(No Model.)

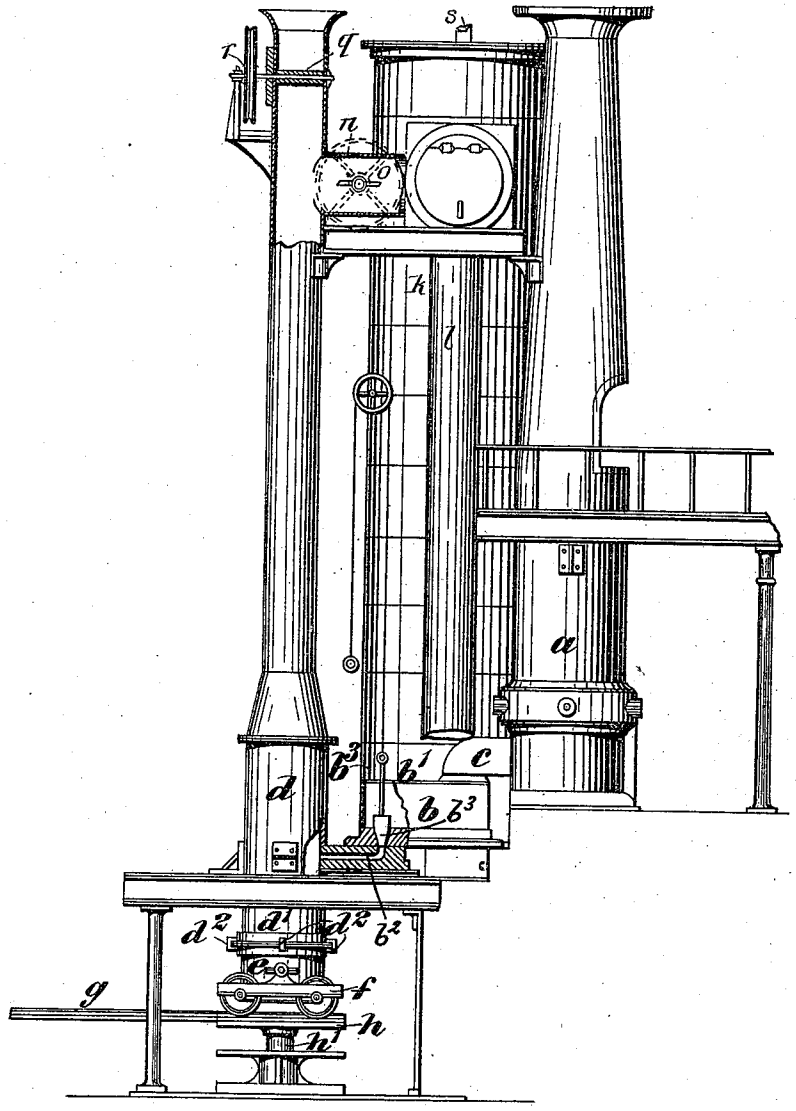
3 Sheets—Sheet 1.

J. HEATON & G. H. HOLDEN.

APPARATUS FOR THE MANUFACTURE OF STEEL OR IRON.

No. 501,138. Patented July 11, 1893.

Fig. 1.



Witnesses
Sam Arnold
Jno Meadowcroft

Inventors
John Heaton
George Henry Holden

(No Model.) 3 Sheets—Sheet 2.

J. HEATON & G. H. HOLDEN.

APPARATUS FOR THE MANUFACTURE OF STEEL OR IRON.

No. 501,138. Patented July 11, 1893.

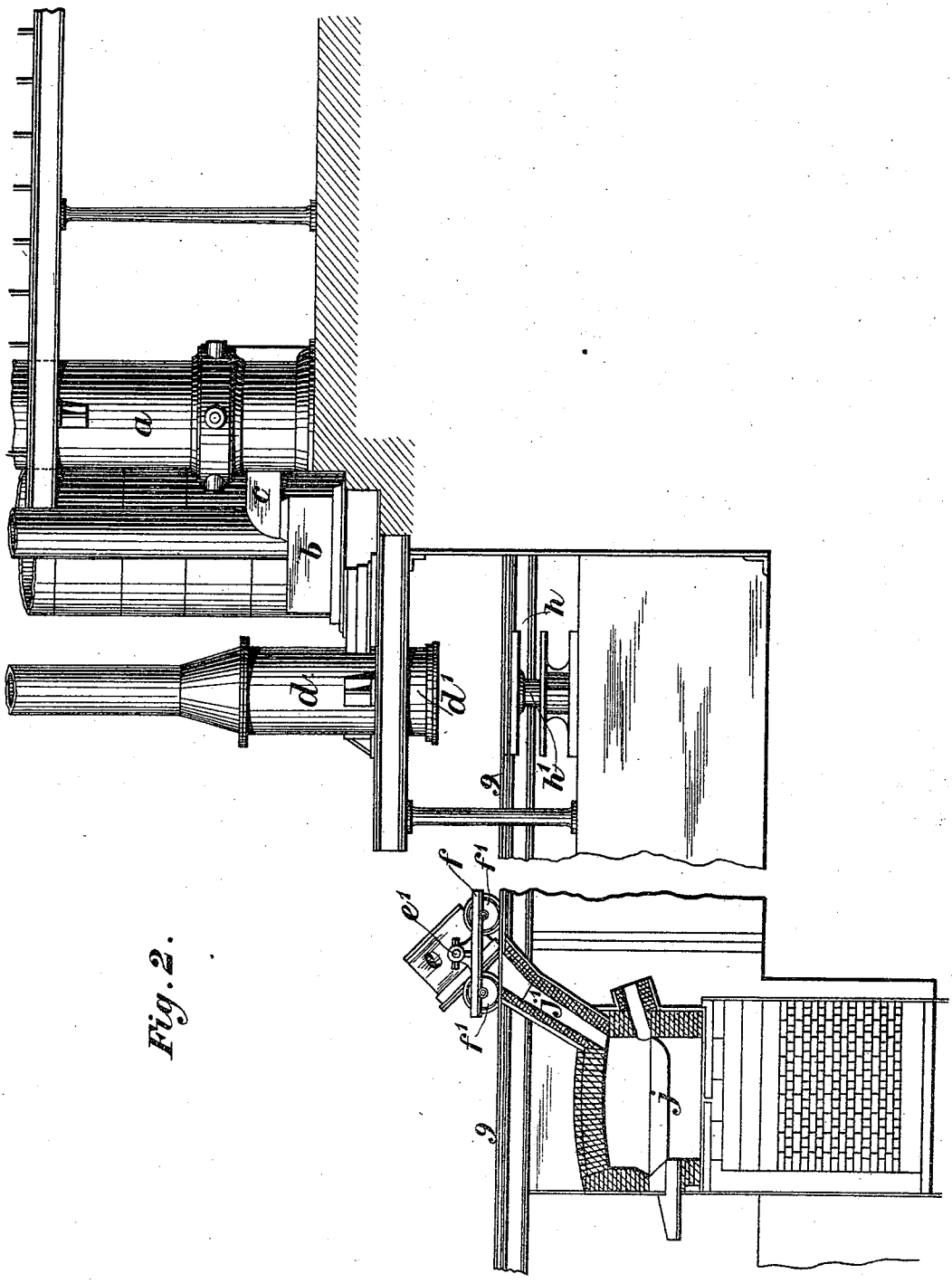


Fig. 2.

Witnesses
Isaac Arnold
Jr. Meadowcroft

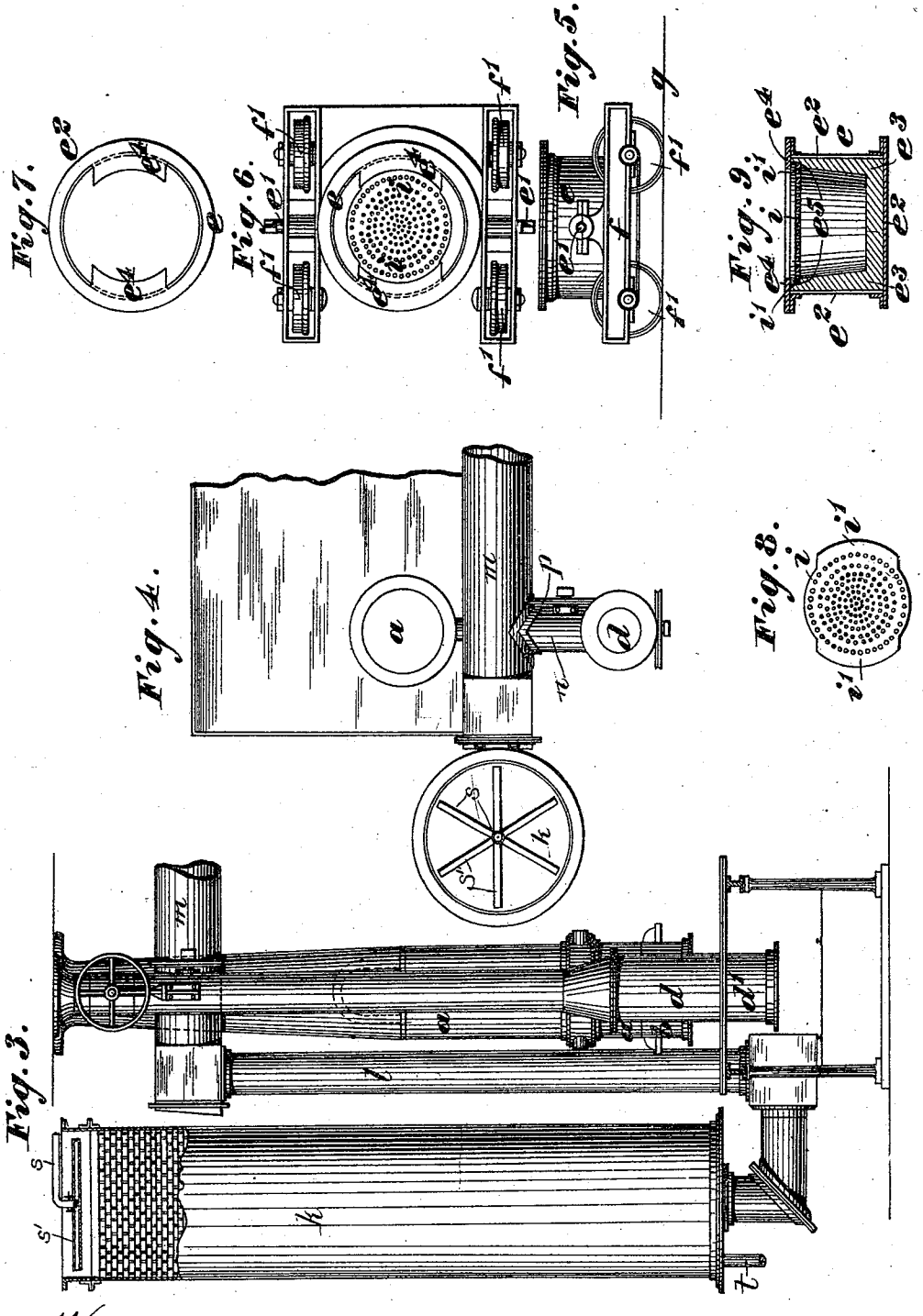
Inventors:
John Heaton
Geo. H. Holden

(No Model.) 3 Sheets—Sheet 3.

J. HEATON & G. H. HOLDEN.

APPARATUS FOR THE MANUFACTURE OF STEEL OR IRON.

No. 501,138. Patented July 11, 1893.



Witnesses
Sam Arnold
Jno Meadowcroft

Inventors
John Heaton
George Henry Holden

UNITED STATES PATENT OFFICE.

JOHN HEATON AND GEORGE HENRY HOLDEN, OF MANCHESTER, ENGLAND.

APPARATUS FOR THE MANUFACTURE OF STEEL OR IRON.

SPECIFICATION forming part of Letters Patent No. 501,138, dated July 11, 1893.

Application filed March 1, 1892. Serial No. 423,423. (No model.) Patented in England May 7, 1890, No. 7,070; in France March 1, 1891, No. 94,019; in Belgium March 5, 1891, No. 211,904; in Germany March 5, 1891, No. 10,873; in Luxemburg March 6, 1891, No. 1,416, and in Canada September 17, 1891, No. 34,421.

To all whom it may concern:

Be it known that we, JOHN HEATON and GEORGE HENRY HOLDEN, subjects of the Queen of Great Britain and Ireland, residing at Manchester, in the county of Lancaster, England, have invented Improvements in Apparatus for the Manufacture of Steel or Iron, (said invention having been patented in the following foreign countries: Great Britain, No. 7,070, dated May 7, 1890; France, No. 94,019, dated March 1, 1891; Belgium, No. 211,904, dated March 5, 1891; Germany, No. 10,873, dated March 5, 1891; Canada, No. 34,421, dated September 17, 1891, and Luxemburg, No. 1,416, dated March 6, 1891,) of which the following is a specification.

In the specification of British Letters Patent granted to one of us, viz., the said John Heaton, dated respectively March 17, 1866, No. 798, and May 3, 1867, No. 1,295, there is described the manufacture of steel or wrought iron from cast or pig iron by subjecting such iron when in a molten state to the action of nitrate of soda, nitrate of potash, chlorate of soda or chlorate of potash.

Now the present invention has reference to improvements in the machinery or apparatus employed in such manufacture as I will now proceed to describe by reference to the accompanying drawings in which—

Figure 1 is a side view of apparatus constructed according to this invention. Fig. 2 is a side view thereof, partly in section, from which are omitted certain parts which are shown in Fig. 1, and in which are shown certain parts which do not appear in Fig. 1. Fig. 3 is a front view of the apparatus with certain parts omitted. Fig. 4 is a plan of a portion of the apparatus. Fig. 5 is a side elevation. Figs. 6, 7 and 8 are plans; and Fig. 9 is a vertical section of certain parts of the apparatus hereinafter referred to. Figs. 5, 6, 7, 8, and 9 are drawn to a larger scale than the other figures.

a is a cupola furnace in which the cast or pig iron to be converted into steel or wrought iron according to the process referred to, is melted.

b is a measuring vessel into which a desired quantity of molten metal is run from the cupola furnace *a* by means of the spout *c*. The measuring vessel *b* is formed to hold a certain quantity of molten metal, and is provided with a lid *b'* which is closed after the molten metal has been run into the vessel *b*.

d is a Heaton converter of the well known type, comprising a vertical cylindrical converting chamber having a removable bottom and surmounted by a cylindrical shaft or flue, these parts being lined with a refractory material. The interior of the measuring vessel *b* communicates with the interior of the converter *d* by means of a lateral passage b^2 capable of being at times closed by means of one or more suitable plugs or valves b^3 that serves or serve to allow the molten metal to flow from the measuring vessel *b* into the converter *d*, and also to prevent sparks or flame from passing from the converter *d* into the measuring vessel *b* while the converting operation is in progress. At the commencement of each "shift" or converting operation, the lower portion *d'* of the body of the converter *d* is heated by any suitable means preferably by a suitable gas arrangement, to a low red heat in order to prevent undue lowering of the temperature of the molten metal during the converting operation so that the required uniformity of production may be secured.

e is a vessel or chamber, hereinafter called the lower portion of the converter, employed to contain the charge of nitrate or chlorate of soda or potash (hereinafter referred to as nitrate of soda) employed in carrying out the converting process. It is provided with trunnions *e'* by which it is supported upon a truck *f* (Figs. 5 and 6) provided with wheels *f'* capable of running upon the rails *g*. In order to admit of its being readily and conveniently placed in position beneath the converter *d*, the truck *f* is run beneath the converter *d* and onto the table *h* of a hydraulic ram *h'*, or other suitable means such for instance as screws or levers, by which the truck *f* can be raised until the lower portion *e* of the converter carried thereby, comes in

contact with and into position beneath the converter d to which it is firmly secured by suitable appliances such as clamps d^2, so that should the hydraulic ram h' or other means employed, from any cause cease to support the lower portion e of the converter, such lower portion of the converter will not become separated from the converter d. The trunnions e' admit of the lower portion e of the converter being readily adapted to the converter d.

The lower portion e of the converter, shown in vertical section in Fig. 9, consists of a vessel formed of an iron casing e^2 open at the top and provided with a lining e^3 of suitable refractory material such as fire-clay or firebrick, and with a perforated plate i that is placed above the nitrate of soda after the same has been placed in e. To enable this plate to be easily placed in position and secured so that it cannot rise into the upper part of the converter the following construction is adopted:—The upper flange of the casing e^2 is formed with parts e^4 that project inward as shown more particularly in Figs. 6, 7 and 9. The perforated plate i shown separately in Fig. 8 is formed with ears or lugs i' which, when the perforated plate i is to be placed in position, are passed downward through the spaces between the projecting parts e^4, after which the plate is turned through an angle of about ninety degrees so as to bring its ears or lugs below the projecting parts e^4 of the casing e^2 as shown in Figs. 6 and 9. The perforated plate i rests upon a ledge e^5 formed in the lining e^3 of the lower portion e of the converter, and is secured in this position by a packing of loam, sand or clay placed between its ears or lugs i' and the projecting parts e^4 of the casing e^2.

In order that the charge of metal obtained by the converting operation may be heated to such a temperature as to become sufficiently fluid to be run into ingots it is transferred while in the lower portion e of the converter to an open-hearth or re-heating furnace, preferably a gas furnace. For this purpose the lower portion e of the converter after being removed from the upper part is moved by its truck f along suitable rails g or in any other convenient manner to suitable hydraulic or other appliances by which the said lower portion of the converter is tilted so that the charge of metal contained therein will be caused to run or pass down a suitable spout, pipe or channel j' into an open hearth or re-heating furnace j preferably a gas furnace as shown more particularly in Fig. 2 and wherein it is heated for the purpose mentioned.

When it is desired to produce a metal to be used as wrought iron or as a soft weldable steel, the metal after being removed from the converter, is transferred in a similar manner to that shown in Fig. 2 to a re-heating furnace such for instance as a blooming furnace, after which it is passed to a shingling hammer and then to the rolling mill to be rolled into billets or slabs or other forms suitable for further use.

The upper end of the converter d may be in direct communication with the external atmosphere. In order however to recover certain useful by-products which would otherwise escape from the upper part of the converter during the converting operation, and be lost, it is advantageous to connect the upper portion of the converter with condensing apparatus as described and claimed in the specification of another application for Letters Patent filed by us of even date herewith, Serial No. 423,426.

The condensing apparatus comprises a condensing tower k containing brickwork arranged checker-wise after the manner of the brickwork in a Siemens regenerator. Into the lower end of this tower are led the gaseous or vaporous products of the converting operations in order that these products may be condensed or heated for the purpose mentioned. The lower end of the condensing tower is connected to the upper part of the converter d by means of a vertical pipe l, a horizontal flue m, and a branch pipe n which is fitted with a valve o provided with a chain wheel p by which the communication between the converter and the flue m can be controlled. The upper part of the converter is also fitted with a valve q provided with a chain wheel r for controlling the communication between the converter and the external atmosphere. When the valve o is closed and the valve q is opened, the gaseous or vaporous products of the converting operation will escape from the upper part of the converter direct into the atmosphere. If the valve o be closed and the valve q opened, the said products will pass through the branch pipe n, flue m, and pipe l into the bottom of the condensing tower k. In some cases in order to assist the condensing and collecting of the by-products the condensing tower may be cooled by any suitable means as for instance by a shower of water admitted through a pipe s with distributing branches s'. The water or other liquid or liquids employed in cooling the gaseous or vaporous products, and which will dissolve a great part of the valuable by-products therein, may be run off by a pipe t and be afterward treated in any suitable manner for the recovery therefrom of the by-products contained therein.

Steel or ingot iron is manufactured in the above described apparatus as follows:—The pig-iron to be converted into steel or wrought iron is placed in the cupola furnace a and melted, and a portion of it is allowed to run along the spout c into the measuring vessel b. When a sufficient quantity of pig-iron has been run from the cupola furnace into the measuring vessel, the supply of metal from the cupola furnace a is shut off. The

lower portion *e* of the converter having been charged with the requisite quantity of nitrate of soda, is, by means of the truck *f* and rails *g*, run upon the table *h* which is then raised until the upper edge of the lower portion *e* of the converter is brought into contact with the lower end of the upper part of the converter *d* to which it is secured by means of the clamps d^2. The plug or valve b^3 is then raised and the molten iron contained in the measuring vessel *b* is allowed to flow into the converter *d*. The molten iron on passing through the perforations in the plate *i* comes in contact with the nitrate of soda, by the oxidizing action of which the cast iron is converted into steel or wrought iron according to the quantity of nitrate of soda employed, as described in the said prior British specification No. 1,295 of 1867. The gases, vapors or other products resulting from the conversion of the cast iron into ingot iron or steel may be allowed to escape from the top of the converter either into the atmosphere, or into a condenser as hereinbefore referred to. When the charge of cast iron in the lower portion *e* of the converter has been converted into steel or ingot iron, the clamps d^2 are removed or loosened, and the table *h* and lower portion *e* of the converter are lowered, and the charge contained in the lower portion *e* of the converter is poured into the re-heating furnace or other furnace wherein it is re-heated until the gaseous and other impurities which remain incorporated with it at the time the converting operation was completed have escaped therefrom, or have been formed into a slag which is then separated therefrom. After the charge of metal has been so re-heated, it may either be poured into an ingot mold or other suitable receptacle to be subsequently treated in any required manner.

By the apparatus hereinbefore described, the process described in the said prior British specification No. 1,295 of 1867 can be very readily carried out with the employment of comparatively little manual labor.

In the preceding description the term "ingot iron" is used to denote a metal having a composition character and properties similar to those of the metal ordinarily designated wrought iron.

What we claim is—

1. Apparatus for the manufacture of steel and iron by the Heaton process, comprising a converter consisting of a vertical converting chamber surmounted by a shaft or flue and having a removable lower portion adapted to contain a charge of nitrate of soda, a melting furnace, and a measuring vessel arranged at a lower level than and so as to receive metal flowing from said melting furnace, and adapted to be placed in communcation with said converter by a lateral passage substantially as herein described for the purpose specified.

2. Apparatus for the manufacture of steel and iron by the Heaton process, comprising a converter *d*, a cupola *a*, and a fixed measuring vessel *b* connected with said converter by a lateral passage b^2 controlled by a valve b^3, said measuring vessel being arranged below the outlet of said cupola and so as to receive a definite quantity of molten metal from said cupola and conduct it to said converter substantially as herein described.

3. Apparatus for the manufacture of steel and iron by the Heaton process, comprising a fixed melting furnace, a converter consisting of a vertical converting chamber surmounted by a shaft or flue and having a lower removable portion adapted to receive a charge of nitrate of soda, a measuring vessel arranged to receive molten metal from said cupola and conduct it to said converter, a truck provided with wheels and whereon the lower removable portion of said converter is mounted, rails arranged below said converter and whereon said truck can travel, and raising and lowering mechanism arranged below said converter and adapted to move said lower part with its truck to and from the upper fixed part of said converter, substantially as herein described for the purpose specified.

4. Apparatus for the manufacture of steel and iron by the Heaton process, comprising a cupola, a converter, consisting of a vertical converting chamber surmounted by a shaft or flue and provided with a lower removable portion adapted to hold a charge of nitrate of soda, a measuring vessel arranged between said cupola and converter and adapted to be placed in communication with each of them, a carrier whereon the lower removable portion of said converter is mounted, means for raising and lowering said lower portion with its carrier to and from the upper portion of said converter, a reheating furnace such as *j* having a charging aperture through its upper part, and a suitable way arranged between said converter and reheating furnace, and above the latter and whereon said carrier can travel, substantially as herein described for the purposes specified.

5. In apparatus for the manufacture of steel and iron by the Heaton process, a converter having a lower removable portion comprising a casing formed at its upper part with inwardly projecting lugs or ears, a lining of refractory material formed at the upper part with a shoulder, and a perforated plate formed with lateral extensions adapted to pass through the spaces between the lugs or ears on said casing substantially as herein described for the purpose specified.

6. The improved apparatus or plant for the manufacture of steel and iron by the Heaton process, comprising a cupola *a*, a measuring vessel *b*, a converter *d* having a lower removable portion *e*, a wheeled truck whereon said lower portion is journaled, a hydraulic ram with table *h* arranged below said converter, a

reheating or melting furnace *j* having a charging aperture *j'* through its upper part, rails *g* extending from said table above the roof of said reheating or melting furnace and means for tilting said removable part of the converter, these parts being arranged substantially as herein described for the purposes specified.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOHN HEATON.
GEORGE HENRY HOLDEN.

Witnesses:
SAM ARNOLD,
JNO. MEADOWCROFT,
Both of 41 *Corporation St., Manchester.*