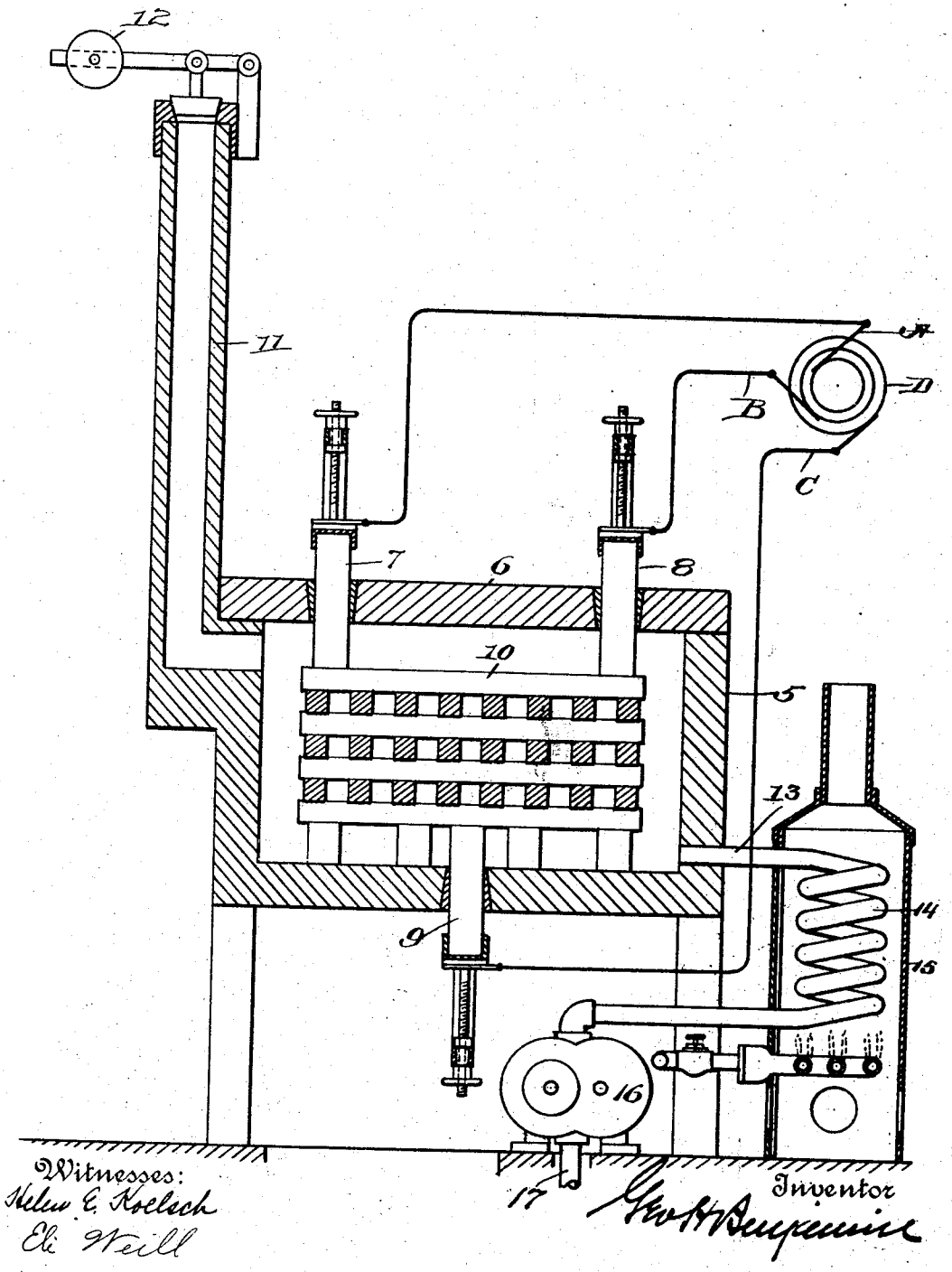
G. H. BENJAMIN.

ART OF MANUFACTURING CEMENT STEEL.

APPLICATION FILED DEC. 23, 1911.

1,054,817.

Patented Mar. 4, 1913.



UNITED STATES PATENT OFFICE.

GEORGE HILLARD BENJAMIN, OF NEW YORK, N. Y.

ART OF MANUFACTURING CEMENT-STEEL.

1,054,817. Specification of Letters Patent. Patented Mar. 4, 1913.

Application filed December 23, 1911. Serial No. 667,478.

To all whom it may concern:

Be it known that I, GEORGE HILLARD BENJAMIN, a citizen of the United States, residing at New York city, in the county and State of New York, have invented certain new and useful Improvements in the Art of Manufacturing Cement-Steel, of which the following is a specification.

My invention depends upon the observed fact, that if a gas or an olefiant body containing carbon, is disassociated in the presence of a body of iron heated to a high temperature by an electric current, and under conditions where atmospheric air cannot find access to the body of iron, the carbon set free (which is in a nascent condition) will combine with the iron.

The purpose of my invention is the production of a better grade of steel with more rapidity than is possible under the present methods employed.

The accompanying diagrammatic drawing will serve to illustrate such a furnace construction as may be employed in carrying my invention into effect.

I wish it understood that I do not in any wise limit myself to the character of the furnace employed, as such furnace will vary in construction in accordance with the character and form of the metal treated, and character of the gas or olefiant body introduced.

In the drawing: 5 represents the furnace, formed of a refractory material, provided with a removable cover 6. Arranged in the top of the furnace are electrodes 7—8, and in the bottom of the furnace an electrode 9, which are adjustable to compensate for wear. These electrodes are respectively connected to the brushes A, B, C, of a three phase dynamo electric machine D. I prefer to use a three phase machine as I find by so doing, that a more uniform heat can be obtained than in any other arrangement, although I wish it understood that I do not limit myself in any wise to the employment of a three phase current or to the disposition of the electrodes as shown. The electrodes are arranged to contact with puddle-bars 10, stacked in the furnace.

Connected with the top of the furnace 5, is a tall chimney 11, and on the top of the chimney, a weighted valve 12. Connected to the bottom of the furnace, is a pipe 13, which forms one end of a coil 14, located in a heater 15. The opposite end of this coil is connected to a pump 16, itself connected through a pipe 17, with any suitable source of gas or olefiant body containing carbon.

The general mode of operation employed is as follows: The electric current is turned on and the puddle-bars heated to a red heat. The gas or olefiant vapor is partially heated in the heater 15 and is then turned into the interior of the furnace and allowed to flow through the furnace, the valve 12 being open until all of the oxid on the surface of the iron is reduced. The valve 12 is then closed and the gas or olefiant vapor pumped into the furnace at a pressure, which pressure will depend upon the character of the metal treated. If the iron is in any sense porous, the pressure need not exceed 45 lbs. to the square inch. If the iron is dense, the pressure can be increased up to 300 lbs. to the square inch. I do not limit myself to the pressures stated, as the pressure may be anywhere from 15 lbs. to 300 lbs. to the square inch. When the valve is closed and the gas introduced, the temperature of the metal is increased by increasing the amount of current. The temperature may be maintained constant or varied, from a dull red heat to a point within a few degrees of the melting point of the metal. In practice I find it is preferable to heat the metal to a dull red heat for an hour, then increase the temperature of the metal to almost the melting point for ten minutes, and then lower to a dull red heat. The gas or olefiant vapor, when brought into contact with the highly heated metal, is disassociated into its elements, carbon and hydrogen. The carbon enters into combination with the iron, and the hydrogen (by reason of its specific gravity) rises to the top of the furnace and into the chimney 11, accumulating therein until the pressure is sufficient to open the valve 12, when the hydrogen flows out to be collected in any suitable receptacle (not shown). The purpose of raising the temperature of the metal above a dull red heat and above the disassociating point of the gas or olefiant body, is two-fold: (1) by reason of the heat imparted, to increase the molec-

ular vibration in the body of iron, and (2) to bring the iron into condition, by reason of which the carbon, as it combines with the iron, will sink into the body of the iron and thus carbonize the iron not only upon its surface, but at the interior of the bodies treated. It is found in practice, that after about eight hours of continuous heating, the iron will have absorbed approximately 5% carbon.

I may vary the treatment above described as follows: I may introduce into the furnace, boron tri-oxid and subject such boron tri-oxid and the iron to preliminary heating for the purpose of removing any iron oxid which may be present on the material to be treated. I may introduce into the furnace, carbon of a graphitic character, and subject the iron to the action of such carbon as well as the carbon separated from the gas or olefiant body. I may introduce into the furnace, a powdered halogen, such for instance as chlorin, fluorin, for the purpose of utilizing such a body as a catalytic agent to aid the chemical combination between the iron and carbon. I may (as ordinarily employed in the production of cement steel) introduce grinder's waste, alone or accompanied with graphitic carbon, and any other body or bodies which will promote combination.

I prefer to use an alternating current, for two reasons: (1) to produce the required heat, and (2) to set up a vibratory movement in the body of iron treated. In practice I have found a current of 25 cycles as suitable for the purpose, although I may use a current of a greater number of cycles.

It will be observed that by reason of the disassociation of the gas or olefiant vapor, both the carbon and hydrogen are in a nascent condition. Taking this fact in connection with the fact previously stated, to wit, that the iron is in molecular vibration by reason of heat and the transmitted current, the conditions are present for intimate and rapid combination between the carbon and the iron, which in fact results.

In this specification I have described the iron treated, as in the form of puddle-bars stacked. It will be understood by those skilled in the art, that the treatment above disclosed may be applied to iron in a molten condition, in which case, however, the temperatures would be varied to insure the fluidity of the iron.

While I cannot state it as a fact, it appears probable that a small percentage of the hydrogen set free, enters into combination with the iron and carbon.

The steel produced by the method above described is fine in grain, and has all the characteristics of fine cement steel. It also shows, on analysis, the presence of a small amount of hydrogen. The carbon associated with the steel is apparently converted under the high temperature, by the presence of the hydrogen, into graphitic carbon.

Having thus described my invention, I claim:

1. The herein described improvement in the art of manufacturing cement steel, which consists in disassociating a body containing carbon and hydrogen, in the presence of iron heated to a high temperature by an electric current and under conditions where it will not be subjected to the action of the atmosphere.

2. The herein described improvement in the art of manufacturing cement steel, which consists in disassociating a gaseous body of the CH group in the presence of iron heated to a high temperature by an electric current and under conditions where the atmosphere is excluded.

3. The herein described improvement in the art of manufacturing cement steel, which consists in subjecting a body of iron to the high temperature effects of a transmitted electric current, varying the temperature at intervals, and simultaneously subjecting said iron to the action of a gas of the CH group, while at the same time excluding the atmosphere.

4. The herein described improvement in the art of manufacturing cement steel, which consists in subjecting puddle-bars to the heating and vibratory effects of a transmitted polyphase current of electricity, and simultaneously to the action of a hydrocarbon body which will be disassociated by the heat of the metal, and preventing the access of atmospheric air to said body of iron.

5. The herein described improvement in the art of manufacturing cement steel, which consists in subjecting iron to the high temperature effects of a transmitted electric current, and simultaneously to the action of a gas of the CH group brought into contact with the iron under pressure, and under conditions where atmospheric air will be excluded.

6. The herein described improvement in the art of manufacturing cement steel, which consists in subjecting a body of iron to the action of an electric current of a character which will raise the temperature of the iron to a high degree and aid in establishing motion in the molecules of the iron, and simultaneously subjecting said iron to the action of a body from which carbon and hydrogen will be disassociated in a nascent condition, and continuing the heat until a definite percentage of carbon has been absorbed by the iron.

7. The herein described improvement in the art of manufacturing cement steel, which consists in subjecting a body of iron to the action of an electric current of a character which will raise the temperature of the iron to a high degree and aid in estab-

lishing motion in the molecules of the iron, and simultaneously subjecting said iron to the action of a body from which carbon and hydrogen will be disassociated in a nascent condition, and continuing the heat until a definite percentage of carbon and hydrogen has been combined with the iron.

In testimony whereof, I affix my signature, in the presence of two witnesses.

GEORGE HILLARD BENJAMIN.

Witnesses:
HELEN E. KOELSCH,
ELI WEILL.