

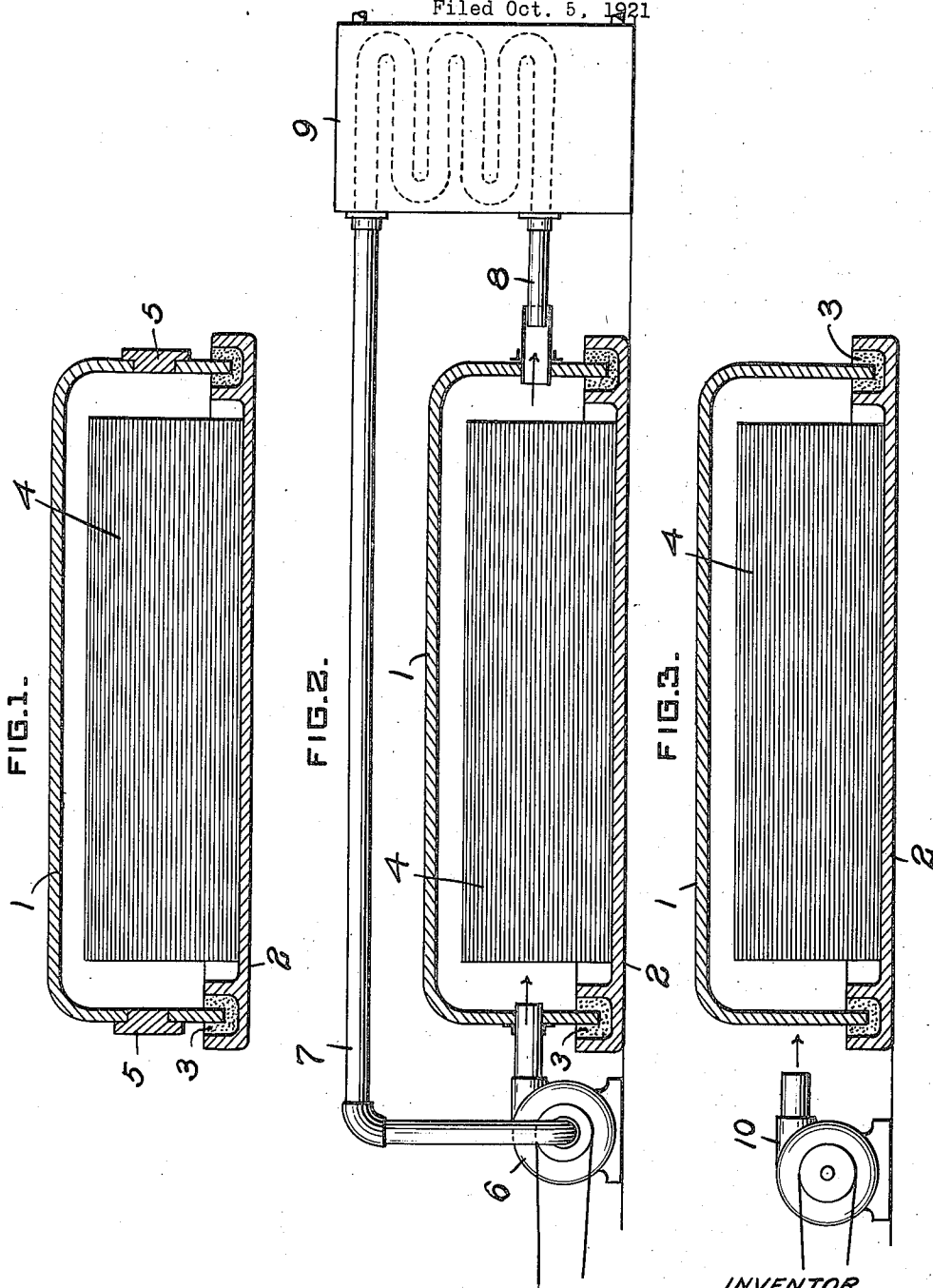
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PROCESS OF ANNEALING SHEET IRON

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PROCESS OF ANNEALING SHEET IRON.

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To all whom it may concern:

Be it known that I, JAMES A. SMAIL, a citizen of the United States, and a resident of Youngstown, in the county of Mahoning and State of Ohio, have made a new and useful Invention in Process of Annealing Sheet Iron, of which the following is a specification.

The invention relates to a process of annealing packs of sheet metal. It has for its principal objects the shortening of the present procedure, but more important, the provision of a process in the practice of which the product is better annealed, tougher and more free from defects such as stretcher strain and the like. The drawings roughly indicate types of apparatus which may be employed, although it will be understood that the process is not restricted to use with any particular type of apparatus, or that a new type of apparatus is required for its practice, the apparatus being shown merely to make the explanation simpler and more direct. In the drawings—

Figure 1 shows in section a pack of plates in position in the annealing box. Fig. 2 is a section similar to that of Fig. 1 but with other apparatus applied to the box, after its removal from the furnace, to facilitate the more rapid cooling of the pack. And Fig. 3 is another section with a different means applied for cooling the annealing box and its contents.

Referring to Fig. 1, the numeral 1 indicates the annealing box, resting upon the base plate 2 with its lower edge embedded in the sand in the groove 3 in order to exclude the air which would oxidize the metal during the annealing process. 4 is a pack of plates which are to be subject to the annealing operation.

Under the practice which has heretofore commonly prevailed, the annealing box with its contents was placed in a furnace gradually raised through a period of several hours to a temperature of upwards 1450° F., and after this maximum temperature was reached it was maintained at this temperature for about two hours, this period of the treatment being known as "soaking." The furnace was then allowed to cool gradually during a period of several hours to a dark red or black heat approximating 800° or 900° F., after which the box was withdrawn from the fur-

nace and opened. The theory of operation has been that the slow raising of the temperature of the pack through the annealing period of from about 1200° F. to 1450° F. and the slow cooling through such period was necessary to the securing of toughness and freedom of defect in the product.

I have found that a better product can be produced by a radically different procedure. According to my treatment, which may be carried out in the same furnace and with the same annealing box, the box and its contents are brought as rapidly as possible up through the range from 1000° F. to 1400° F. or slightly thereabove and is kept at such temperature only long enough to insure that all the sheets in the pack shall arrive at a fairly uniform temperature, after which the annealing box is immediately removed from the furnace and cooled in the open air. I am of the opinion that the more rapid the cooling through the critical range from 1450° F. to 1250° or 1200° F., the better the product. The rapidity of cooling may be increased by artificial means such as those indicated in Figs. 2 and 3 although the invention is not limited to use with either of those means or in fact with any means.

In the arrangement of Fig. 2, the closure plugs 5, 5 are removed after the box is taken from the furnace, and the apparatus shown is applied for circulating a cooling, non-oxidizing gas through the box to speed up the cooling of the pack. This apparatus comprises a circulating fan 6, piping 7 and 8 and a cooling chamber 9 through which the piping carrying the circulating gas is passed and cooled in any desired way.

In the arrangement of Fig. 3, the box 1 is exposed after withdrawal from the furnace, to a blast of air from the fan 10.

Various other expedients may be employed for facilitating the cooling of the box and its contents. For instance, the box might be allowed to remain in the furnace, and a cooling blast of air circulated into and through the furnace to cool it and its contents down at a rapid rate.

My theory as to the better results secured by my improved process and compared to the process commonly employed is that the soaking process and the slow cooling during the critical period from about 1450° F. down to 1000° F. as practiced in the usual proce-

5 dure promoted the formation of free or massive cementite, which is a granular carbide formed by the union of the carbon in the iron with the iron itself. This coarse
6 grained or massive cementite is relatively brittle and of low tensile strength, so that its presence in the finished product impairs its ductility and is conducive of the lines known as "stretcher strain" when the sheets
10 are full finished.

15 With my process the annealing is accomplished during the rising temperature in the furnace from 1200° F. up to 1450° F. or somewhat higher, after which time the rapid cooling tends to prevent the formation of coarse grained or massive cementite, the carbide which is formed during this more rapid cooling through the critical period being of the type known as pearlite in which the
20 structure consists of thin interspersed laminations of cementite and pure iron or ferrite. This is the most ductile form in which the cementite can occur and it should be held in this form in so far as possible instead of being
25 allowed to change into massive free form which increases the brittleness of the sheets and their liability to develop defects along the lines where the cementite occurs.

30 It will be understood that the term iron is used in its generic sense to mean iron or steel in the wide range of forms known as sheet iron or sheet steel; also that the temperatures specified are only roughly approximated.

35 What I claim is:

1. A process of annealing a pack of iron sheets which consists in bringing the pack up through an annealing temperature in an enclosed atmosphere, and then causing said
40 pack to cool down rapidly while still closed off from the outside atmosphere.

2. A process of annealing a pack of iron sheets which consists in bringing the pack up through an annealing temperature of
45 from 1200° F. to 1450° F. or upwards in an enclosed atmosphere and causing said pack to cool down rapidly through the same range while still closed off from the outside atmosphere.

50 3. A process of annealing a pack of iron sheets which consists in bringing the pack up through an annealing temperature in an annealing box in a furnace, then removing the box with its pack therein from the furnace while at the upper portion of the annealing range of temperature and allowing
55 the box and its contents to drop rapidly in temperature.

60 4. A process of annealing a pack of iron sheets which consists in bringing the pack up through an annealing temperature in an annealing box in a furnace, then removing the box with its pack therein from the furnace while at the upper portion of the annealing range of temperature and allowing
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the box and its contents to drop rapidly in temperature through the critical range of from 1450° F. down to 1200° F.

5. A process of annealing a pack of iron sheets which consists in bringing the pack
70 up through an annealing temperature of from 1200° F. to 1450° F. and upward in an annealing box in a furnace, then removing the box with its pack therein from the furnace while at its upper range of temperature and allowing the box and its contents to drop rapidly in temperature of from approximately 1450° F. down.

6. A process of annealing a pack of iron sheets which consists in bringing the pack
80 up through an annealing temperature in an annealing box in a furnace, then removing the box with its pack therein from the furnace while at the upper portion of the annealing range of temperature and as soon
85 as the entire pack has arrived at a uniform temperature, and allowing the box and its contents to drop rapidly in temperature through the critical range from approximately 1450° F. down.

7. A process of annealing a pack of iron sheets which consists in bringing the pack up through an annealing temperature in an enclosed atmosphere, terminating the application of heat to the pack as soon as it
95 arrives at a uniform temperature at its upper range, and then causing said pack to cool down rapidly while still closed off from the outside atmosphere.

8. A process of annealing a pack of iron sheets which consists in bringing the pack up through an annealing temperature in an enclosed atmosphere, and then applying cooling means to the pack to cause said pack
100 to cool down rapidly while still closed off from the outside atmosphere.

9. A process of annealing a pack of iron sheets which consists in annealing the plates in a rising temperature in an enclosed atmosphere, and then removing the application
110 of heat to the pack while at its upper range of temperature and permitting the pack to cool rapidly while still closed off from the outside atmosphere.

10. A process of annealing a pack of iron sheets which consists in annealing the plates in a rising temperature in an enclosed atmosphere in a furnace, and then removing the pack in its enclosed atmosphere from the furnace while the pack is still at its upper
115 range of temperature, and permitting the pack to cool rapidly while still closed off from the outside atmosphere.

11. A process of annealing a pack of iron sheets which consists in bringing the pack
125 up through an annealing temperature in an annealing box in a furnace, then removing the box with its pack therein from the furnace while at the upper portion of the annealing range of temperature, and then cool-
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ing the pack by passing a current of non-oxidizing gas through the box.

12. A process of annealing a pack of iron sheets which consists in annealing the plates
5 in a rising temperature ranging from 1000° F. to 1400° F. and upward in an enclosed atmosphere and then removing the application of heat to the pack while at its upper range of temperature, and permitting
10 the pack to cool rapidly while still closed off from the outside atmosphere.

13. A process of annealing a pack of iron sheets which consists in annealing the plates
15 in a rising temperature ranging from 1000° F. to 1400° F. and upward in an enclosed atmosphere and then removing the application of heat to the pack while it is at its upper range of temperature, and per-

mitting the pack to cool rapidly from a temperature of 1400° F. down to 1000° F. while
20 still closed off from the outside atmosphere.

14. A process of annealing a pack of iron sheets which consists in bringing the pack up through an annealing temperature of upwards of 1000° F. and then applying cool-
25 ing means to cause the pack to cool down rapidly while still closed off from the outside atmosphere.

In testimony whereof, I have hereunto subscribed my name this 26th day of Sep-
30 tember, 1921.

JAMES A. SMAIL.

Witnesses:

GEORGE W. COVER,
F. J. CARR.