidizing process.

7. The method of oxidizing steel or iron  
sheets which consists in pickling and anneal-  
ing them, then cooling, separating and re-  
30 packing them one by one, then oxidizing

them in an annealing box, then cold rolling  
them, then repacking them and repeating  
the oxidizing process and finally cold rolling  
the sheets.

8. The method of oxidizing iron or steel 35  
sheets which consists in pickling and anneal-  
ing them, then cooling, separating and re-  
packing them one by one, then oxidizing  
them in an annealing box, then cold rolling  
them, and then repacking them and repeat- 40  
ing the oxidizing process.

9. The method of oxidizing steel or iron  
sheets which consists in pickling and anneal-  
ing them, then cooling and separating the  
sheets one from another and oxidizing them 45  
in an annealing box, then cold rolling them,  
then repeating the oxidizing process, and  
finally cold rolling the sheets.

10. The method of oxidizing steel or iron  
50 sheets which consists in pickling and anneal-  
ing them, then cooling and separating the  
sheets one from another and oxidizing them  
in an annealing box, and then cold rolling  
them, then repeating the oxidizing process.

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