

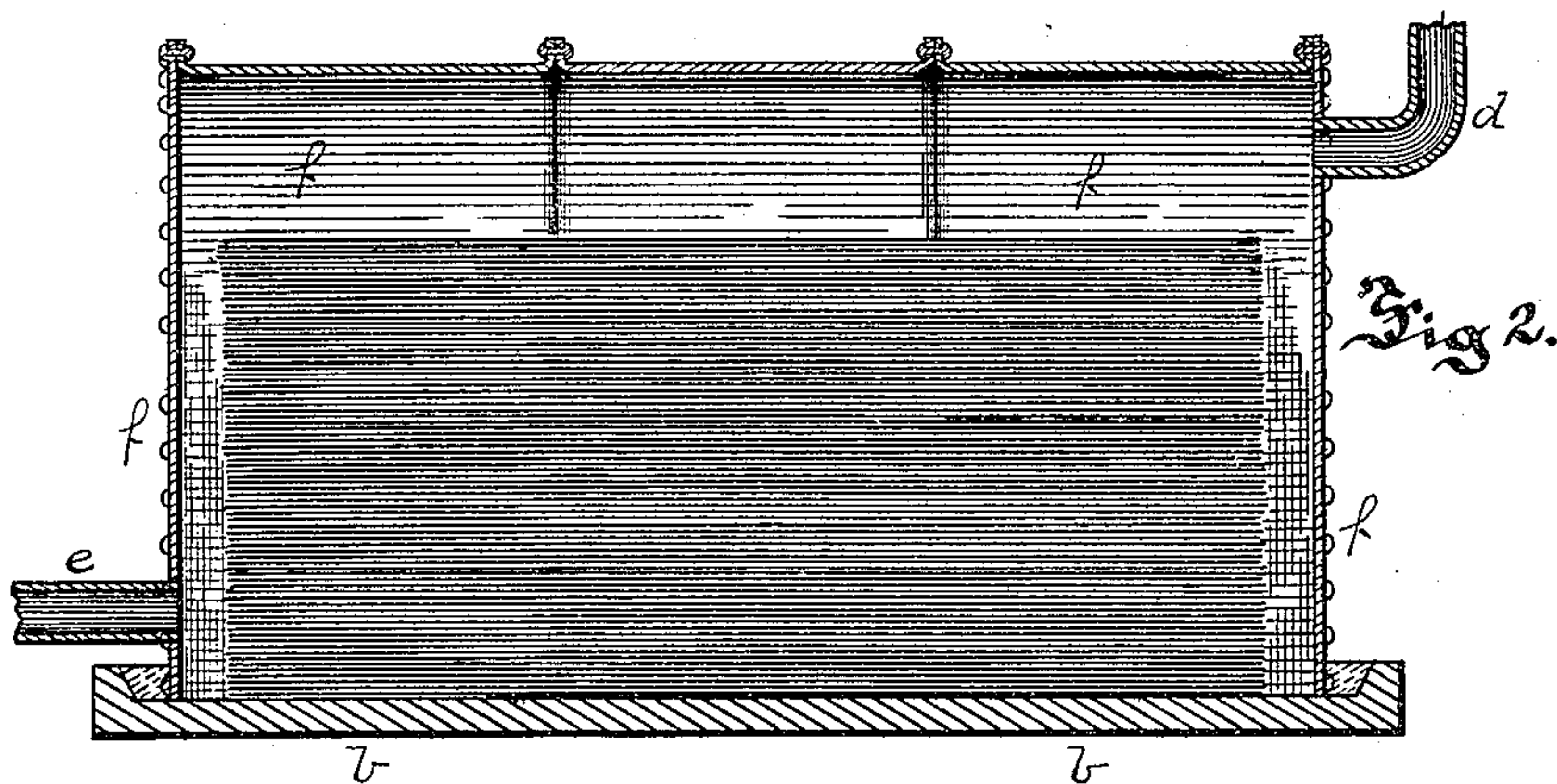
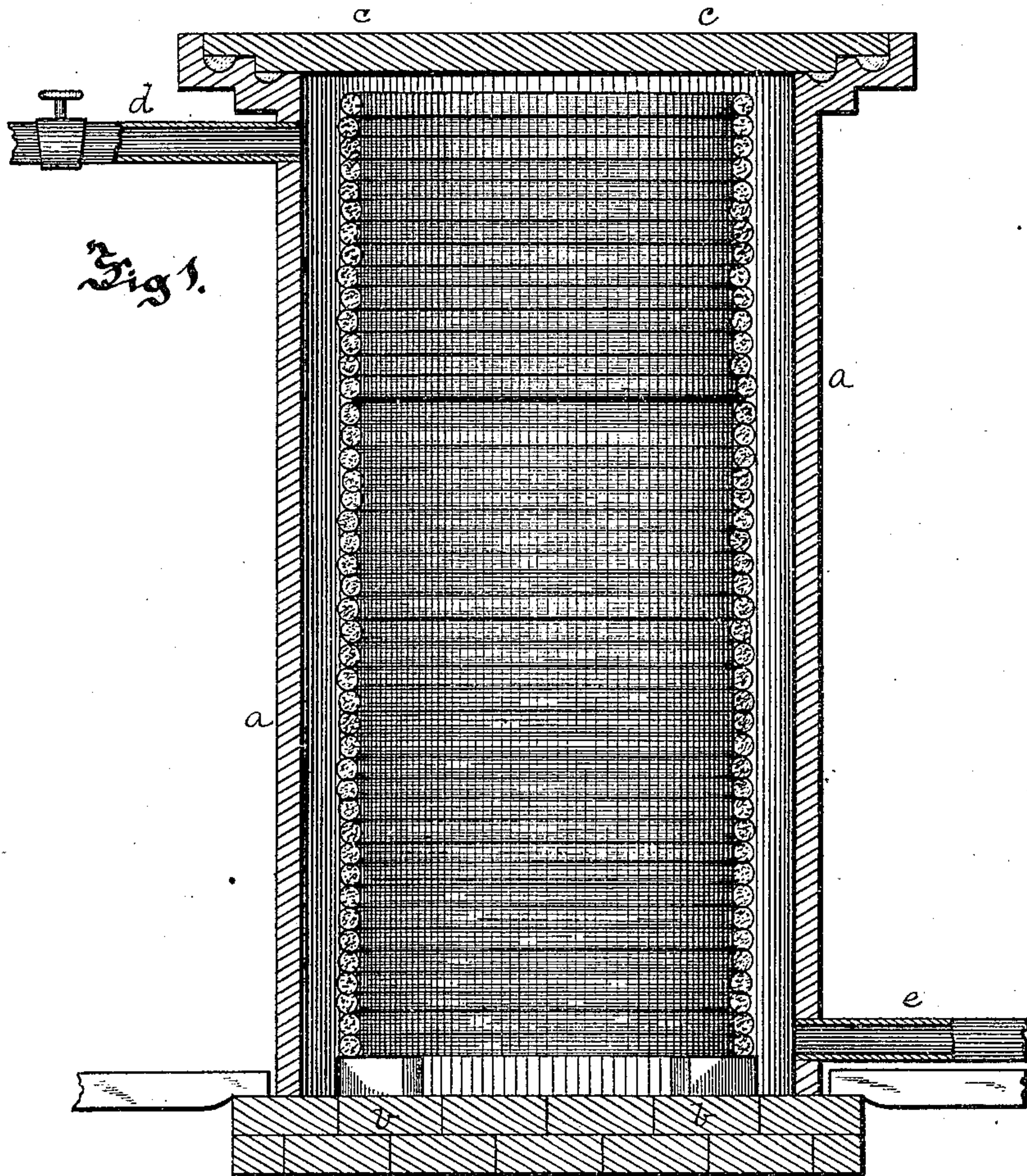
(No Model.)

E. V. McCANDLESS.

METHOD OF DEOXIDIZING THE SURFACE OF SHEET METAL.

No. 312,142.

Patented Feb. 10, 1885.



Witnesses.  
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# UNITED STATES PATENT OFFICE.

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## METHOD OF DEOXIDIZING THE SURFACE OF SHEET METAL.

SPECIFICATION forming part of Letters Patent No. 312,142, dated February 10, 1885.

Application filed December 6, 1884. (No specimens.)

*To all whom it may concern:*

Be it known that I, EDWARD V. McCANDLESS, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Method of Deoxidizing the Surface of Sheet Metal, Wire, and other Articles; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention has reference to the manufacture of sheet metal, wire, and other articles of wrought metal; and it relates specially to the reduction of the coating of oxide or scale formed on these articles during the process of manufacture. It is well known that in the manufacture of sheet metal a coating of scale or oxide of varying thickness is formed on the surface thereof, and during the process of annealing, unless great care be taken to prevent the entrance of air into the annealing-box, this oxide coating increases in thickness. In the manufacture of polished sheet-iron, or in coating the sheet-iron with zinc and the kindred metals or alloys, it is necessary to remove this oxide coating by immersion in an acid bath, in which the scale or oxide is gradually eaten off, this being commonly termed "pickling," and subsequently to protect the wet sheets from reoxidation by washing and immediate immersion in a lime bath until they are further treated. In the manufacture of wire the rods from which the wire is drawn have this coating of oxide or scale, the scale being increased in thickness in the annealing of the rods, it thus requiring pickling before the first drawing of the wire, and as the art is generally practiced the pickling of the wire after each annealing, for the reason that the oxide or scale formed thereon in annealing prevents the even drawing of the wire, and renders the surface imperfect. In this pickling process the acid enters into the pores of the metal, and cannot be entirely removed even with the most thorough washing, and it gradually rusts out the metal, the pickling in this way deteriorating the quality of the metal. The average cost of pickling wire during its manufacture from rods is about three to five dollars per ton, and the metal eaten off and wasted by

the pickling process is about two to five per cent. In drawing the wire it is also necessary to coat it with grease, wax, or like lubricant, thus adding to the expense of its manufacture.

The object of my invention is to overcome these difficulties in the manufacture of these articles, and to impart to them a fine metallic surface.

It consists, essentially, in inclosing the articles to be treated within a suitable air-tight box or receptacle, and raising them to a high heat, and then passing through it a current of natural gas, or equivalent deoxidizing gas—such as hydrogen gas—and afterward cooling the treated metals by passing through the receptacle a current of such gas in a cold state. By this process the oxygen of the scale or coating unites with the gas carried through the box, and the gas thus deoxidizes the scale and reduces it to a metallic state, causing the union of the reduced scale with the body of the metal, and forming thereon a smooth and bright surface of pure metal, which can be compacted and spread evenly over the body of the metal by cold-rolling, and which forms a fine smooth surface for the wire-drawing, overcoming the necessity of pickling, while it provides a metallic surface free from oxygen, ready to receive and hold any metallic coating employed to protect the metal thereof—such as zinc, tin, lead, or calamine alloy.

To enable others skilled in the art to make and use my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a vertical section of a box suitable for carrying out my invention in the treatment of wire, and Fig. 2 is a like view of a box for the treatment of sheet metal.

The box in which my improved method is employed in treating wire is made of cast or wrought iron, having the body *a*, base *b*, and lid *c*, and boxes of similar construction are employed in treating other articles, such as coiled strips. The box employed in treating sheet-iron is generally formed of a wrought-iron cover, *f*, formed of plates riveted together, the cover fitting on a base having a sealing of



sand around it. They are made practically air-tight by any suitable means, such as sand-joints at the lid and base, and are heated in any suitable furnace of such construction as to obtain an even and steady heat. The natural gas is conducted to the box through one or more pipes, *d*, entering it through or close to the top thereof, and the gas passing from the box close to the base thereof through one or more pipes, *e*. The gas is caused to pass through the box in a downward direction, to exhaust the air from the box, as the gas is of much lighter specific gravity, and so forces out the air, exhausting it completely, whereas if it rose through the box it might pass through the air and a portion thereof remain.

The wire, sheets, or like articles to be treated are placed within the box in any suitable way, the wire coils being generally piled as illustrated in Fig. 1, the sheets being laid in packs, as illustrated in Fig. 2, the sheets being separated by a thin sprinkling of powdered charcoal, if desired, and the box is then raised to a proper heat, it being necessary that the articles to be treated be raised at least to a bright-red heat. While they are at this heat the deoxidizing-gas is admitted to the box, and passes in a downward current through it. The gas preferred by me for the purpose is what is termed "natural" gas, being obtained through Artesian wells in certain districts, and is carried through pipes to the places required for use. It is exceedingly inexpensive, the only cost being for drilling and piping. It is composed of hydrogen and carbon, its general formula being about as follows: marsh gas, ( $\text{CH}_4$ ), ninety-five per cent.; hydrogen, two per cent.; carbonic acid, one-half of one per cent.; carbonic oxide, one-half of one per cent.; nitrogen, one per cent.; oxygen, one per cent., its general chemical name being carbureted hydrogen. The natural gas is exceedingly light and penetrating, and will pass between the sheets of iron or steel even when a large number are piled or packed within the box, so that the entire surfaces of the sheets are subjected to its action. Instead of the natural gas a current of hydrogen gas may be employed in the same manner, or hydrocarbon gas produced from petroleum. As the metal is at a deoxidizing heat, the oxygen of the scale or metallic oxide on the surface of the metal unites with the hydrogen and carbon of the gas and passes off from the treating-box as steam and carbonic acid or carbonic oxide.

In order to prevent the oxidation of the metal while it is being raised to the required temperature I prefer to pass through the box a gentle current of the natural gas sufficient to drive out the air and envelope the metal in a non-oxidizing atmosphere, and, as soon as the proper temperature is reached, to increase the current of gas to reduce the surface oxide, as before described. After the scale is reduced to metallic iron the box containing the articles treated may be withdrawn and al-

lowed to cool, care being taken to prevent the entrance of air. I prefer, however, to cool the articles below an oxidizing temperature by continuing through the box the current of natural gas, the normal temperature of which is about 40° Fahrenheit, the gas acting to rapidly cool the articles treated, and at the same time preventing the entrance of any air. This may be done by withdrawing the fire or cutting off the heat therefrom and continuing the current of gas through it, or by withdrawing the box from the furnace and making connections from another gas-pipe to it.

The sheet metal, wire, or other articles treated according to my invention have a bright metallic surface, silvery in color and almost as bright as tin-plate, the entire surface oxide being reduced to a metallic state and firmly united with the body of the metal. Where the scale or surface oxide has been formed in irregular flakes on the surface of the metal by cold-rolling the sheet or bar, the reduced metallic coating or surface, being soft and ductile, can be spread over the article, forming a smooth surface finish. The articles treated in this manner are not so liable to oxidation as the ordinary iron or steel and can consequently be employed without protective metallic coating for many purposes for which galvanized and like coated metal has been considered necessary.

In the manufacture of galvanized, tinned, or calaminated sheet metal or wire the treated metal having the surface oxide reduced, as above described, can be coated with the metals or alloys without the previous pickling, the surface of the metal forming a fine surface for the metals to adhere to, as the reduced surface is somewhat porous, which assists in holding the metal.

In the manufacture of wire the rods and coils may be treated, as above described, instead of pickling and coating with a lubricant, and the reduced surface-coating forms a fine smooth surface for drawing the wire, the reduced metal being compacted on the surface of the metal and drawn out with it. The wire may be treated in this manner either in connection with the ordinary annealing process to render it ductile for further drawing, the current of gas being carried through the ordinary annealing-pot subsequent to the annealing of the wire, and, if desired, a slight current during the annealing, to prevent oxidation, or after the annealing it may be placed in a separate pot and brought more rapidly to the proper heat for reducing the scale thereon. The former way is preferred, as it to some extent prevents the formation of the scale. Sheets and other articles may also be treated in connection with annealing, if desired.

In the manufacture of the sheet metal, wire, and other articles, I am thus enabled to save the cost of pickling and cleaning as well as prevent the loss of the metal eaten off by the acid in pickling. I also preclude the liability



of injury to the metal by reason of the acid treatment as before referred to, this being of great importance, as it prevents the deterioration of the metals, or the corroding of the metal under the surface of the protective coating employed therewith.

What I claim as my invention, and desire to secure by Letters Patent, is—

10 The method herein described of reducing the scale or oxidized surfaces of iron or steel to a metallic state, consisting in inclosing the articles in an air-tight receptacle, raising them

to a reducing temperature, passing through the receptacle a current of natural gas or other deoxidizing-gas, and cooling the treated metals by passing through the receptacle a current of such gas in a cold state, substantially as set forth. 15

In testimony whereof I, the said EDWARD V. McCANDLESS, have hereunto set my hand.

EDWARD V. McCANDLESS.

Witnesses:

JAMES I. KAY,  
JAS. M. COOKE.