No. 773,034. PATENTED OCT. 25, 1904.

T. G. SELLECK.

PROCESS OF TREATING STEEL.

APPLICATION FILED AUG. 22, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 2.

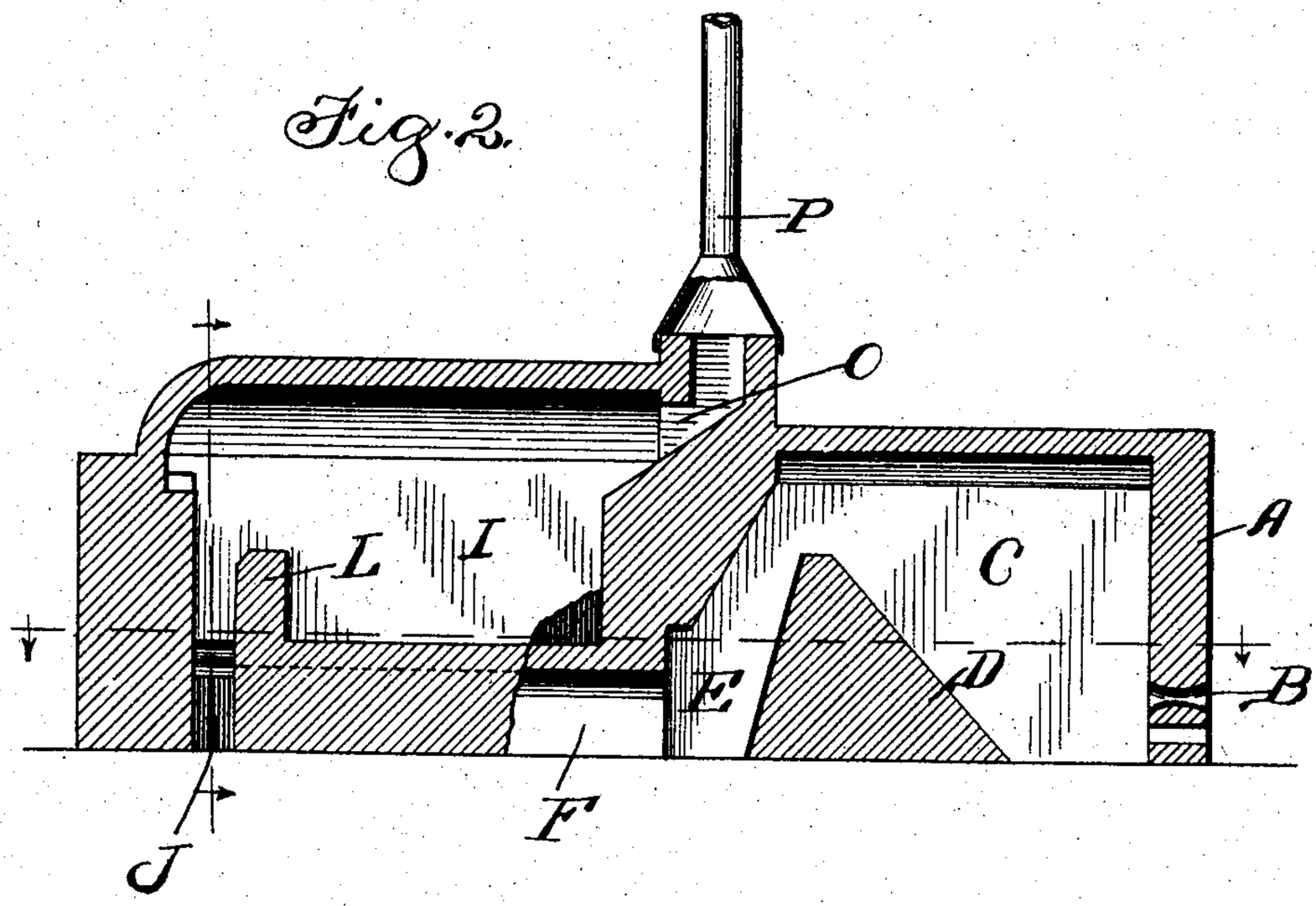
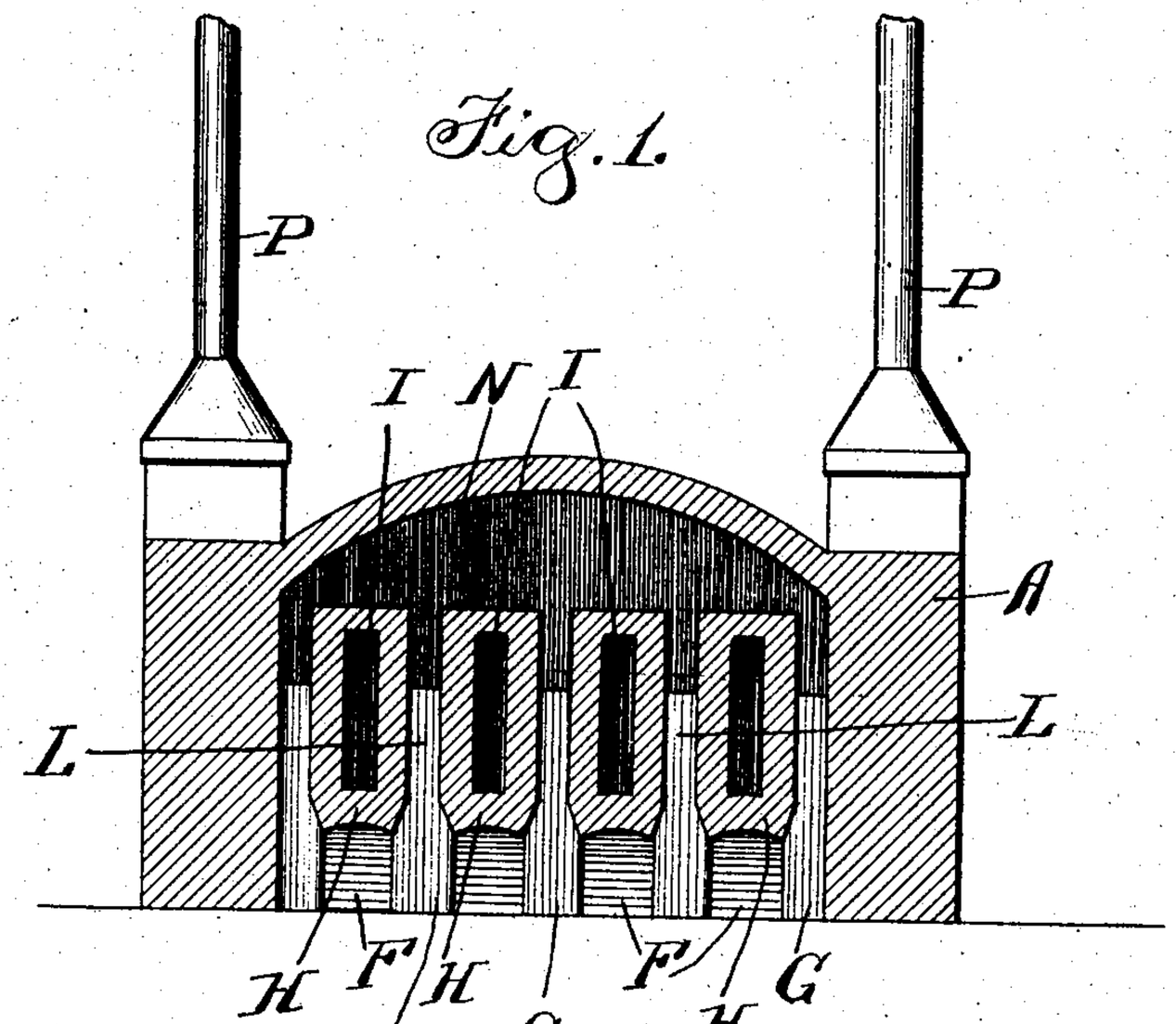


Fig. 1.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

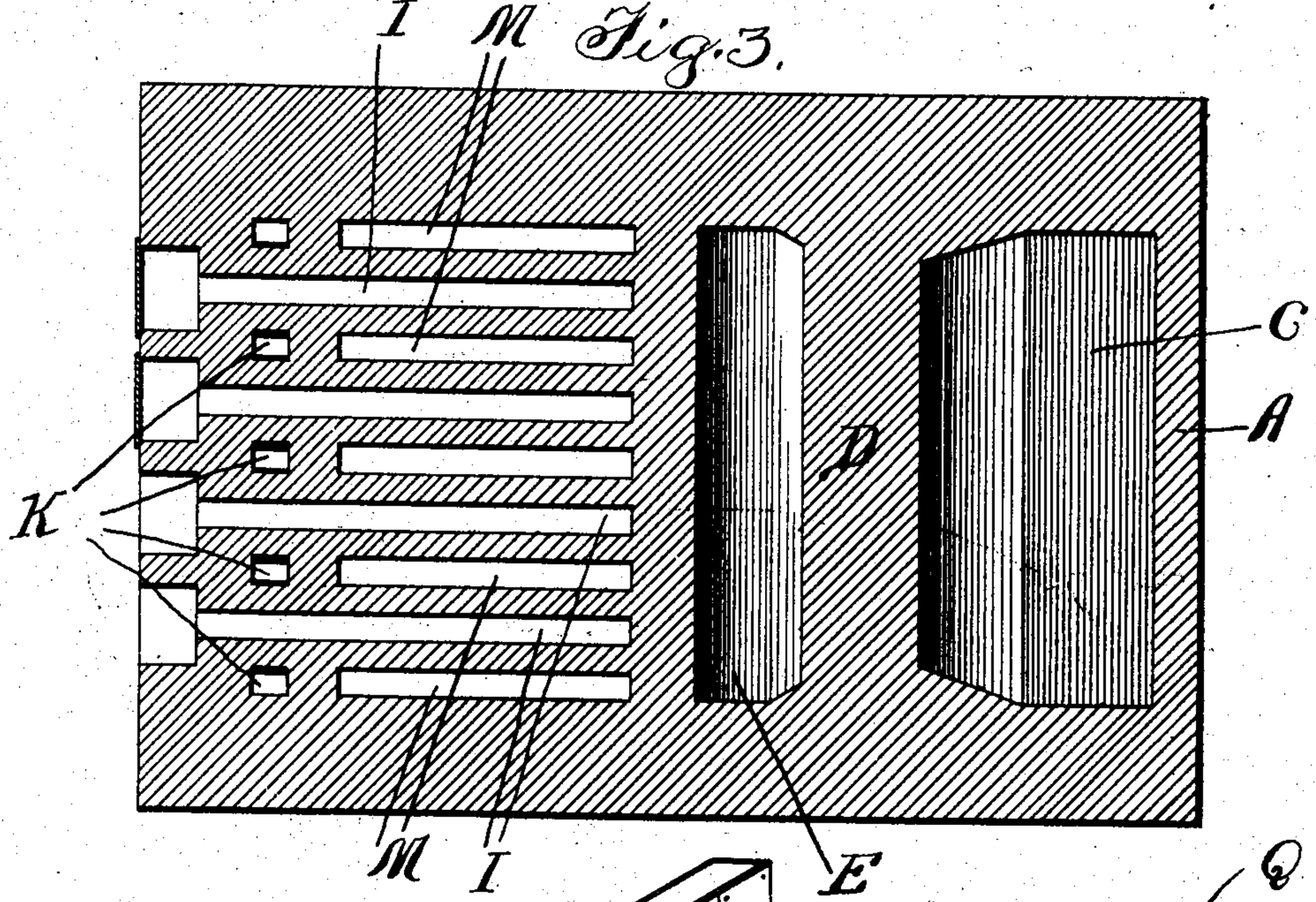

Fig. 4.

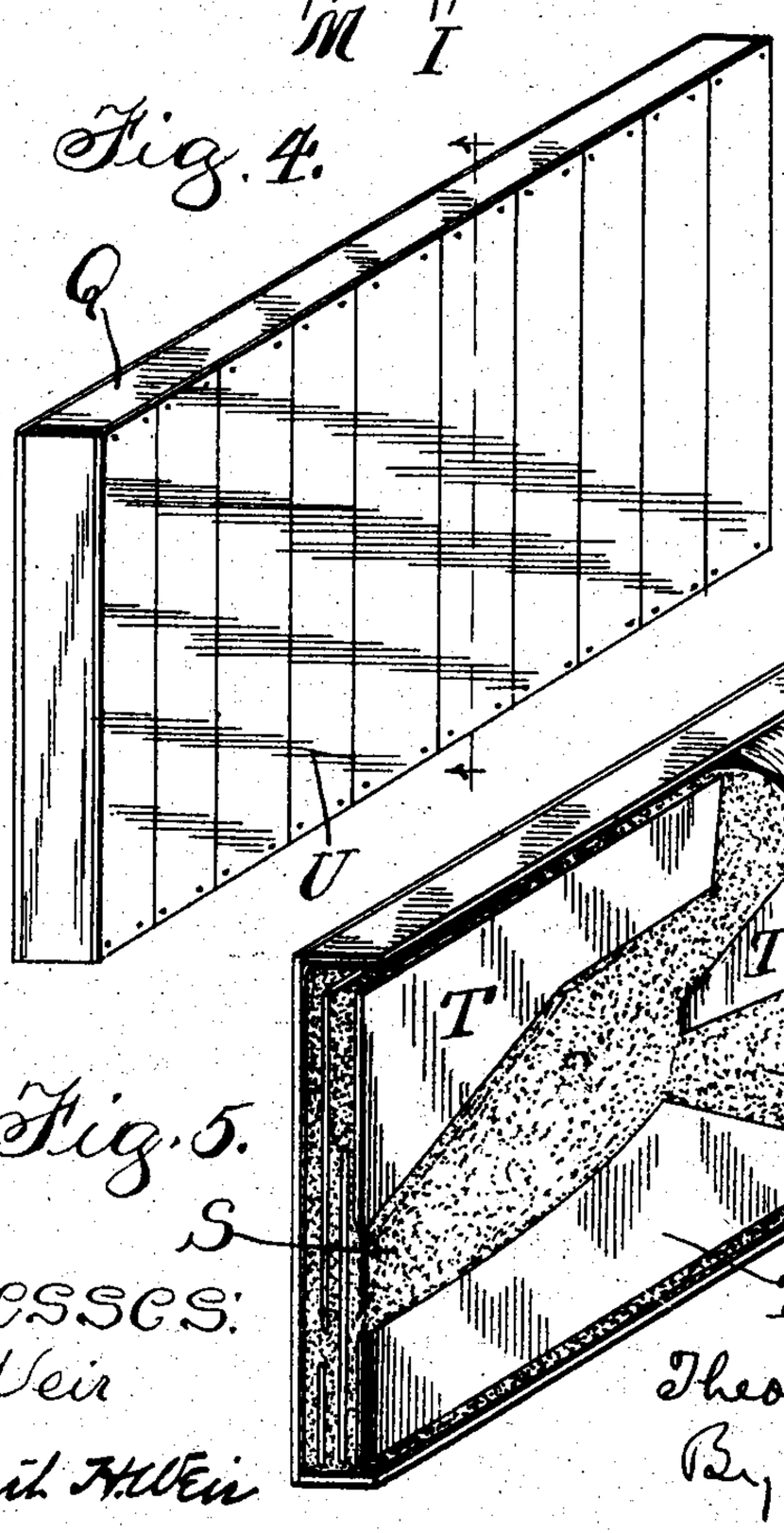

Fig. 6.

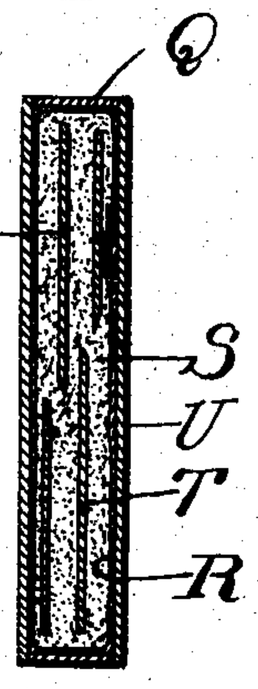

Fig. 5.

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PHOTO-LITHOGRAPHED BY SACHETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

No. 773,034. Patented October 25, 1904.

UNITED STATES PATENT OFFICE.

THEODORE G. SELLECK, OF CHICAGO, ILLINOIS, ASSIGNOR TO ACME STEEL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PROCESS OF TREATING STEEL.

SPECIFICATION forming part of Letters Patent No. 773,034, dated October 25, 1904.

Application filed August 22, 1903. Serial No. 170,388. (No specimens.)

To all whom it may concern:

Be it known that I, THEODORE G. SELLECK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Processes of Treating Steel, of which the following is a specification.

My invention relates to improvements in methods of producing soft-center steel in which a low-carbon or decarbonized steel is packed between layers of a carbonizing compound and is then subjected to a prolonged and a high degree of heat until the surface of the steel has combined with the carbon in the surrounding compound to such a depth as may be desired for any given purpose.

The object of my invention is to facilitate the rapid production of such steel and to produce such steel in which the carbonizing process shall be practically uniform throughout the entire surface of the steel when the steel is removed from the converting-furnace and in which after final treatment the steel shall be free from spots of varying hardness or brittleness.

These and such other objects as may hereinafter appear are attained by the process hereinafter described, which process may be conveniently practiced with the apparatus illustrated in the accompanying drawings, in which—

Figure 1 is a sectional view of a furnace on the line 1 1 of Fig. 2 looking in the direction indicated by the arrows. Fig. 2 is a longitudinal sectional view thereof. Fig. 3 is a sectional plan view on the line 3 3 of Fig. 1 looking in the direction indicated by the arrows. Fig. 4 is a perspective view of a charge of steel and carbonizing mixture ready for insertion in one of the boxes of the furnace. Fig. 5 is a perspective view of such charge with the envelop partly removed, and Fig. 6 is a cross-sectional view of such package and its contents.

Like letters of reference indicate the same parts in the several figures of the drawings.

In the form of furnace shown the rear wall of the furnace A is provided with an oil-burner opening B, communicating with the combustion-chamber C. Arranged at the back of the combustion-chamber C is the deflecting-wall D, in front of which is the transverse flue E. Leading forwardly from the flue E are longitudinal flues F, separated by piers G, which support arches H, said arches constituting the tops of the flues F and the bottoms of the boxes I. At their forward end said flues communicate with another transverse flue J, which communicates with vertical flues K, which lead over baffle-walls L into longitudinal flues M, arranged between the boxes, the space over the boxes and in free communication with said longitudinal flues constituting a chamber or horizontal flue N, from which flues O lead into the chimneys P for the escape of the waste product of combustion. It will thus be seen that a jet of flame entering the combustion-chamber is deflected by the deflecting-wall and is broken up into a sheet of flame, which passes forwardly through the longitudinal flues upwardly and back over and between the boxes, thus keeping the boxes at all times surrounded by a mass of live flame, which will insure a constant and substantially uniform high degree of heat in all parts of said boxes.

Figs. 4, 5, and 6 show a convenient form of packing the charges of steel for insertion in the boxes. Q is a thin wooden box roughly made, within which is laid a sheet of paper R, upon which is then laid a layer of carbonaceous compound S. Upon this compound is laid a layer of the pieces of steel T which are to be converted. The steel is then covered with another layer of the carbonaceous compound, other layers of steel are added, and so on until the package is filled, when the free edges of the paper are folded over the layers of steel and carbonaceous compound and the passage is closed by loosely nailing on strips U.

It is understood in this art that for the purpose of converting the soft steel to soft-center steel it is necessary that the pieces of steel shall be packed in and surrounded by layers of a highly-carbonaceous compound and that these layers of carbon shall be held in place

surrounding the steel during the converting process. It will thus be seen that in the manner described the pieces of steel to be converted are effectively surrounded with the carbonaceous compound and the compound is effectively held in place in a very simple and inexpensive manner, the packages thus formed being of such a size as will be readily inserted within one of the boxes I, so as to be thoroughly inclosed therein. Obviously the carbon compound can be held in place as readily by other suitably-removable means, which may be used quite as well as the paper and wood shown and described.

It is the common practice in this art to pack the steel to be converted or the articles to be case-hardened into receptacles in the furnace before the furnace is heated, to then raise the furnace to the required temperature, which requires about a week of continuous heating, to maintain the furnace at such high temperature for the required length of time, to then allow the furnace to cool off, and to then remove the steel or steel articles from the compartments in the furnace. The objection to this method is the loss of time in heating and cooling the furnace and the fact that as the steel is inaccessible while the furnace is at its highest temperature the steel cannot be examined and tested before removing the entire charge from the furnace and the extent to which the process of conversion is gone cannot be known with any certainty. It is also a known practice to pack the steel or steel articles in metallic cases, which are inserted in compartments in the furnace; but this practice is also objectionable for the further reasons, first, that the metallic packages must be heated to a high degree before the requisite degree of heat reaches the steel packed therein, and, second, that this heating tends to destroy the packages and to thereby increase the cost of conversion to a prohibitive figure.

In the practice of my invention I preferaby use a furnace, such as that shown in the drawings, in which the boxes or compartments for removing the steel may be surrounded on all sides by live flame and which, owing to the fact that the boxes open at their forward ends through the front wall of the furnace, which open ends may be readily sealed and unsealed, may be charged and discharged without cooling the furnace. This construction enables me to keep the furnace at all times at a converting temperature, to examine and test the steel from time to time, to rapidly discharge the boxes of the furnace without reducing the temperature of the furnace, and to immediately recharge the same while the furnace is at the same high temperature, thereby causing the converting process to begin at once.

In preparing the charges of steel I pack the same between layers of carbonizing compound in packages which may be quickly removed after the charges have been inserted in the boxes of the furnace. This removal of the packages may be accomplished either by confining the charges by combustible means—such as wood, rope, or any other combustible package—or by inclosing the charges in packages which may be mechanically withdrawn, such as metallic sheets or envelops or the like. In practice I prefer packing the charges between layers of carbonizing compound in thin wooden boxes. These boxes may be very cheaply and hastily made and, if desired, may be lined with paper which surrounds the charges to confine the carbonizing compound, which might otherwise sift through the cracks in the boxes if the boxes are not made tight. I next insert the boxes containing the charges in the boxes of the converting-furnace, the wooden or like boxes containing the charges being pushed sufficiently far back into the brickwork boxes of the furnace to be substantially unaffected by the cooling which occurs immediately adjacent to the open ends of the brickwork boxes. When wooden or other combustible packages are used to inclose the charges, the intense heat of the furnace quickly destroys them and the charges are immediately subjected to a converting temperature. It is of course understood that immediately after the charges are inserted in the boxes of the furnace the open ends of the furnace-boxes are sealed in any suitable manner to prevent both the cooling and the active combustion which would result from the free access of air thereto. When there is reason to believe that the converting process has continued for a sufficiently long period, the outer ends of the furnace-boxes may be opened and test-bars removed and tested. Whenever the test-bars show that the hardening or conversion of the steel has proceeded to a sufficient extent, the furnace-boxes are discharged. The converted steel is next allowed to cool and is then annealed in an annealing-furnace. I have found, however, that where the steel is simply allowed to air cool and is then annealed there will frequently be found irregularly-distributed spots of irregular size which crack under the action of the shears or other tools, showing that these spots have been unduly hardened. Such brittle spots constitute defects which are fatal to the value of the metal for most purposes. Such defects appear to be due to the fact that when the charges are removed from the furnace particles of the carbonizing material adhere to the metal in more or less irregular spots and the converting action at such spots does not immediately cease. In any event I have found that by plunging the metal into water immediately as it is discharged from the converting ovens or boxes, then allowing it to cool, and then annealing it in an annealing-furnace I avoid these faulty spots and produce soft-center steel of uniform quality throughout.

In using the term "removable package" in

my specification and claims I refer to any package which may be removed from around the charges after they have been inserted in the furnace either by combustion or by mechanical means.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A process of converting steel, which comprises surrounding low-carbon steel with a carbonizing compound and packing the charge, so formed, within a removable package, conveying said package to a converting zone, and then removing the package from the charge contained therein while the charge is in the converting zone.

2. A process of converting steel, which comprises surrounding low-carbon steel with a carbonizing compound, inclosing the charge, so formed, within a removable package, conveying said package into a converting zone, and then removing the package by combustion from around the charge contained therein.

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