No. 714,616. Patented Nov. 25, 1902.

G. J. SNELUS.

APPARATUS FOR THE MANUFACTURE OF IRON AND STEEL.

(Application filed June 16, 1902.)

(No Model.) 2 Sheets—Sheet 1.

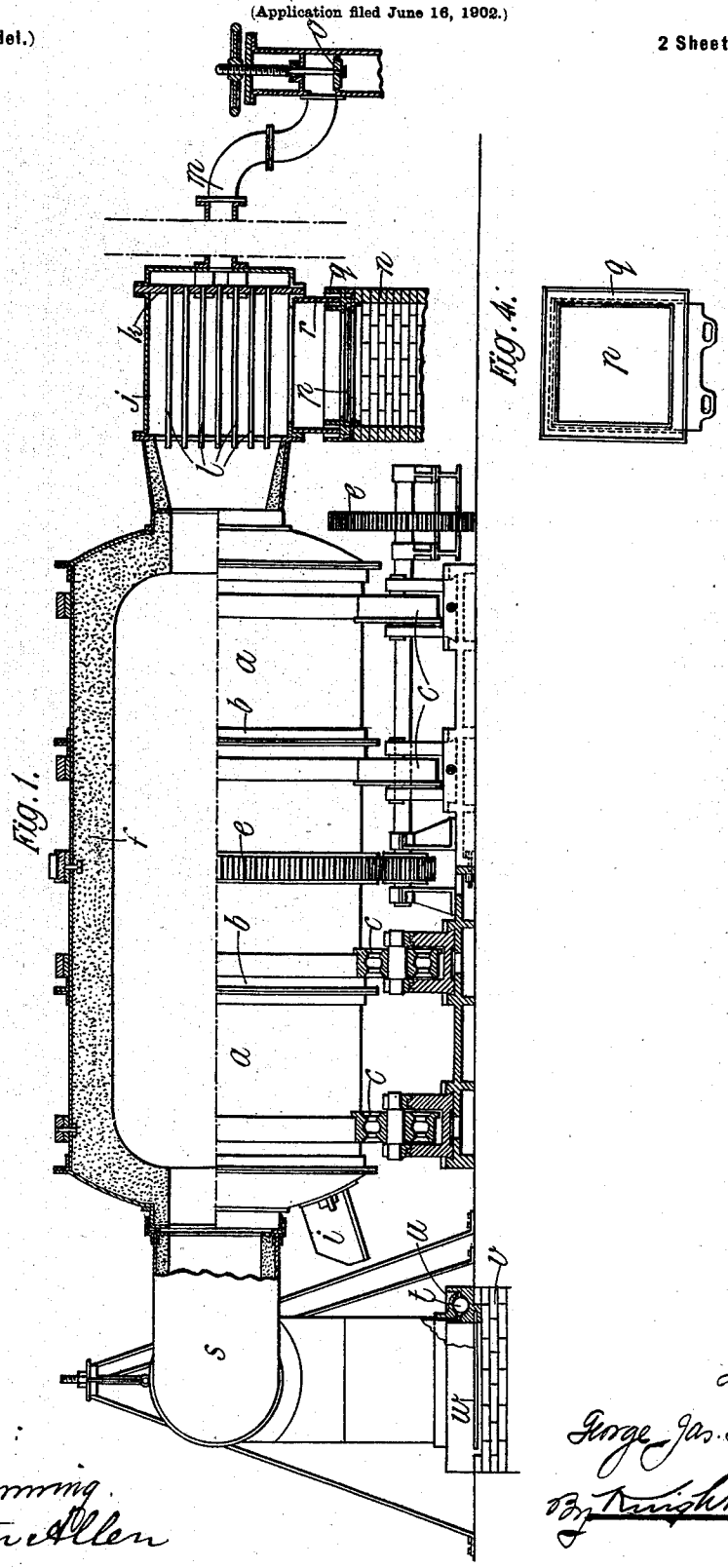


Fig. 1.

Fig. 4.

Witnesses:
H. E. Manning.
Walter Allen

Inventor:
George Jas. Snelus
By Dwight Bros
attys.

No. 714,616. Patented Nov. 25, 1902.

G. J. SNELUS.

APPARATUS FOR THE MANUFACTURE OF IRON AND STEEL.

(Application filed June 16, 1902.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 3

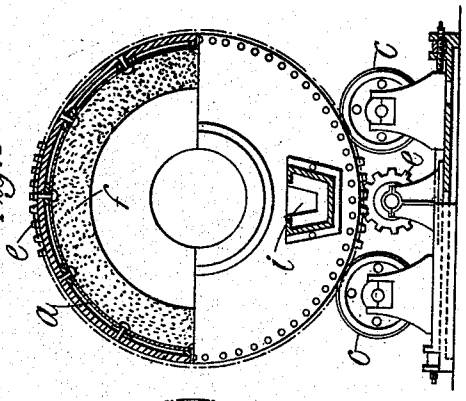


Fig. 2.

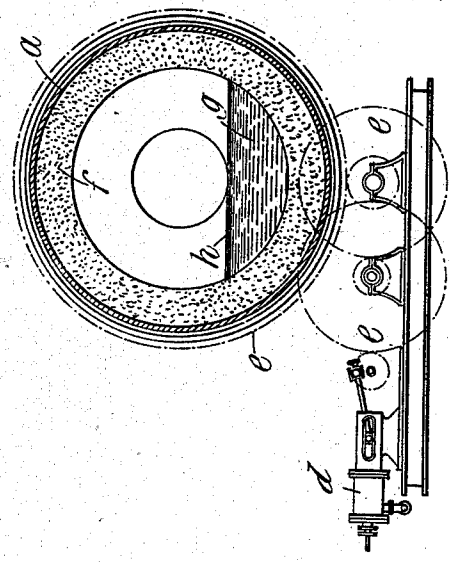
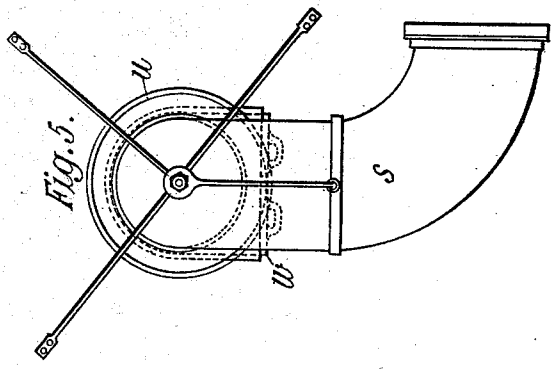


Fig. 5.



Witnesses:
N. E. Manning
Walter Allen

Inventor:
George Jas. Snelus
by Wright Bros. attys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

GEORGE JAMES SNELUS, OF FRIZINGTON, ENGLAND.

APPARATUS FOR THE MANUFACTURE OF IRON AND STEEL.

SPECIFICATION forming part of Letters Patent No. 714,616, dated November 25, 1902.

Application filed June 16, 1902. Serial No. 111,906. (No model.)

To all whom it may concern:

Be it known that I, GEORGE JAMES SNELUS, F. R. S., vice-president of the Iron and Steel Institute, a subject of the King of Great Britain, residing at Ennerdale Hall, Frizington, in the county of Cumberland, England, have invented certain new and useful Improvements Relating to the Manufacture of Iron and Steel, of which the following is a specification.

This invention has for its object improvements in apparatus for refining pig-iron to make it suitable for malleable castings, &c., and for the manufacture of steel by the "reaction" process, in which molten pig-iron is brought into intimate contact with molten oxids of iron at a high temperature for the purpose of oxidizing the carbon silicon, phosphorus, &c., by the reaction of oxid of iron, whereby the oxid is reduced to the metallic state and the reduced iron is absorbed by the metallic bath, thereby greatly increasing the yield of metal. Other metals—such as manganese, nickel, chromium, &c.—can be added to the bath by adding thereto their respective oxids. In this way pig-iron can be refined to make it suitable for making malleable castings, &c., or the reaction process can be carried still further till the metalloids are almost completely removed, and the refined metal can then be recarburized to steel of various grades in the usual ways.

According to my invention I provide a cylindrical iron casing about two diameters in length, made in sections for facility of lining (so that they can be afterward bolted together to form the complete rotator) and partially open at each end. The rotator is mounted on friction-rollers and rotated by gearing. The sections are placed with their axis in a vertical position and lined with basic material by ramming the material around cores, as is usual in lining Bessemer converters, or they may be similarly lined with basic blocks. The sections are then luted with basic mixture placed on the roller-bearings and bolted together. At one end of the rotator I place a specially-designed gas-blowpipe, so as to produce an intense heat in the rotator and at the other end a short movable flue. I use, preferably, the waste gases from the blast-furnace as the source of heat and the ordinary hot blast from the stoves for combustion. The blowpipe-casing, of iron, stands in a channel-iron over the gas-flue, (the groove being filled with tar to form a hydraulic joint,) the gas being regulated by a damper or valve. The gas-chamber of the blowpipe is separated from the air-chamber by a thick diaphragm. The blast-main is connected to the air-chamber, and the blast is controlled by a suitable valve. A number of small tubes, preferably of porcelain to prevent oxidation, are fitted into the diaphragm and project into the gas-chamber. These split up the blast, cause an induced current in the gas, and the intimate mixture of air and gas produce an intense temperature. Thus all the extraneous heat required for the process is obtained readily and economically without the use of special producers and regenerators. The waste heat could be regenerated in the usual way; but for simplicity sake I prefer to pass it into the chimney-flue by the use of a small movable connecting-flue, which can be turned out of the way to charge the rotator or to repair the lining. The movable flue is supported on ball-bearing revolving in a channel filled, preferably, with tar to form a hydraulic joint over the chimney-culvert, so that it can be easily rotated. The flue is controlled by a damper. After the rotator has been lined and placed in position the lining is dried and then thoroughly heated by the blowpipe. The surface is then coated with a layer of oxid of iron by melting it in the rotator while it is slowly revolving. When all is ready, a charge of molten iron is run in directly from the blast-furnace or by means of a ladle. A charge of oxid of iron (preferably iron scale or magnetic oxid) and lime is then charged in on top of the metal and the rotator is slowly revolved. The oxid and lime can be melted in a basic-lined cupola and added in the fluid state. A few turns of the rotator then brings the metal and oxid into intimate contact and a violent reaction takes place. Large quantities of carbonic oxid are evolved, so that the gas can be almost entirely shut off and enough air admitted to burn the carbonic oxid. Further oxid and lime are added as necessary, and the progress of refining is observed by drawing test samples. When ready, the metal is drawn off by the tap-hole at the

flue end. By slightly turning the rotator after the metal has been withdrawn the slag may be poured into a separate receptacle. The metal can then be run into pigs for malleable castings, &c., or if the refining has been carried far enough it can be recarburized into steel in the ladle in the usual way or transferred to a separate finishing-furnace. If it is desirable to specially reduce the sulfur, I add Saniter's mixture, consisting of chlorid of calcium with or without fluor-spar, in the rotator after the first violent reaction.

Referring to the drawings, Figure 1 is a side elevation, partly in section, of the rotary furnace and the blowpipe. Fig. 2 shows a cross-section of the rotary furnace and shows also the driving mechanism. Fig. 3 is a partly sectional view of the flue end of the rotary furnace. Fig. 4 is a plan of the groove supporting the blowpipe and of the damper controlling the furnace-gas inlet. Fig. 5 is a plan of the removable flue.

a is the cylindrical iron casing of the furnace, made in sections having wrought-iron flanges *b b* at their ends, by which the sections can be bolted together. The casing *a* is supported on antifriction-rollers *c c* and is driven by an engine *d* through the agency of toothed gearing *e*.

f is the basic lining of the furnace.

g is the metal, and *h* the slag, within the furnace. The ends of the furnace are only partially closed, as shown. At the flue end is placed the tap-hole or outlet *i* for metal and slag. Communicating with the opposite end of the furnace is the blowpipe comprising a chamber *j*, which contains a diaphragm *k*, which carries porcelain pipes or tubes *l*, and with which the hot-blast pipe *m*, leading from the hot-blast main, and also the blast-furnace gas-culvert *n*, communicate. The pipe *m* is controlled by a screw-valve *o*, and the culvert *n* is controlled by the valve or damper *p*. The pipe *m* communicates with the ordinary source for supplying hot-air blast to the blast-furnaces employed for obtaining the pig-iron, and the culvert *n* supplies hot furnace-gases from said blast-furnaces, thus supplying all the extraneous heat required for effecting the reaction within the furnace without the use of regenerators or other expensive apparatus.

q is the groove, containing water or other material, such as tar, and in which a flange *r* on the blowpipe rests, thereby making an effective joint between the blowpipe and the culvert.

s is the removable flue, supported on ball-bearings *t* in a groove *u*, filled with tar and supported by the smoke-shaft *v*.

w is the damper, controlling the flue *s*. When it is required to have access to the interior of the furnace, the flue *s* is turned upon its bearings out of communication with the end of the rotary furnace.

During the reaction in the rotary furnace a portion of the necessary heat results from the reaction between the metalloids (carbon, silicon, phosphorus, and sulfur) and the oxids contained in the mixture in the furnace, and a portion of the heat also results from the combustion of the carbonic oxid produced. The blowpipe, however, supplies any further or extraneous heat that may be required, and said blowpipe is readily controlled by the valve *o* and the damper *p*.

The surface of the rotating furnace constantly brings fresh metal in contact with the fluid or pasty oxid, so that the reaction is very rapid, while the refining of the pig-iron is entirely effected by the reaction between the metalloids and the oxid of iron, almost theoretical results being attainable.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In apparatus for the refining of pig-iron by iron oxid or metallic oxid with or without "Saniter" mixture for the production of malleable-iron castings or steel, the combination of a rotary furnace, a basic lining in said furnace, means for rotating said furnace, a blowpipe communicating with said furnace and provided with a hot-air inlet and a blast-furnace gas-inlet, means for controlling said blowpipe-inlets, a diaphragm in the blowpipe and porcelain tubes carried by the diaphragm, substantially as described.

2. In apparatus for the refining of pig-iron by iron oxid or metallic oxid with or without "Saniter" mixture for the production of malleable-iron castings or steel, the combination of a rotary furnace made in sections and having partially-closed ends, a basic lining in said furnace, means for rotating said furnace, a blowpipe communicating with the open part at one end of the furnace and provided with a hot-air-blast inlet and a blast-furnace gas-inlet, a valve controlling said hot-air-blast inlet, a damper controlling said blast-furnace gas-inlet, and horizontally-arranged porcelain tubes in the blowpipe through which tubes the hot-air blast passes on its way to the rotary furnace, substantially as described.

3. In apparatus for the refining of pig-iron by iron oxid or metallic oxid with or without "Saniter" mixture for the production of malleable-iron castings or steel, the combination with a rotary furnace having partially-closed ends, and means for rotating said furnace, of a blowpipe having a horizontal hot-air-blast inlet and a vertical blast-furnace gas-inlet, a flange surrounding the said vertical inlet and a liquid-containing groove in which the said flange rests so as to support the blowpipe, substantially as and for the purpose specified.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 6th day of June, 1902.

GEORGE JAMES SNELUS.

Witnesses:
O. F. ORMROD,
THOMPSON ROBINSON.