

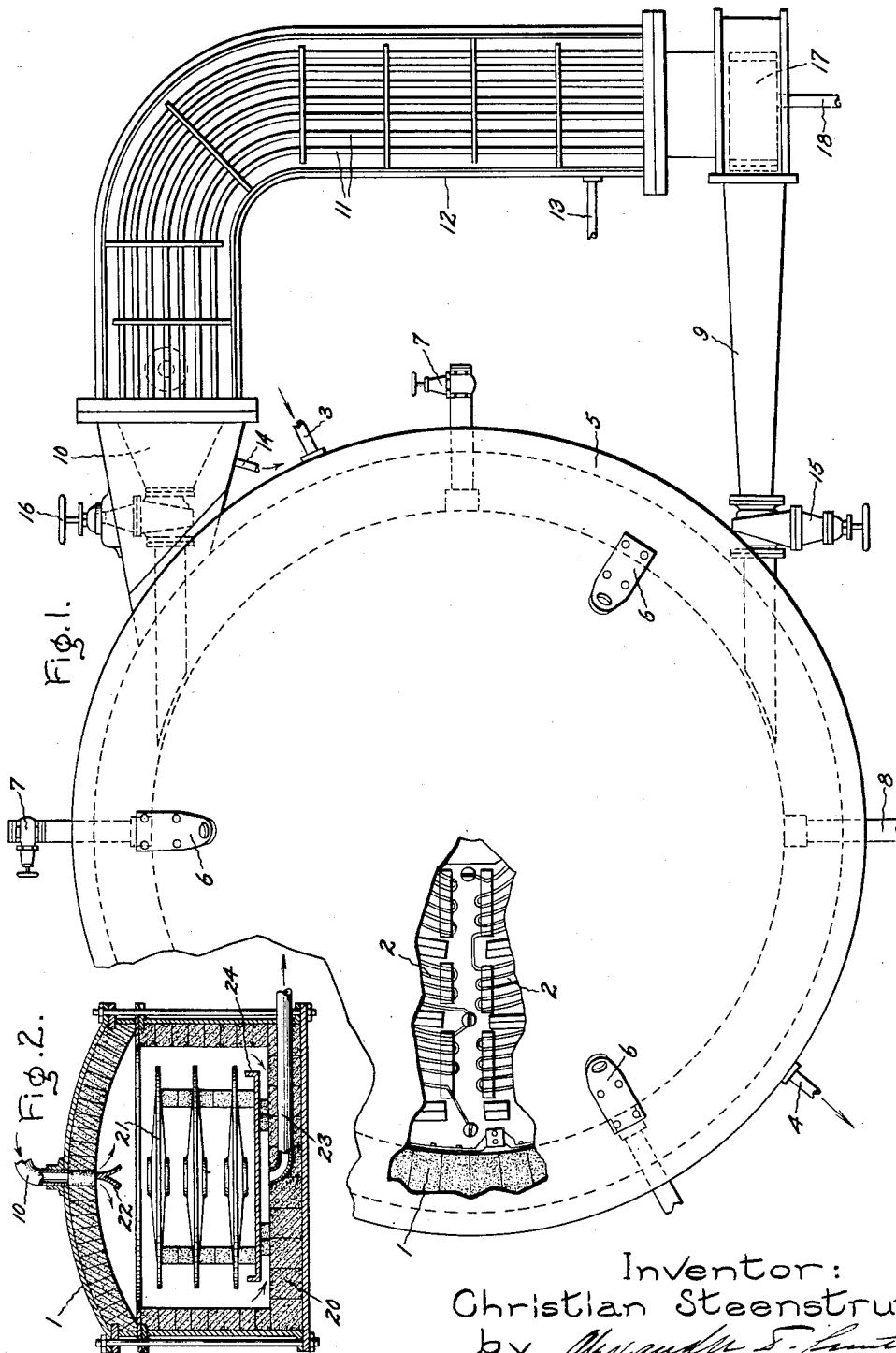
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C. STEENSTRUP

METHOD OF CARRYING OUT METALLURGICAL OPERATIONS

Original Filed Sept. 23, 1922



Inventor:  
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## UNITED STATES PATENT OFFICE.

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## METHOD OF CARRYING OUT METALLURGICAL OPERATIONS.

Original application filed September 23, 1922, Serial No. 590,007. Divided and this application filed August 13, 1924. Serial No. 731,861.

*To all whom it may concern:*

Be it known that I, CHRISTIAN STEENSTRUP, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Methods of Carrying Out Metallurgical Operations, of which the following is a specification.

My invention relates to a method of carrying out metallurgical operations, and has for its object a simple, reliable, and efficient method of carrying out various metallurgical operations in an enclosed space.

This application is a division of my co-pending application, Serial No. 590,007, filed Sept. 23, 1922.

Certain metallurgical operations for example, the uniting of metallic parts by fusion of copper or other metals, are carried out in the presence of a reducing gas, in closed furnaces which are well heat-insulated. After the operation is completed, a long time, sometimes several days, has been required to cool the furnace and its contents and hence the output of the furnace has been very seriously restricted and the cost of the product has been correspondingly increased.

A slow rate of cooling in some cases is disadvantageous in its effect upon the work. For example, when uniting metal parts by fused copper, silver, or the like, in hydrogen, it is desirable to cool the work rapidly, after the union has been completed, particularly from the highest temperature down to a point where further alloying or other undesired action stops.

In accordance with my invention, greater efficiency and economy of operation of gas-filled furnaces is obtained by utilizing the same gas which is necessary to the metallurgical operation as a cooling medium. This is accomplished by establishing a circulation of said gas through the furnace and a cooling means after the heat-treating process has been completed. As a result of my invention a complete operation can be carried out in a large industrial furnace in less than one-fourth of the time formerly required.

As a further consequence of my invention an improved product can be produced, par-

ticularly when coating or uniting metal by fused copper.

In the accompanying drawing, Fig. 1 is a plan view of an apparatus for carrying out my invention, part of the furnace cover being broken away to show the electric heating elements, and Fig. 2 is a vertical section of a slight modification.

Referring to the drawing, the apparatus suitable for carrying out my invention in one form comprises a closed metal container 1 lined with suitable refractory heat-insulating materials and containing suitable heating means, as for example, electric resistors 2. Inlet and outlet pipes 3 and 4, respectively, are provided for admitting and carrying away gas, as for example, hydrogen. During the heating operation or working period of the furnace, sufficient gas is supplied to provide a slight excess so as to produce a low pressure in the confined work-containing space or chamber. When operating with a combustible gas, such as hydrogen, some gas is permitted to burn at the outlet pipe 4 to indicate whether or not a suitable pressure exists in the apparatus. The cover 5 of the furnace which during the working period is held down by bolts or clamps is removable by elevating devices engaging with the ears 6. Valve tubes 7 containing sight glasses communicate with the furnace interior to permit observation of the furnace interior. Thermo-couples may be inserted into the furnace through tubes 8.

Connected to the furnace by conduits 9 and 10 is a cooler comprising a plurality of pipes 11 located in a casing 12. A circulation of cooling water about the pipes 11 in the casing 12 is maintained by means of the inlet and outlet pipes 13 and 14.

During the period that the work is heated to carry out desired operations, as for example, the union of metal parts in hydrogen by fusion of metal, the valves 15 and 16 in the conduits 9 and 10 are closed to prevent the circulation of the gas through the cooler. After the work of the furnace is completed the supply of current to the resistors 2 is interrupted. To lower the temperature of the furnace the valves 15 and 16 are opened and a blower or pump 17 is put into operation. The blower may be

driven by any suitable means, a shaft 18 being shown for the purpose. Due to the blower, the hydrogen or other selected gas is circulated through the pipes 11 where it gives up heat to the cooling fluid. During this cooling or temperature reducing period of the furnace the supply of hydrogen thereto is maintained. When the temperature has been lowered to a desired point, the valves 15 and 16 are closed, the furnace is opened and the work removed. It is particularly desirable to lower the temperature rapidly over a range of about 100° below the fusing temperature of the brazing metal so as to stop alloying action, which, particularly in the case of some metals, would tend to cause deterioration of the union or joint. With this in view the pump may be driven rapidly at the start and later on at a decreased rate if a slower cooling operation is desired.

In Fig. 1 I have shown the conduits 9 and 10 leading to and from the cooler as being connected at substantially diametrically opposite points to the container, and for many kinds of work this is entirely satisfactory. There are other kinds of work, however, for which this is not the most advantageous arrangement, for example, in the copper brazing of parts which are placed one over the other in the container and where the center portion of each part is more massive than its peripheral portion. Where such is the case, I find it preferable to deliver the gas from the cooler to the container at some central point from which the gas flows first over the massive portion of the work and then over the lighter portion. To more effectively direct the cool gas baffles of any suitable character may be employed. In Fig. 2 is shown a construction suitable for the last-mentioned class of work, 1 indicates the heat-insulated container which is provided with suitable heating means as before, and 20 a brick work foundation. 21 indicates the work or parts to be brazed or otherwise treated which may for example, be turbine diaphragms or wheels which are more massive in the center than at the periphery. The parts may be supported within the container in any suitable manner. The gas from the cooler enters the container by the conduit 10 and flows directly downward striking the work at the center where the mass is greatest. Where the mass is greatest at the periphery a conical deflector or baffle 22 is preferably employed to deflect the gas from the center toward the periphery. In the brick work is a conduit 23 which is connected to the conduit 9 leading to the pump associated with the cooler. Above the opening of the conduit 23 is a baffle plate 24 which serves to direct the gas from the center outwardly and thus prevent it from shunting more or less directly

from the inlet to the outlet. By the use of the means described, the parts within the container may be cooled in such manner as to avoid undue strains in the parts as they are cooled.

I particularly wish to emphasize the fact that whereas the reducing gas was formerly used for one purpose only, i. e. to assist in carrying out a metallurgical process, it is now used not only for that purpose, but also to reduce the temperature of the furnace and of the work or charge contained therein. It is also to be noted that the use of said gas prevents the entrance of air to the furnace during both operations.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. The method of carrying out metallurgical operations in an enclosed space which consists in heating a charge in said space in a non-oxidizing atmosphere to a working temperature, and then cooling the charge rapidly while still closed off from the outside atmosphere.

2. The method of carrying out operations at high temperature in an enclosed space which comprises confining a non-oxidizing gas in said space while a charge therein is subjected to a working temperature, and thereafter circulating said gas between said space and a zone maintained at a lower temperature thereby cooling the charge.

3. The method of operating a closed furnace which consists in heating a charge in the furnace in the presence of a non-oxidizing gas to a working temperature, and then cooling the charge rapidly in said furnace in the presence of said gas while maintaining the furnace closed to the outside atmosphere.

4. The method of operating a high temperature closed furnace which comprises charging the furnace, maintaining a supply of non-oxidizing gas within the furnace, heating the furnace and its contents to a working temperature, shutting off the supply of heat, establishing communication between the furnace and a cooler, and maintaining a circulation of said gas through the cooler and furnace to cool the latter and also its charge.

5. The method of brazing which consists in heating the parts to be joined in the presence of a non-oxidizing gas until they unite, and then cooling the parts rapidly in said gas to prevent further alloying of the metals.

6. The method of copper brazing which consists in heating the parts to be joined in an enclosed space in the presence of a reducing gas until they are united by the copper brazing metal, and then cooling the parts rapidly in said gas to prevent further alloying of the copper with the metal of the parts.

7. The method of copper brazing which consists in heating the parts to be joined in a closed furnace filled with a reducing gas until the parts are united by the copper  
5 brazing material, shutting off the supply of heat, and then circulating said gas from said furnace to an external cooling means and from said cooling means back to the furnace so as to cool the charge rapidly and thereby prevent further alloying of the 10 copper with the metal of the parts.

In witness whereof, I have hereunto set my hand this 9th day of August, 1924.

CHRISTIAN STEENSTRUP.