(12) **United States Patent**
Geissenhainer

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(54) **IRON & STEEL, BY ANTHRACITE COAL**

(76) Inventor: **F.W. Geissenhainer**

J. F. W. Geisenhainer

The Schedule referred to in these Letters Patent, and making part of the same, containing a description in the words of the said J. F. W. Geisenhainer himself of his improvement in the manufacture of Iron & Steel by the application of Anthracite coal

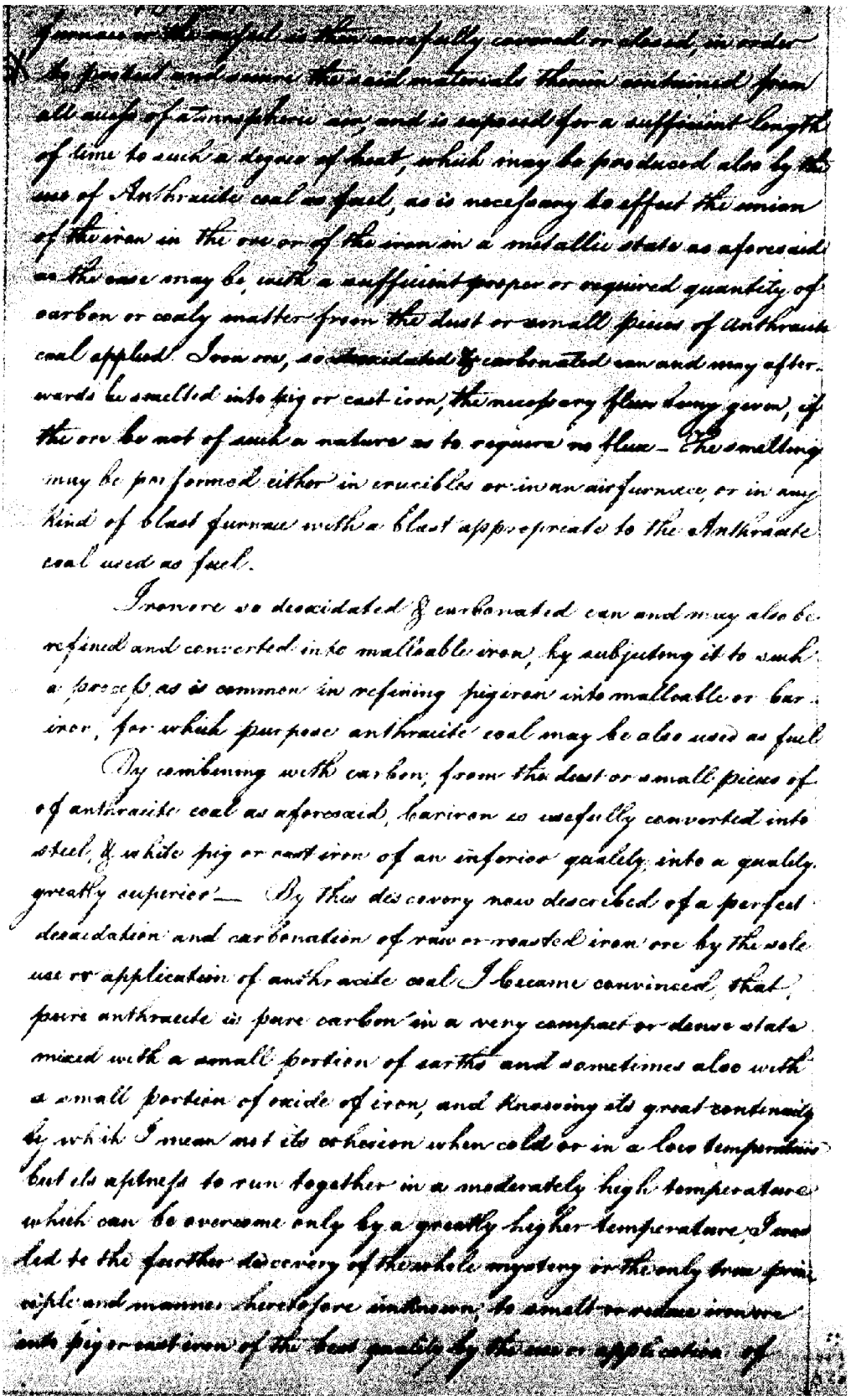
To all to whom these Presents shall come

Be it Known that I. J. F. W. Geisenhainer of the City of Newyork in the State of Newyork have invented or discovered a new and useful improvement in the manufacture of Iron & Steel, by the application of Anthracite coal in smelting iron ore into pigs or cast iron in carbonating and refining Iron ore into malleable iron and in combining iron in a metallic state with a greater quantity of carbon, as bar iron, for steel, as white pig or cast iron, for a superior quality

A correct account of which, drawn and signed by me, in the presence of a witness and attested by the signature of his name on the thirty first of August in the year of our Lord One thousand eight Hundred and Thirty One, was deposited and filed in the Patent Office on the fifth day of September in the same year One thousand Eight Hundred and thirty one — And that the following is a full and exact description of my said inventions discovery or improvement viz.

I discovered first that Iron ore, raw or roasted can & may be deoxydated & carbonated, and that so likewise, iron in a metallic state can and may be combined with a greater quantity of carbon than it possesses, by the sole use or application of anthracite coal fully as well and as perfect as by the use or application of charcoal of wood —

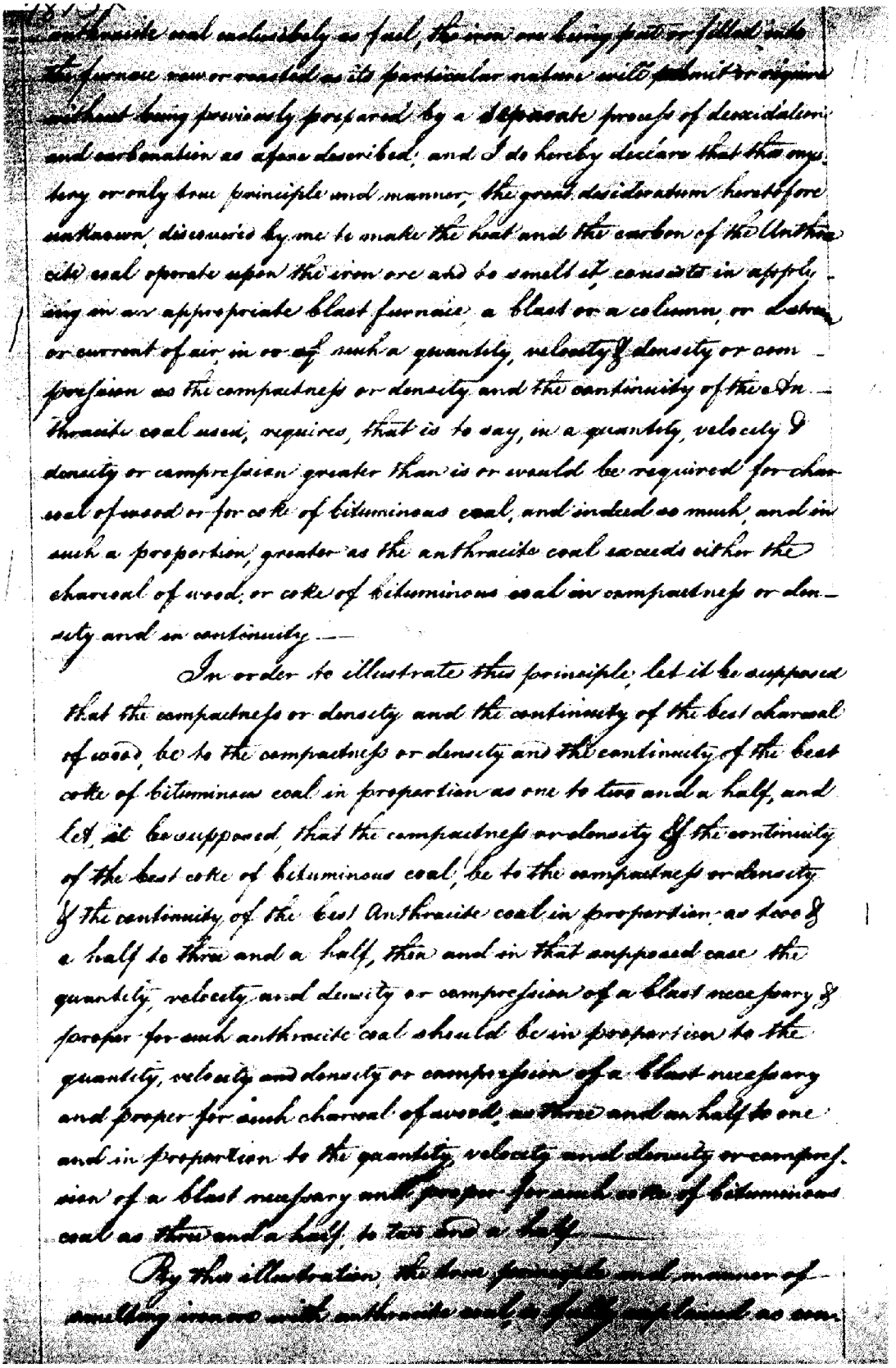
For this purpose, the iron ore or the iron in a metallic state as the case may be, is mixed or triturated with dust or small pieces of Anthracite coal in a converting furnace similar to those used in converting bar iron into steel, or in a furnace of another construction, or in any other suitable



furnace or the ingot is then carefully covered or closed, in order to protect and secure the said materials therein contained from all access of atmospheric air, and is exposed for a sufficient length of time to such a degree of heat, which may be produced also by the use of Anthracite coal as fuel, as is necessary to effect the union of the iron in the ore or of the iron in a metallic state as aforesaid as the case may be, with a sufficient proper or required quantity of carbon or coaly matter from the dust or small pieces of Anthracite coal applied. Iron ore, so decacidated & carbonated can and may afterwards be smelted into pig or cast iron, the necessary flux being given, if the ore be not of such a nature as to require no flux. The smelting may be performed either in crucibles or in an air furnace, or in any kind of blast furnace with a blast appropriate to the Anthracite coal used as fuel.

Iron ore so decacidated & carbonated can and may also be refined and converted into malleable iron, by subjecting it to such a process as is common in refining pig iron into malleable or bar iron, for which purpose anthracite coal may be also used as fuel.

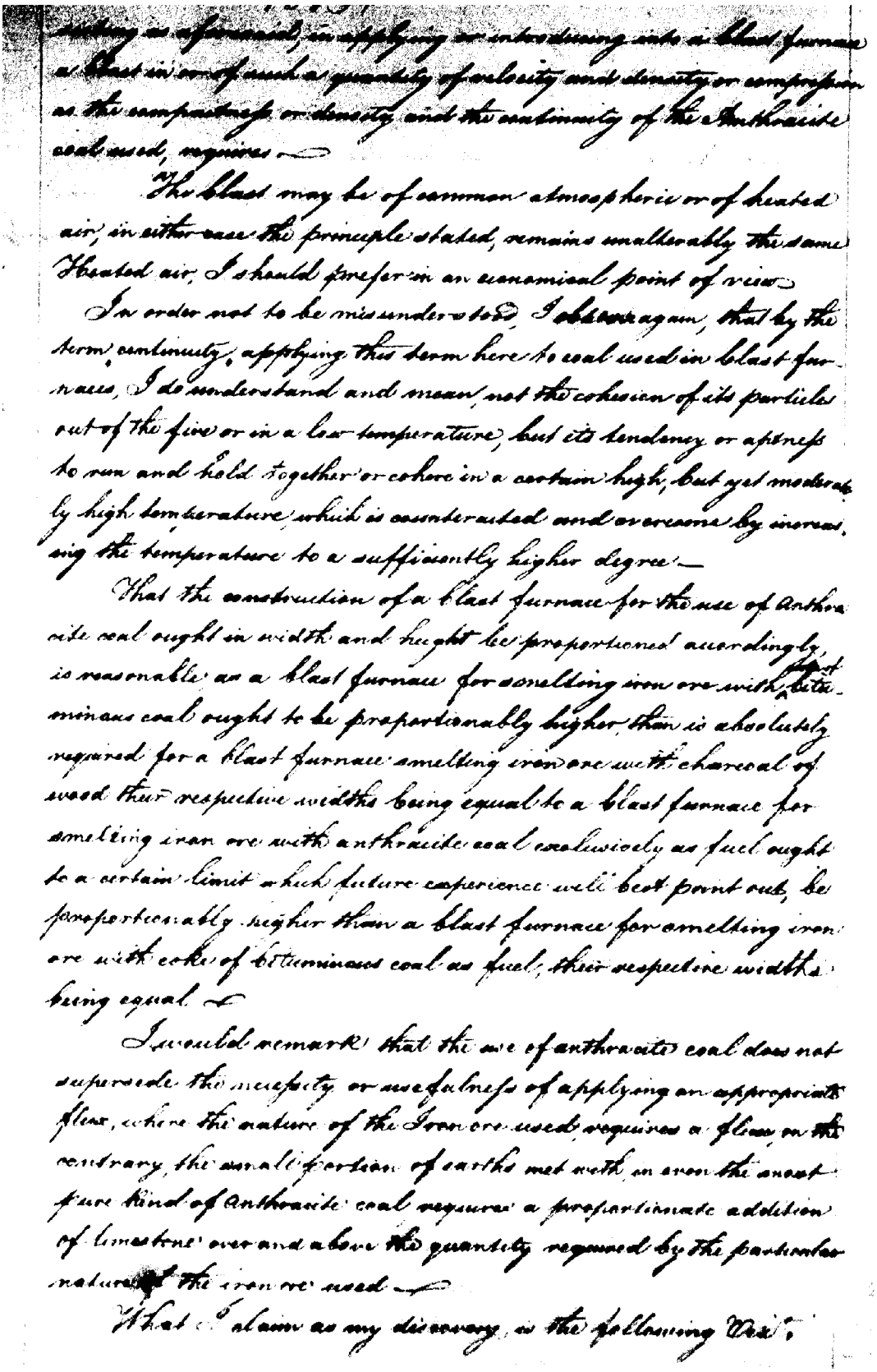
By combining with carbon, from the dust or small pieces of of anthracite coal as aforesaid, iron so usefully converted into steel, & white pig or cast iron of an inferior quality into a quality greatly superior. By this discovery now described of a perfect decacidation and carbonation of raw or roasted iron ore by the sole use or application of anthracite coal I became convinced, that pure anthracite is pure carbon in a very compact or dense state mixed with a small portion of earths and sometimes also with a small portion of oxide of iron, and knowing its great tendency to which I mean not its cohesion when cold or in a low temperature but its aptness to run together in a moderately high temperature which can be overcome only by a greatly higher temperature, I was led to the further discovery of the whole mystery or the only true principle and manner heretofore unknown, to smelt or reduce iron ore into pig or cast iron of the best quality by the sole application of



anthracite coal exclusively as fuel, the iron ore being fluxed or fitted into the furnace raw or roasted as its particular nature will admit or require without being previously prepared by a separate process of deoxidation and carbonation as above described, and I do hereby declare that the only true principle and manner, the great desideratum heretofore unknown, discovered by me to make the heat and the carbon of the anthracite coal operate upon the iron ore and to smelt it consists in applying in an appropriate blast furnace a blast or a column or body or current of air in or of such a quantity, velocity & density or compression as the compactness or density and the continuity of the anthracite coal used, requires, that is to say, in a quantity, velocity & density or compression greater than is or would be required for charcoal of wood or for coke of bituminous coal, and indeed as much, and in such a proportion, greater as the anthracite coal exceeds either the charcoal of wood or coke of bituminous coal in compactness or density and in continuity.—

In order to illustrate this principle, let it be supposed that the compactness or density and the continuity of the best charcoal of wood, be to the compactness or density and the continuity of the best coke of bituminous coal in proportion as one to two and a half, and let it be supposed that the compactness or density & the continuity of the best coke of bituminous coal, be to the compactness or density & the continuity of the best Anthracite coal in proportion as two & a half to three and a half, then and in that supposed case the quantity, velocity and density or compression of a blast necessary & proper for such anthracite coal should be in proportion to the quantity, velocity and density or compression of a blast necessary and proper for such charcoal of wood, as three and an half to one and in proportion to the quantity, velocity and density or compression of a blast necessary and proper for such coke of bituminous coal as three and a half, to two and a half.—

By this illustration, the above principle and manner of smelting iron ore with anthracite coal is fully explained as near



nothing as aforesaid, in applying or introducing into a blast furnace a blast in or of such a quantity of velocity and density or compression as the compactness or density and the continuity of the Anthracite coal used, requires.

The blast may be of common atmospheric or of heated air, in either case the principle stated, remains unalterably the same. Heated air, I should prefer in an economical point of view.

In order not to be misunderstood, I observe again, that by the term, continuity, applying this term here to coal used in blast furnaces, I do understand and mean, not the cohesion of its particles out of the fire or in a low temperature, but its tendency or aptness to run and hold together or cohere in a certain high, but yet moderate by high temperature, which is counteracted and overcome by increasing the temperature to a sufficiently higher degree.

That the construction of a blast furnace for the use of Anthracite coal ought in width and height be proportioned accordingly, as is reasonable as a blast furnace for smelting iron ore with Bituminous coal ought to be proportionably higher, than is absolutely required for a blast furnace smelting iron ore with charcoal or wood their respective widths being equal to a blast furnace for smelting iron ore with anthracite coal exclusively as fuel ought to a certain limit which future experience will best point out, be proportionably higher than a blast furnace for smelting iron ore with coke of bituminous coal as fuel, their respective widths being equal.

I would remark that the use of anthracite coal does not supersede the necessity or usefulness of applying an appropriate flux, where the nature of the Iron ore used requires a flux, on the contrary, the small portion of earths met with, in even the purest kind of Anthracite coal requires a proportionate addition of limestone over and above the quantity required by the particular nature of the iron ore used.

What I claim as my discovery, is the following Viz:

First, the application of anthracite coal exclusively or in part, in deoxidating and carbonating iron ore as above specified & described.

Secondly, the application of anthracite coal exclusively or in part in combining iron in a metallic state with a greater quantity of carbon, if Bar iron for steel, if pig or cast iron, for a superior quality as above specified and described.

Thirdly, the smelting or reducing of iron ore so deoxidated and carbonated by the application of Anthracite coal as aforesaid, into pig or cast iron.

Fourthly, the refining or converting of iron ore so deoxidated and carbonated by the application of Anthracite coal as aforesaid into malleable or bar iron.

Fifthly, the application of anthracite coal as fuel in smelting or reducing iron ore raw or roasted, but not prepared by a previous separate process of deoxidation and carbonation as above described into pig or cast iron.

Blast furnaces upon the principle and in the manner above stated by applying a blast in or of such a quantity, velocity and density or under such a pressure as the compactness or density and the continuity of the Anthracite coal used, requires exceeding the quantity, velocity and density or compression not only of a blast, necessary and proper in the use of charcoal of wood as fuel, in each operation but also of a blast necessary and proper in the use of coke of bituminous coal as fuel, in each proportion as the compactness or density and continuity of the anthracite coal exceeds the compactness or density and the continuity of either charcoal of wood, or coke of bituminous coal, as above amply and fully described and illustrated.

Sixthly – Tho' I cannot and do not claim an exclusive right of the use of heated air for any kind of fuel, nevertheless I believe I have a right to claim and do claim the use of heated air, applied upon and in connection with the main principle and manner discovered by me to smelt iron ore in blast furnaces

with anthracite coal by applying a blast of ore in such a quantity velocity and density or under such pressure, as the compactness o- density and the continuity of the anthracite coal requires. as above amply and fully described and illustrated.

Dated at the city of Newyork on the twenty first day of November, One thousand Eight Hundred and Thirty three

Witnesses
Peirpont Potter
H. K. Western

sig.d Friederich W. Geipenhain.

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