

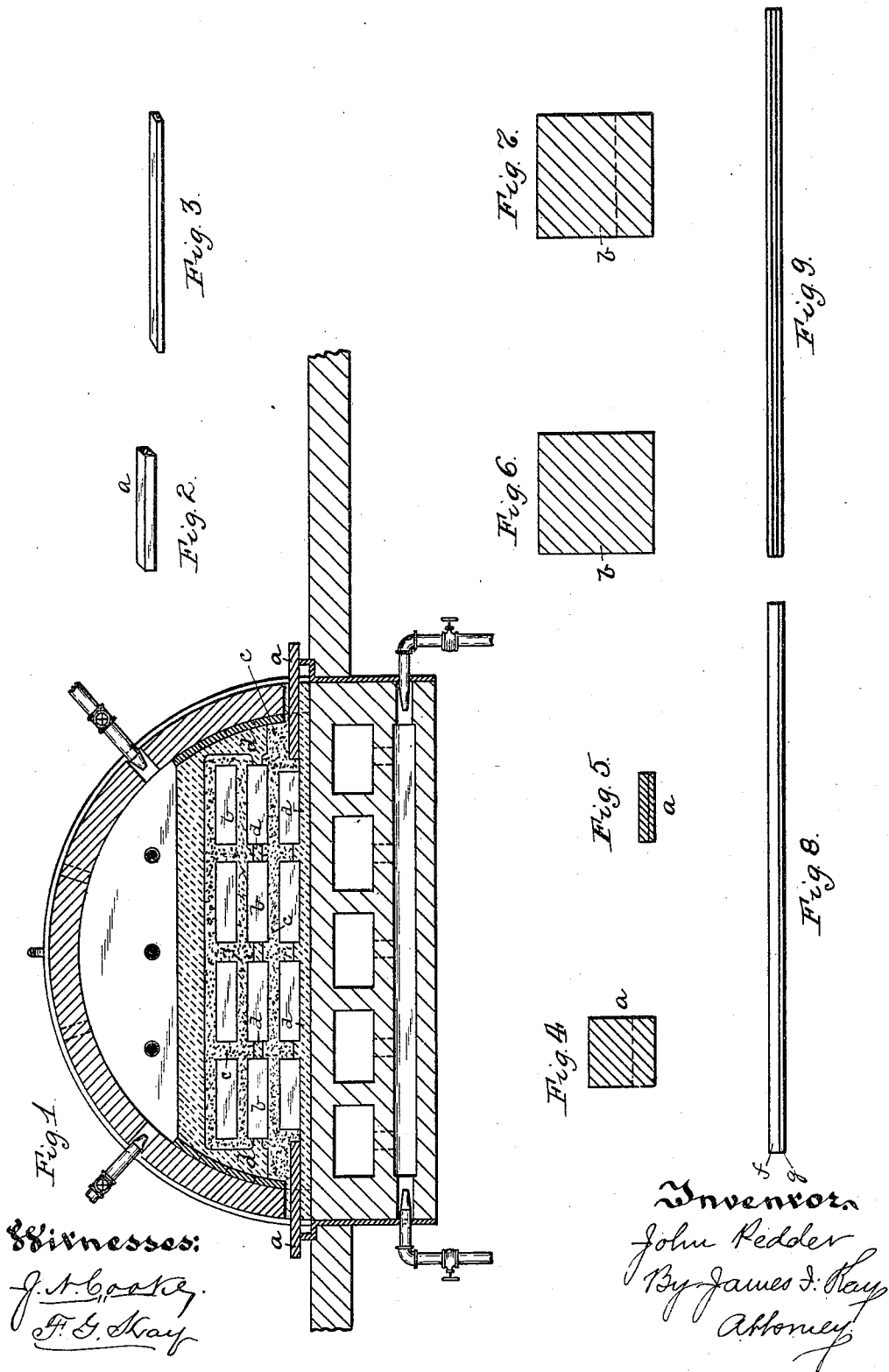
(No Model.)

J. PEDDER.

METHOD OF TESTING THE CONDITION OF STEEL.

No. 461,618.

Patented Oct. 20, 1891.



UNITED STATES PATENT OFFICE.

JOHN PEDDER, OF PITTSBURG, PENNSYLVANIA.

METHOD OF TESTING THE CONDITION OF STEEL.

SPECIFICATION forming part of Letters Patent No. 461,618, dated October 20, 1891.

Application filed March 15, 1890. Serial No. 343,972. (No model.)

To all whom it may concern:

Be it known that I, JOHN PEDDER, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Methods of Testing the Condition of Steels in Forming Plates having Different Layers of Carbon; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to a method of testing the condition of steel in the form of ingots, blooms, or other shapes—such as slabs, heavy armor, plates, &c.—during the well-known process of converting them into plates or bars having different layers of carbon by carburizing or decarburizing, and commonly known as the cementation process. The practice of inserting test-bars into the cementation-furnace and withdrawing them from time to time to determine by an examination of the surface and fracture of the bar the progress of the carburization of the contents of the furnace, has long been employed in connection with the cementation process. From the manner in which this process is now carried on it is impossible, however, to determine with any great degree of accuracy what will be the character of the plates rolled from the ingots, blooms, or slabs with which the furnace is charged. This is due to the fact that though part has absorbed the carbon and part has not, the grain of the metal remains the same and the only change indicated is in the appearance of the grain, which is exceedingly hard to distinguish, while an examination of the fracture of a test-bar shows such a gradual change from the soft to the hard steel that there are no clearly-defined lines of demarkation by which to determine with any accuracy whether the finished plates will contain the layers of differently carburized metal in the proportion desired.

To bring out clearly the different layers of carbon in the test-bars and thus determine the condition of the charge in the furnace is the object of my invention.

It consists, generally stated, in inserting within the treating-furnace the ingots, blooms, or other shapes to be treated, and in addition thereto test-bars of determined size relative to such ingots, blooms, or other shapes to be treated, exposing them to the action of the

treating material, withdrawing one of these test-bars from time to time and reducing it to plate, breaking the plate, and by such fracture determining the condition of the steel under treatment, it being found that in the reduction of the test-bar to plate the portion of the bar containing the different proportions of carbon are acted on differently and a clearly-defined line thus developed between the soft and hard steel, which indicates at once by the fracture of the plate the depth the treatment has extended into the body of metal.

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

Figure 1 represents a section of a furnace with test-bars exposed to the treating material. Fig. 2 is a view of a bar removed from the furnace. Fig. 3 shows the bar reduced by rolling to plate. Fig. 4 is an enlarged section of the bar. Fig. 5 is a cross-section of the plate. Fig. 6 is a view of the bloom to be treated. Fig. 7 is a view of the bloom carburized, and Figs. 8 and 9 are edge views of the carburized plate.

Like letters of reference indicate like parts in each.

My invention may be practiced in connection with any of the ordinary cementation-furnaces for the treating of ingots, blooms, slabs, or other shapes, hereinafter referred to under the single term "bloom."

The trial or test bar *a* is of a size determined relative to the blooms to be carburized, and for convenience of illustration let it be assumed that the test-bar *a* is two inches square in cross-section and that the blooms to be carburized, as shown in Fig. 6, are four inches thick, it being understood that the test-bar and blooms are of the same grade of steel. Assume, in the first place, that it is desired to carburize only one face of the bloom *b* for a depth of two inches, so that when reduced to plate the finished plate will have a hard and a soft face. The furnace is charged with the blooms *b*, arranged with only one face exposed to the carburizing material *c*, the other face, together with part or all of the sides and ends, being protected by loam, as at *d*, to prevent the action of the carbon thereon. The

test-bars *a* are arranged, as before, with only one face exposed to the carburizing material. Upon withdrawing from time to time one of said test-bars *a*, reducing it to plate in the rolls, and ascertaining from its fracture that it has been completely carburized all the way through, it follows that the bloom *b* has also been carburized for a depth of two inches, or half its thickness, and that when withdrawn from the furnace and reduced to plate it will present in section a plate having two clearly-defined layers of carbon, the thickness of the layers depending on the relative thickness of the bloom and test-bar and the depth of carburization desired, as ascertained by the test-bar, the two layers being indicated at *f g*, as shown in Fig. 8. In the second place, let it be assumed that it is desired to produce what is commonly known as "soft-center" steel—that is, to produce a bloom which when reduced to plate will furnish a plate having its faces carburized for a certain depth proportionate to the thickness of the layers of carbon desired in the finished plate. Taking the bloom *b* for illustration, if both its faces are carburized for an inch and a half, leaving an inch in the center of soft steel, the plate rolled from it will have its faces carburized for a proportional depth with a proportional center of soft steel. To bring about this result it will be necessary to carburize the two-inch test-bar on one face for a depth of an inch and a half, leaving the remaining half inch in its original state, so that upon reducing said bar to plate by rolling and examining its fracture, the proportion of hard steel to soft will be in the same ratio as in the bar before reduction. The furnace is charged with blooms *b*, arranged with both faces exposed to the carburizing material *c*, their sides and ends being protected by the loam *d*. The test-bars are inserted within the furnace with one face thereof exposed to the carburizing material, and are withdrawn from time to time and reduced to plate to test the condition of the blooms, as in the cases hereinbefore mentioned. One of the test-bars is withdrawn from the furnace from time to time and is rolled to plate and broken to expose the fracture thereof, and it is found that as the carbon gradually enters the metal the depth of penetration will be exposed in the plates rolled from the test-bars, the softer steel being compacted to a greater degree in rolling than the harder steel and differing to some extent in carbon therefrom and the line between the two being clearly defined where it could not be distinguished in the test-bar before rolling. If an examination of the fracture of one of the bars reduced

to plate discloses a plate, as shown in Fig. 5, with one face carburized to the depth desired in the finished plates to be rolled from the blooms, while the other face remains in its original state of soft steel, which is readily perceptible on account of the clearly defined line developed between the soft and hard metals by the reduction of the test bar to plate, the inference may be drawn that the four-inch bloom *b* with both faces exposed to the carburizing material will have both its faces carburized for the same depth as the test-bar *a*. As the test-bar *a* was not carburized all the way through, so the faces of the bloom *b* have been carburized only a certain depth, leaving, as was suggested, about an inch of soft steel in the center, so that when said bloom *b* is reduced to plate the fracture will show the layers of carbon in the same proportion as shown in the fracture of the plate rolled from the test-bar *a* and as illustrated in Fig. 5.

All reference to the dimensions of the test bars and ingots in the specification have only been made for convenience of illustration, and it is apparent that the time and manner of treatment are to be varied according to the relative sizes of the bars and ingots and the degree of carburization desired.

By this method of testing the condition of the ingots during the progress of cementation the lines of demarkation between the different layers of carbon are brought out so clearly in the rolled-plate bars that the condition of the ingots may be accurately inferred and a very definite idea of the character of the finished plates rolled from said ingots may be obtained.

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

The herein-described method of testing the condition of steels in forming plates or other shapes of different layers of carbon, consisting in inserting within the treating-furnace the ingots, blooms, or other shapes to be treated and in addition thereto test-bars of a determined size relative to such ingots, blooms, or other shapes, exposing them to the action of the treating material, withdrawing one of these test-bars from time to time and reducing it to plate, breaking the plate, and by such fracture determining the condition of the steel under treatment, substantially as and for the purposes set forth.

In testimony whereof I, the said JOHN PEDDER, have hereunto set my hand.

JOHN PEDDER.

Witnesses:

ROBT. D. TOTTEN,
J. N. COOKE.