(No Model.)

H. J. GRAF.

PROCESS OF MELTING IRON.

No. 485,927. Patented Nov. 8, 1892.

Fig. 1

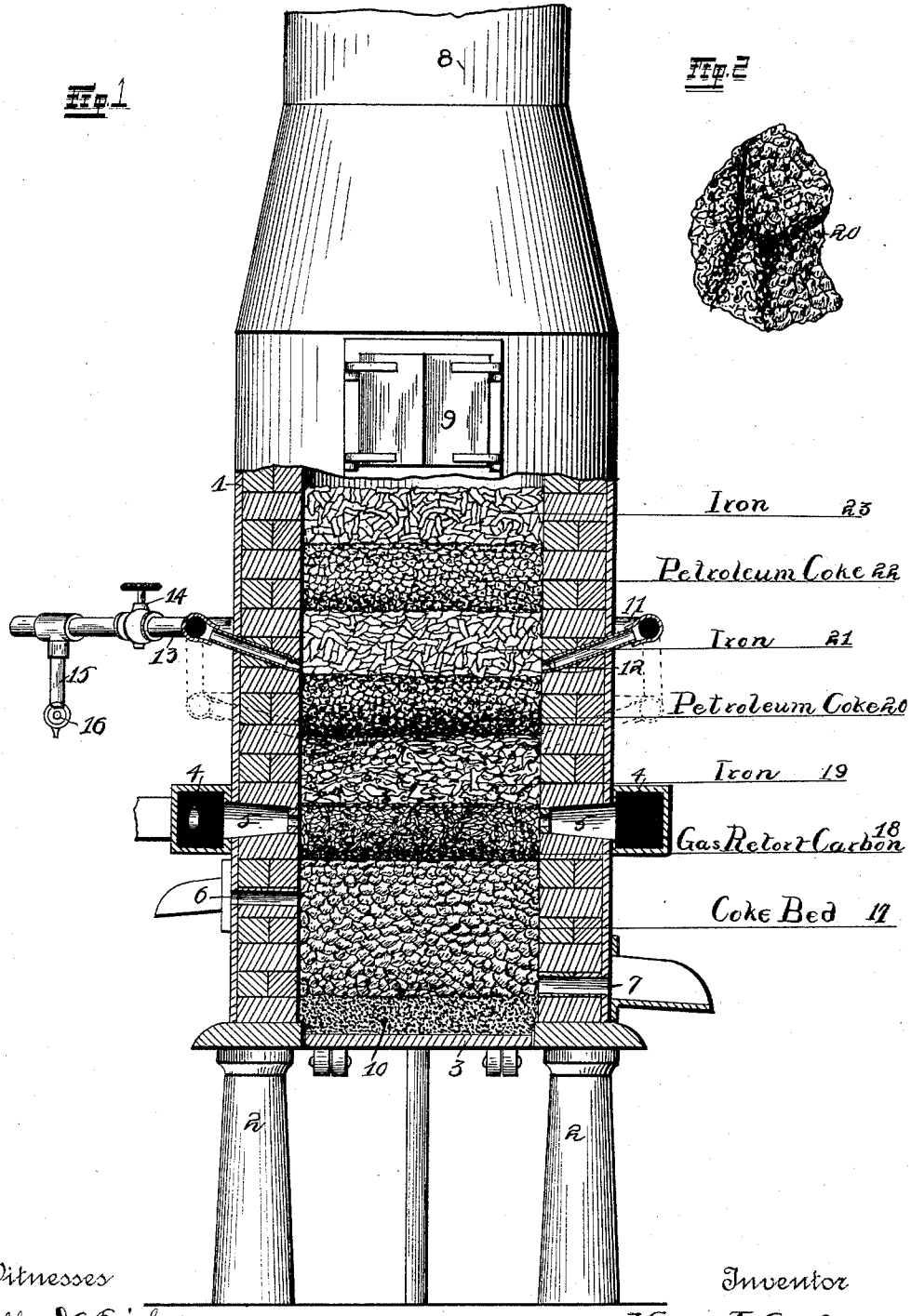

Fig. 2

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UNITED STATES PATENT OFFICE.

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PROCESS OF MELTING IRON.

SPECIFICATION forming part of Letters Patent No. 485,927, dated November 8, 1892.

Application filed June 22, 1892. Serial No. 437,589. (No model.)

To all whom it may concern:

Be it known that I, HENRY J. GRAF, of the city of St. Louis and State of Missouri, have invented certain new and useful Improvements in Processes of Melting Iron, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention has for its object to provide certain improvements in the process of remelting iron in cupola-furnaces; and it especially relates to improvements upon the process described in Letters Patent No. 454,209 issued to me June 16, 1891; and it consists in the arrangement, combination, and combustion of the materials constituting the charge, as will be more fully hereinafter described, and designated in the claim.

I will now proceed to describe more specifically the manner of carrying out my invention, and for facility in doing the same I have illustrated apparatus suitable therefor.

In the drawings, Figure 1 is a vertical section of an ordinary cupola-furnace, showing the position of the alternate layers of charging material. Fig. 2 is a perspective view of a detached and enlarged particle of petroleum-coke made use of in carrying out one of the features of my invention.

Referring to the drawings, 1 represents the outer shell of an ordinary cupola, the same being provided with a suitable lining upon its interior and being mounted upon suitable iron columns 2 or some other form of foundation. This shell is provided with a drop-bottom 3, blast-chamber 4, tuyeres 5, a slag-hole 6, a tap-hole 7, an open-top stack 8, and a charging-opening 9. The direct or natural draft is used in starting the fire, as is usual in these cases. When the cupola-furnace is in use, a bed of sand 10 is placed in the bottom of the shell. A steam-chamber 11 is provided having inwardly and downwardly inclined nozzles 12, extending through the lining of the shell 2 to the interior of the cupola-furnace. These nozzles 12 are arranged relatively in a circular form with the steam-chamber 11. A supply-pipe 13, provided with a valve 14, a drip-pipe 15, provided on its lower free end with a valve 16, said drip-pipe being connected with and depending from the supply-pipe 13, all form essential features assisting in carrying out my invention. In the charging materials used in this furnace I make use of what is termed "petroleum-coke." This coke is a residue of oil-stills that has been subjected to such a degree of heat that it is perfectly dry and exhausted of all volatile constituents of hydrocarbon, its name being derived from its origin and not from its contents. The petroleum-coke I use is preferable for this work for several reasons—namely, it requires less blast than ordinary coke, keeps up a steady and high temperature, improves the iron, so that it can be used again for homogeneous work, and, owing to the decrease in blast, the iron is not subject to decarbonization to the extent apparent in the use of ordinary coke. The gas-retort carbon made use of is the residue of the decomposition of coal in the manufacture of gas. It is readily combustible and retains the heat generated, thus materially assisting in the process of remelting iron in cupola-furnaces.

In addition to the above constituents of the charge the pig-iron forms the essential feature.

In charging the furnace I first place a stratum 17 of ordinary coke directly upon the sand bed 4. Above this is placed a stratum of the gas-retort carbon 18. Above this is placed a statum of pig-iron 19, then a stratum of petroleum-coke 20, a stratum of iron 21, another of petroleum-coke 22, and still another stratum of iron 23, and so on toward the top, the petroleum-coke and pig-iron alternating in layers. The introduction of the blast renders this mass fluid and the carbon contained in the several elements of the charge is precipitated into the iron, which prevents the carbon from combining in any solidified form in the charge. There are several foreign elements in the charge, which materially assist decarbonization in the iron. They are principally sulphur, phosphorus, and other like elements.

To improve upon the fusing of iron by the use of the air-blast, I make use of steam introduced into the charge through the nozzles 12. This steam before entering the cupola-furnace must have reached the highest attainable

temperature in order that the heat already generated will have no effect upon the steam, other than that which is intended and which forms the main feature of my invention. As is well known, steam consists, essentially, of hydrogen, a combustible gas, and oxygen, a gas which, although not combustible, still aids combustion. The entrance of the steam forced into the interior of the furnace is practically the same from all of the nozzles 12 supplied from the steam-chamber 11. The heat acts on the hydrogen of the steam and renders it capable of generating the highest known temperature. Its supporting gas oxygen aids in this combustion. At the same time that the steam is introduced into the cupola the pressure of the air-blast is reduced. As is well known, air has an element, nitrogen, which is non-combustible, and therefore has a counteracting effect in the operation of the furnace. The reduction in the pressure of the air-blast and the introduction of the highly-combustible elements of the steam introduced tend to thoroughly eliminate the objectionable elements—such as sulphur, phosphorus, &c.—from the charge. I have found by experiments carried on in a full-sized cupola-furnace that the temperature, and consequently the fluidity, is increased, causing hard iron to become soft. It effectually eliminates all foreign elements, such as sulphur, phosphorus, &c. The use of petroleum-coke increases the quantity of the output, as it liberates every ounce of iron from the slag. It requires less blast, saves labor and fuel, and leaves the iron open-grained and clean. It gives to it tenacity and in molding causes the iron to hold most of its carbon until the point of solidification, when a portion of the carbon is precipitated in graphitic form, assuming a coating in the mold and preventing the sand from adhering to the casting.

Having fully described the process of melting iron in cupola-furnaces, what I claim is—

The herein-described process of melting iron, consisting in first charging the iron with petroleum-coke in alternate layers and combining therewith a stratum of gas-retort carbon arranged between one of the layers of coke and iron, then subjecting the mass when ignited to an air-blast, and then reducing the blast and introducing steam through the mass while at a high temperature, substantially as and for the purpose set forth.

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

HENRY J. GRAF.

Witnesses:
C. K. JONES,
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