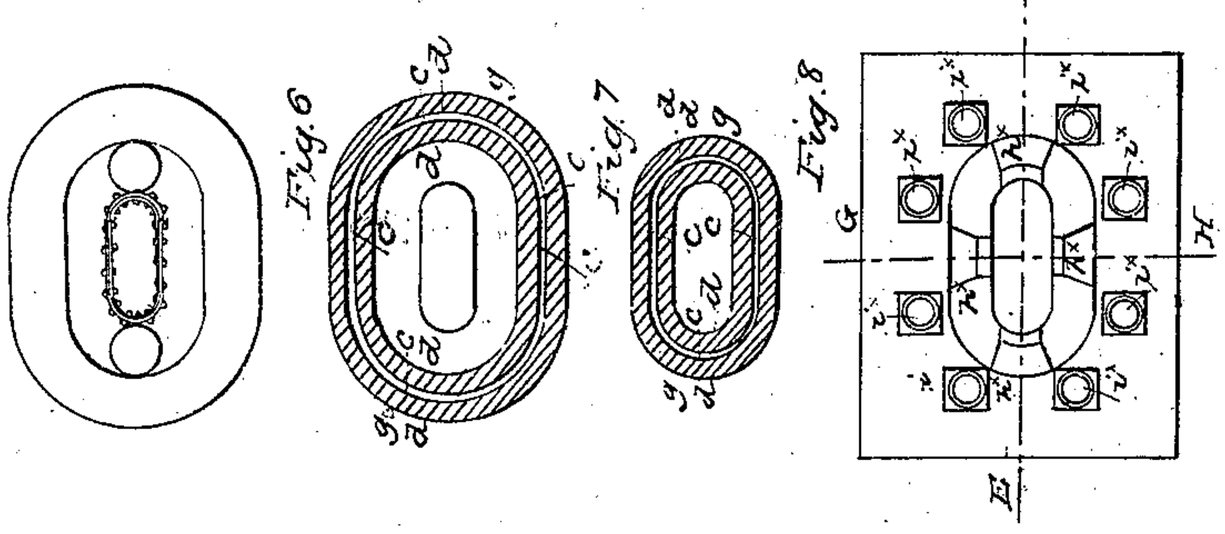
2 Sheets—Sheet 1.

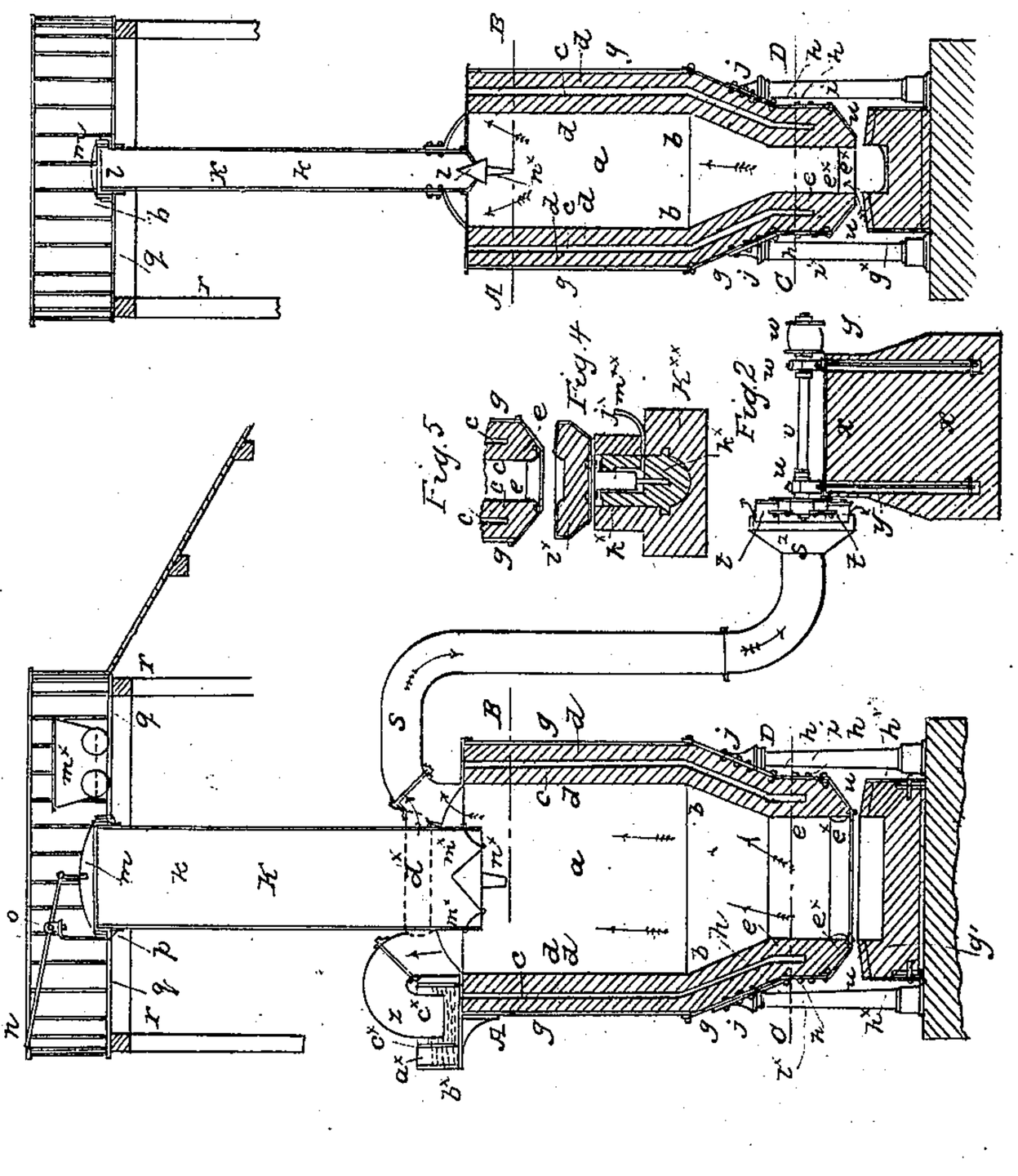
R. W. SIEVIER.

Blast Furnace.

No. 24,525.

Patented June 21, 1859.





WITNESSES

Wm Lalley

E. Clark C

INVENTOR

R. W. Sievier

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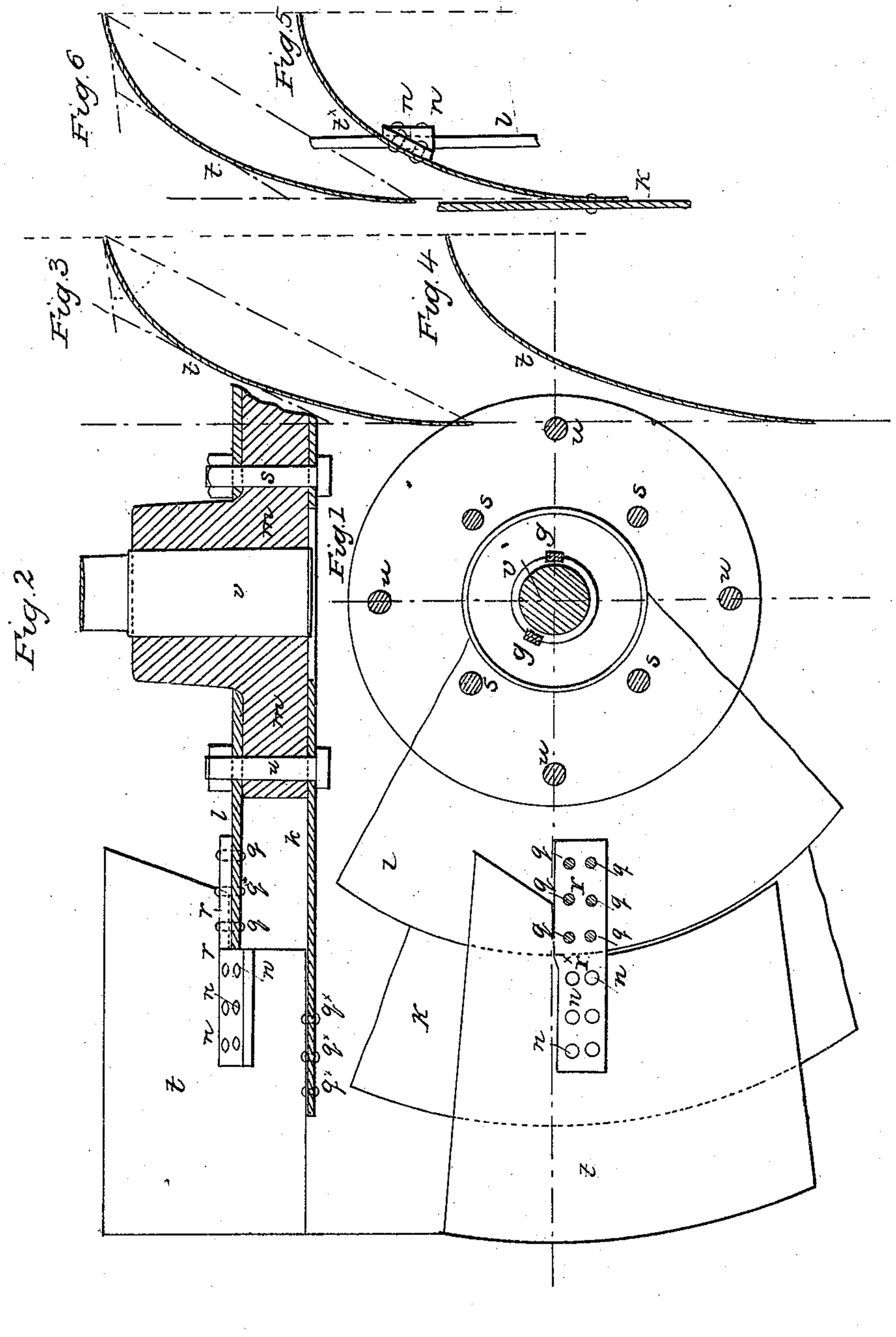

WITNESSES

Saml. Sinclair

Wm. Lilley

INVENTOR

R. W. Sievier

UNITED STATES PATENT OFFICE.

ROBERT WM. SIEVIER, OF UPPER HOLLOWAY, ENGLAND, ASSIGNOR TO WILLIAM LILLEY.

IMPROVED SMELTING-FURNACE FOR IRON.

Specification forming part of Letters Patent No. **24,525,** dated June 21, 1859.

To all whom it may concern:

Be it known that I, ROBERU WILLIAM SIEVIER, of Upper Holloway, London, in the Kingdom of Great Britain, but temporarily residing in Hamburg, do declare the nature of my said invention for the Improvement in the Smelting and Purifying the Metal in Iron and Metal Ores to be as follows:

It consists in causing a current of air necessary for the reduction of the ore in the furnace by exhausting the air or gases as produced by the combustion of the carbon, the exhaust being effected by means of a fan, pumps, or otherwise, so that a sharp draft or current of air of sufficient density may enter into the lower opening of the furnace and produce the effect desired. High chimneys, I am aware, have been tried to produce the same effect, but abandoned as useless; also, a peculiar method of constructing furnaces to be more suitable for manufacturing a wrought-iron or sheet-iron immediately from the ore, which furnace may be used for other metallic ores.

Figure 1, Plate 1, represents the furnace, which I call the "side" view, and Fig. 5 the "end" view. It will be seen that this furnace is of an oblong or sort of oval shape. (To prevent confusion, the letters are the same on every diagram which represents the same parts.) *a* represents the body of the furnace; *b b*, the boshes, which are constructed, as well as the interior sides of the furnace, with fire-bricks cemented well together with fire-clay; or a small furnace may be lined with fire-clay entirely. Fire-stone may also be used. This is entirely a matter of discretion by the smelting-master. In building with fire-bricks or fire-stone inside the iron casing, which I prefer being made of boiler-plate *g g*, care must be taken to lay the bricks one on another, so as to "break the joints," as it is called, in brick-work, and the fire-clay, which is used as a mortar or cement, must be finely sifted, so as to lie close and fill up every space between the bricks, that no air may get between them, as the air must be drawn through the masses of the material in the furnace.

c c is a channel all round the furnace, which must be filled with sand of a good quality; and *d d d d* are fire-bricks. The lower part, *e e*, must be of the best material, to resist the heat; and it is better to narrow in that part of the bottom of the furnace marked $e^{\times}$ $e^{\times}$. This part ought to be constructed of the best material, to resist the action of the fire. The whole of this furnace, except the opening of the bottom, must be air-tight; and I therefore prefer it being surrounded by an iron casing hooped around at the lower part with iron hoops *h h h h*, and the whole supported on pillars $i^{\times}$ $i^{\times}$, the furnace being bracketed to them at *j j*. At the top of the furnace is an upright iron tube composed of plate-iron *k k*, (I should prefer that part which enters the furnace to be of fire-bricks,) which is the receptacle for the ore, &c., which is put in at the top *l*. This tube has a cover, *m*, which is raised up by the lever *n*, working on a swivel-joint at *o*, so that when it is risen up it can be moved to the right or to the left, to enable the workmen to fill the tube with the necessary material. This cover fits, as is seen, in a recess, *p p*, which is filled with water or sand, to keep the joint as air-tight as possible.

$M^{\times}$ is supposed to be a truck containing ore. &c.

q q is the stage upon which the workman stands. This stage may be supported by pillars *r r*, or by any convenient means.

S is the exhausting-tube, which goes on to the exhauster, Fig. 2, $D^{\times}$, placed in any convenient situation, it matters not how far in any reason from the furnace—say, one hundred yards—so that a continuation of the tube is carried to it. This exhauster is represented by a fan, which I prefer for general purposes, which is composed of a number of leaves, *t t*, and it is fixed upon the axle *v*, which is seen on a large scale, Plate 2. These leaves are set at an angle, so that when the fan turns it screws the air out of the furnace and causes a rush of air into the slots or apertures all round the bottom of the furnace at *u u*, which causes the ore to be reduced and the metal to run from it. The gases produced from combustion are drawn away in the direction of the arrows. The exhauster Fig. 2 is fitted on the shaft *v*, which shaft is held in the bearing u $u^{\times}$ $u^{\times}$, and the shaft is turned by the pulley *w*, by a strap attached to the motive power. This fan should be placed near the ground, to give it a solid foundation, as it has to be turned with great

velocity; and I recommend that this fan should never be of a greater diameter than four feet; but when more exhaustion of air or gases is required than will be given by one of that size, to have two, or even three or more should be used, and, should one get out of order, the furnace might go on during its repair. They are easily arranged so that the tube from each fan or exhauster may be connected with the main exhaust-pipe, and a means of shutting the tube off by a sliding door, so as to shut off the exhauster that requires repairing.

X X, Fig. 2, represents a firm brick or stone foundation or pier, and *y y* iron bolts, which pass down it and firmly hold the plate to which the bearings $u^{\times}$ $u^{\times}$ are attached.

Z represents a safety-tube in case of slight explosion by ignition of the gases. This tube is bent downward, like a siphon, and passes down into a cistern, $a^{\times}$, containing water, and, should an explosion take place, the water only surrounding the tube is displaced, as there is a partition, $c^{\times}$, in the cistern, and the communication between the two parts is by holes, as seen at $b^{\times}$. There is also a communication from the siphon-tube *z* with the exhausting-tube *s* by a tube, $d^{\times}$, by which means the air and gases are more regularly drawn off at the top of the furnace. At the lower part of the furnace, at $g^{\times}$, is the crucible, for the reception of the melted metal or slag. I prefer having a slag-slot in three places—viz., one at each end and one at the middle of one of the sides—seen in Fig. 8, $h^{\times}$ $h^{\times}$ $h^{\times}$. I require these outlets to free the metal from slag and impurities as soon as possible. $k^{\times}$ may be used for a tapping-hole to remove anything out that may be accumulated at the bottom of the furnace. The crucible underneath the furnace runs on wheels $h^{\times}$ $h^{\times}$ upon a rail, in order that the lumps or balls of metal may be easily removed when wrought-iron is produced; and in some cases the lumps or balls, when carbon may have got mixed with them, may be easily placed in a sweating-furnace, or piling for a short time, to burn these pieces out before placing them under the hammer. Before the crucible is removed a few iron rods ought to be placed underneath the bottom of the furnace and propped up, so as to prevent the upper part from coming down while the balls are being removed. In this operation the crucible need not be moved more than one foot to one foot six inches either way, to easily remove the loops or balls. There is another plan I prefer to adopt for moving the crucible, as seen at Fig. 4, in which the crucible is raised or lowered by a hydraulic press.

$i^{\times}$ represents the crucible; $j^{\times}$, the piston of hydraulic press; $k^{\times}$ $k^{\times}$, the body, and $m^{\times\times}$ the feed-pipe to the pumps, and $k^{\times\times}$ the foundation, the arrangement of the press being too well known to need any description. If the crucible is very long, I should prefer two hydraulic presses, both attached to the same force-pump. I think this would elevate the crucible better. By employing this hydraulic press any required size or width of the openings for the admission of air may be easily made. All these crucibles are in an iron casing. These movable crucibles will also allow of repairs being easily made in that part of the furnace which burns away.

Fig. 5 represents the end view of the furnace, and Figs. 6, 7, 8 plan views. It will be seen by them that the furnace is nearly twice as wide one way as the other, and the crucible Fig. 8 is much more so. Fig. 6 represents that part of the furnace cut through at the red line A B, and Fig. 7 as cut through at the red line C D, and Fig. 8 the upper part of the crucible. $i^{\times}$ $i^{\times}$ $i^{\times}$ $i^{\times}$ $i^{\times}$ $i^{\times}$ $i^{\times}$ $i^{\times}$ are the base of the columns which support the furnace.

$e^{\times}$ is a piece of metal, but if made of fire-clay and baked, it would be much better. It is a conical-shaped piece supported by stays $m^{\times}$ $m^{\times}$. It has an elongated piece attached to it at $n^{\times}$. This is to divide the ore and materials as they pass down the tube R K, and lay them against the sides of the furnace as I desire them, if the ore and materials are put into the upper part in regular layers.

The operation of the furnace is very simple. Ore, lime, and carbon are placed in the usual way in the upper part, the fire is lighted in the usual manner, and when the furnace is sufficiently heated the fan is first put in slow motion and gradually increased. I place a water-gage on the exhaust-pipe, and commence the strength of the exhaust, say, at two inches water, increasing to four, five, six, seven, eight, nine, ten inches, as you find it desirable. The ore is very speedily reduced or melted, and the gases are withdrawn as generated, as larger or smaller surface of material may be acted upon at the will of the operator, and exposed to the influence of the oxygen of the atmosphere by lowering the crucible, which decarbonizes the metal and produces wrought-iron. This decarbonization can be increased or decreased, according to the nature of the metal desired, by raising or lowering the crucible with the hydraulic press, or by plugging up portions of the slots *u u* of the movable crucible on the rail. Bodies in a pulverized state, or gases, may be admitted or drawn in among the molten metal, to assist in any change of the metal, as may be desired.

Sheet 2 represents the fan or exhauster. Fig. 1 represents a partial front view; *v*, the shaft; *g g*, two keys to hold the exhauster tight upon the shaft. *m* is a cast or wrought iron boss. All the letters are placed upon the same parts in the different views. *s s s s* and *u u u u* are bolts and nuts, which attach the two plates or disks *k* and *l*, to which are fixed the leaves *t* of the fan. The flat metal piece *r* is riveted to the inner plate, *l*, and is twisted a little at $r^{\times}$. (Better seen in Fig. 2.) This twist is necessary to fix the leaf *t* by the rivets *n n n*, and the rivets *g g g* attach it to the disk *l*.

Figs. 3 and 4 are the curvatures of the blades of the fan, Fig. 3 being the undermost side and

Fig. 4 the upper side. Fig. 5 represents the leaf fixed to the twisted piece *r* and $r^{\times}$ with its curvature, and *k* represents an edge view of the disk *k*, to which the upper part of the leaf is riveted.

Having fully described my invention, I claim and desire to secure by Letters Patent—

1. The use of the exhaust-pipe in connection with a fan, pump, or others means to exhaust the foul air and gases, and cause a current of air to pass through the bottom or apertures of the furnace, of sufficient density for the smelting and purifying iron and other ores, in the manner and for the purposes above set forth.

2. The exhaust-fan constructed and operating as herein explained.

3. The use of the movable crucible, as described, and for the purposes above set forth.

In testimony whereof I, the said ROBERT WILLIAM SIEVIER, hereto subscribe my name, in the presence of witnesses, whose names are hereto subscribed, on 27th day of April, A. D. 1859.

R. W. SIEVIER.

In presence of—
S. Q. STOKES,
JOHN B. MILLER.