

(No Model.)

2 Sheets—Sheet 1.

S. BISSELL.
METALLURGICAL FURNACE.

No. 286,110.

Patented Oct. 2, 1883.

Fig. 1.

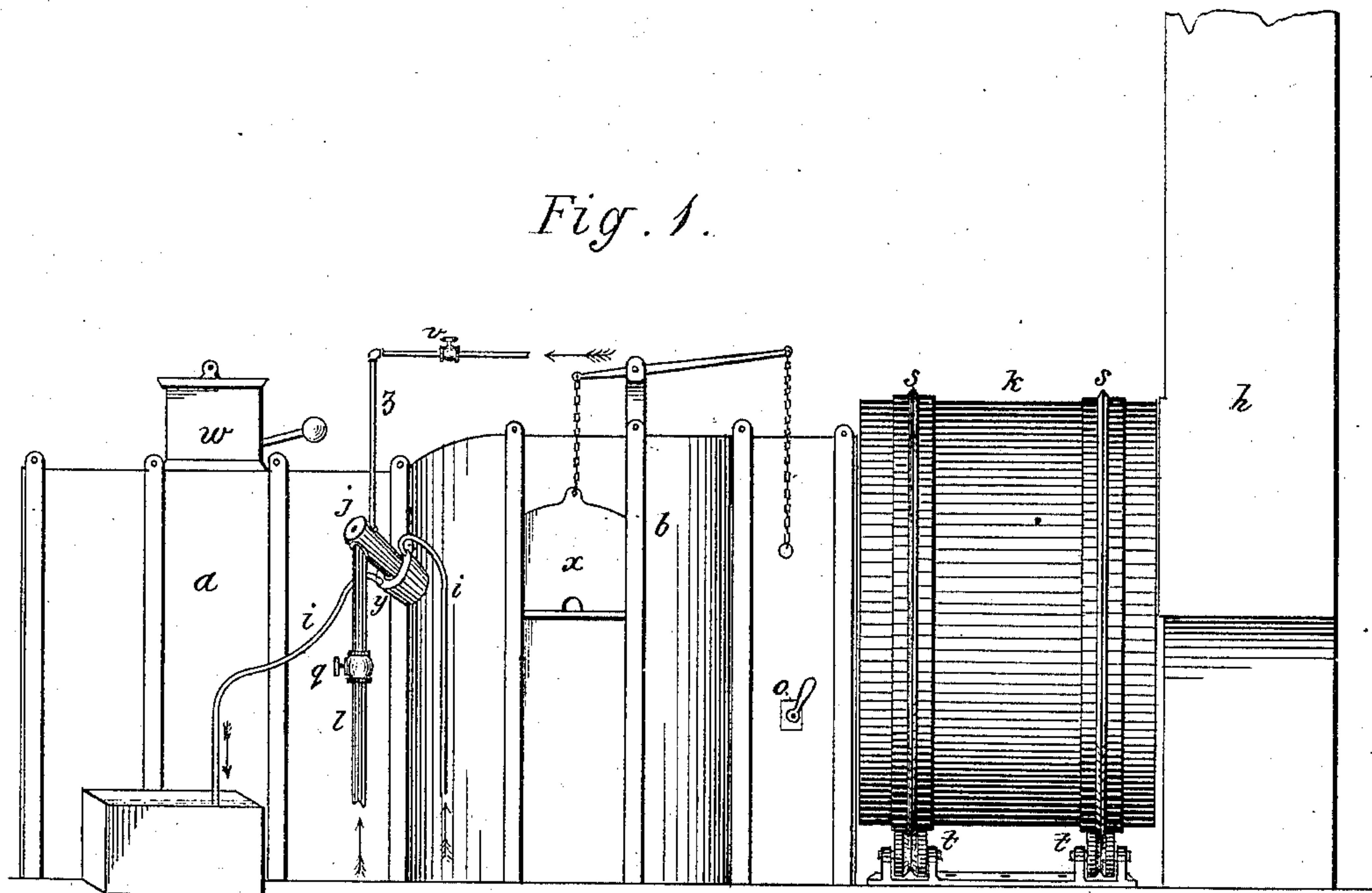
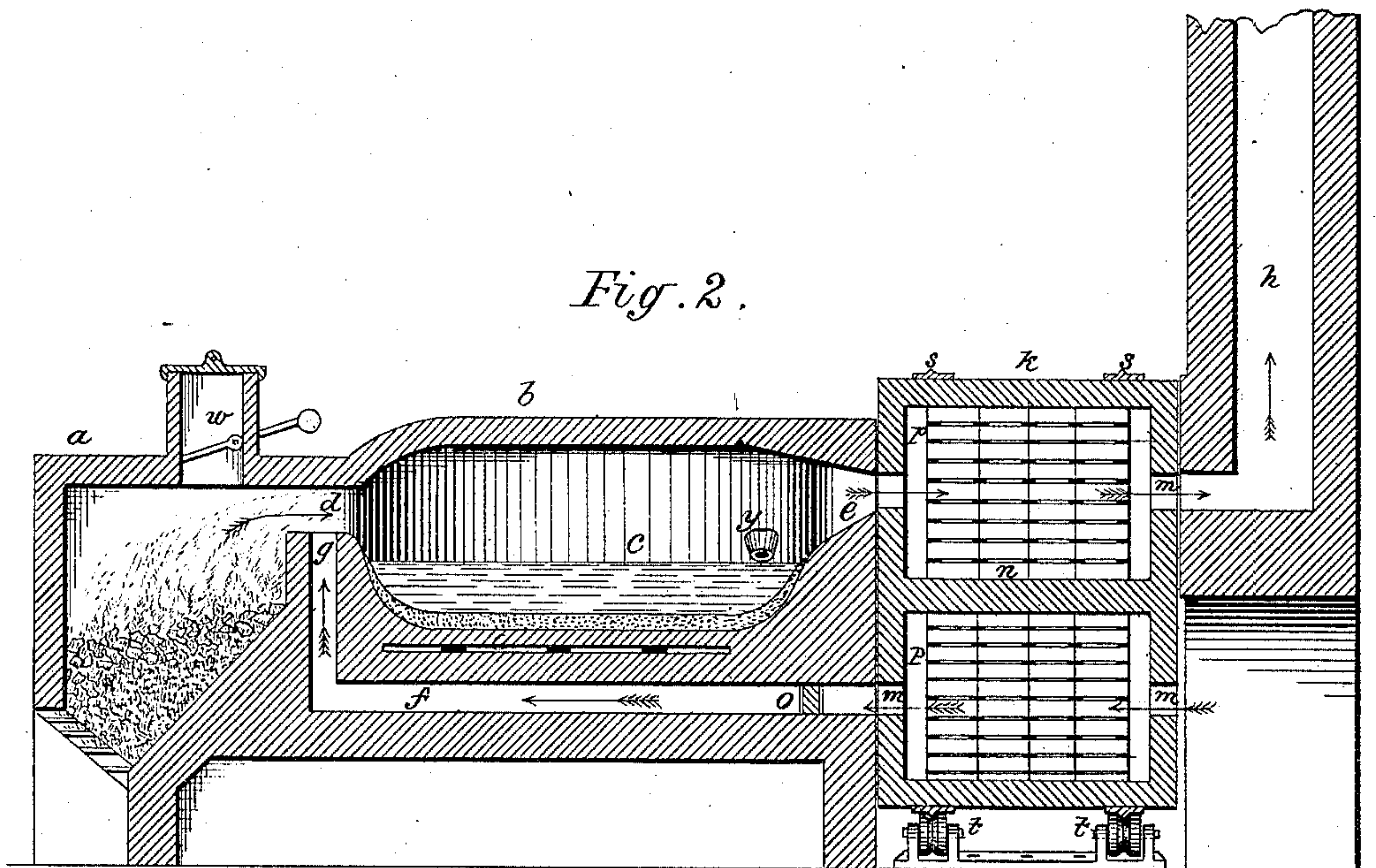


Fig. 2.



Witnesses

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(No Model.)

2 Sheets—Sheet 2.

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Fig. 3.

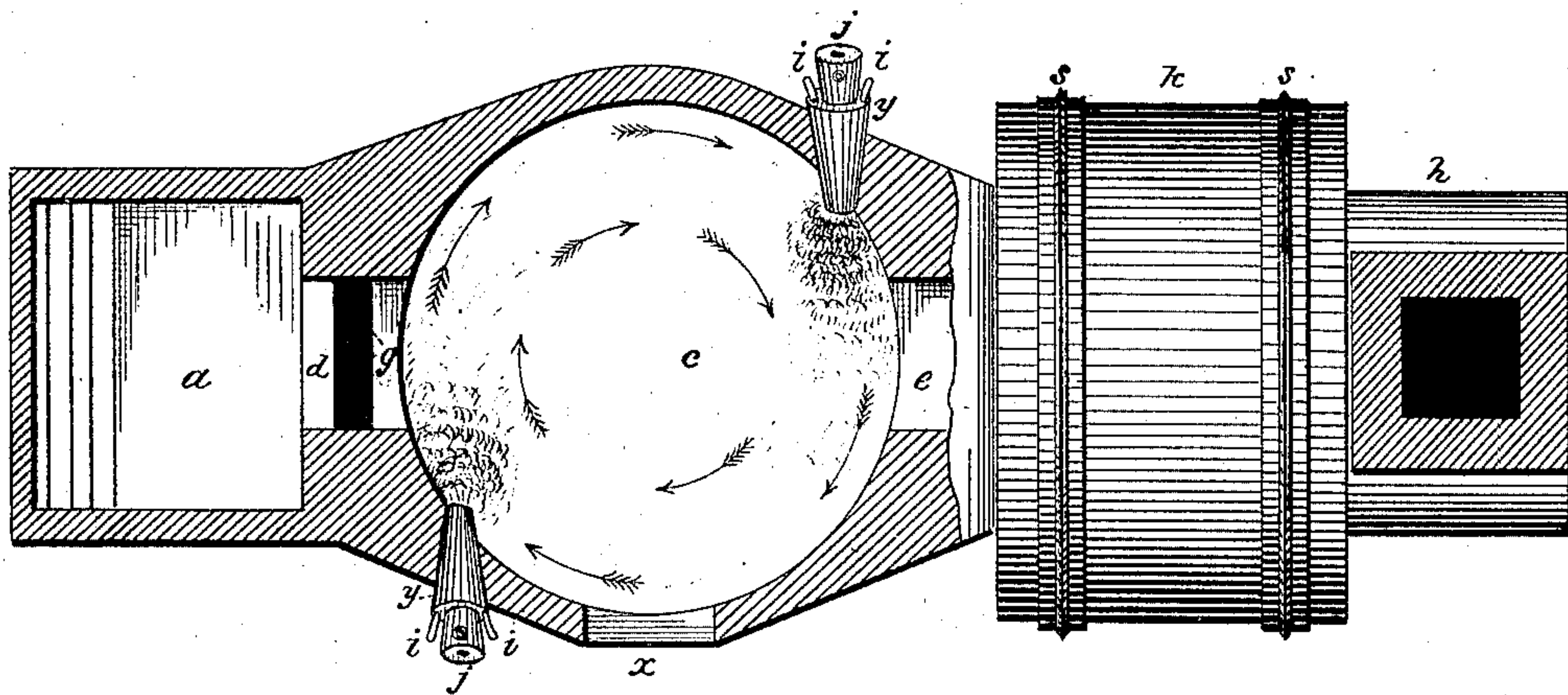


Fig. 4.

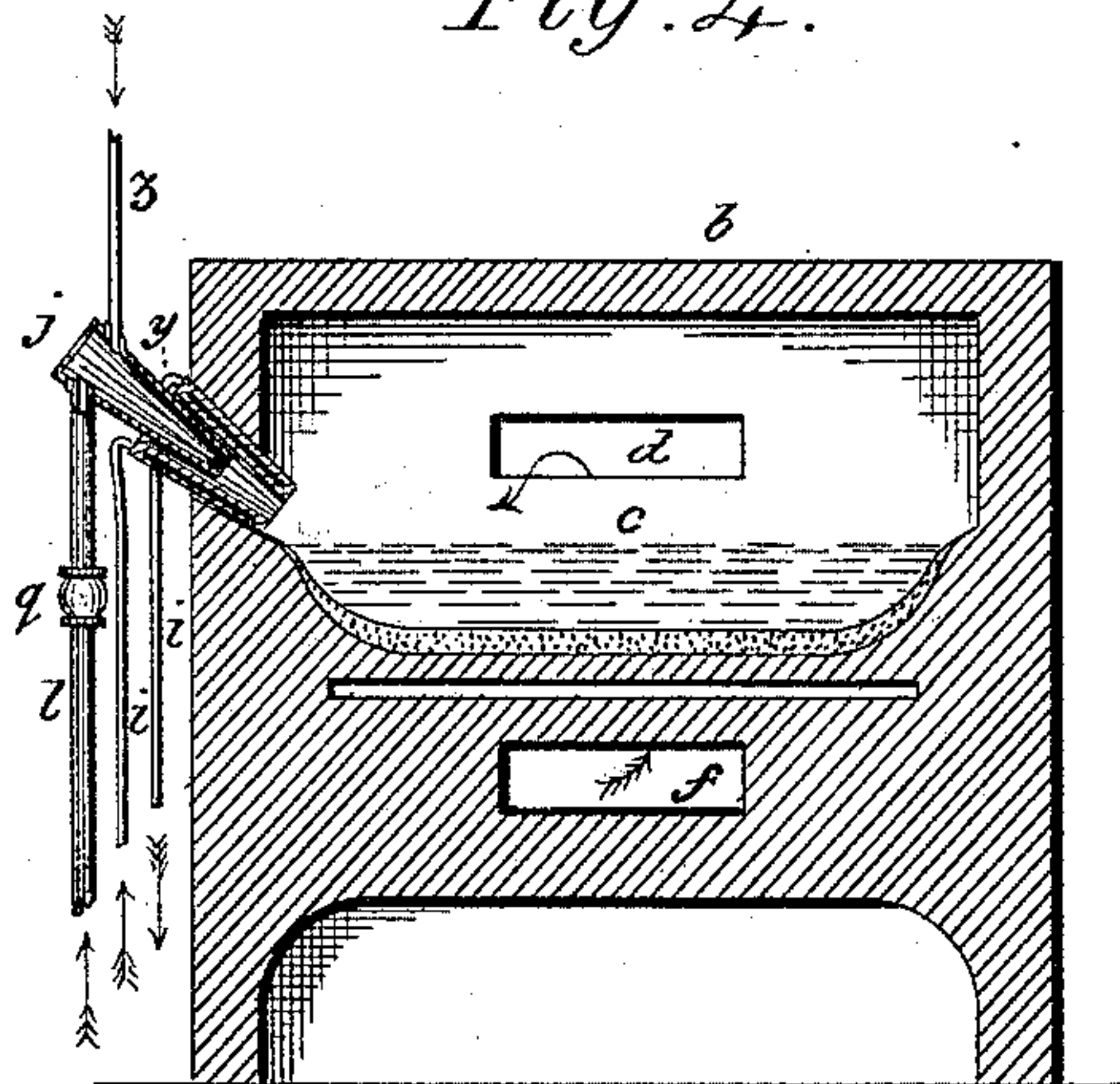
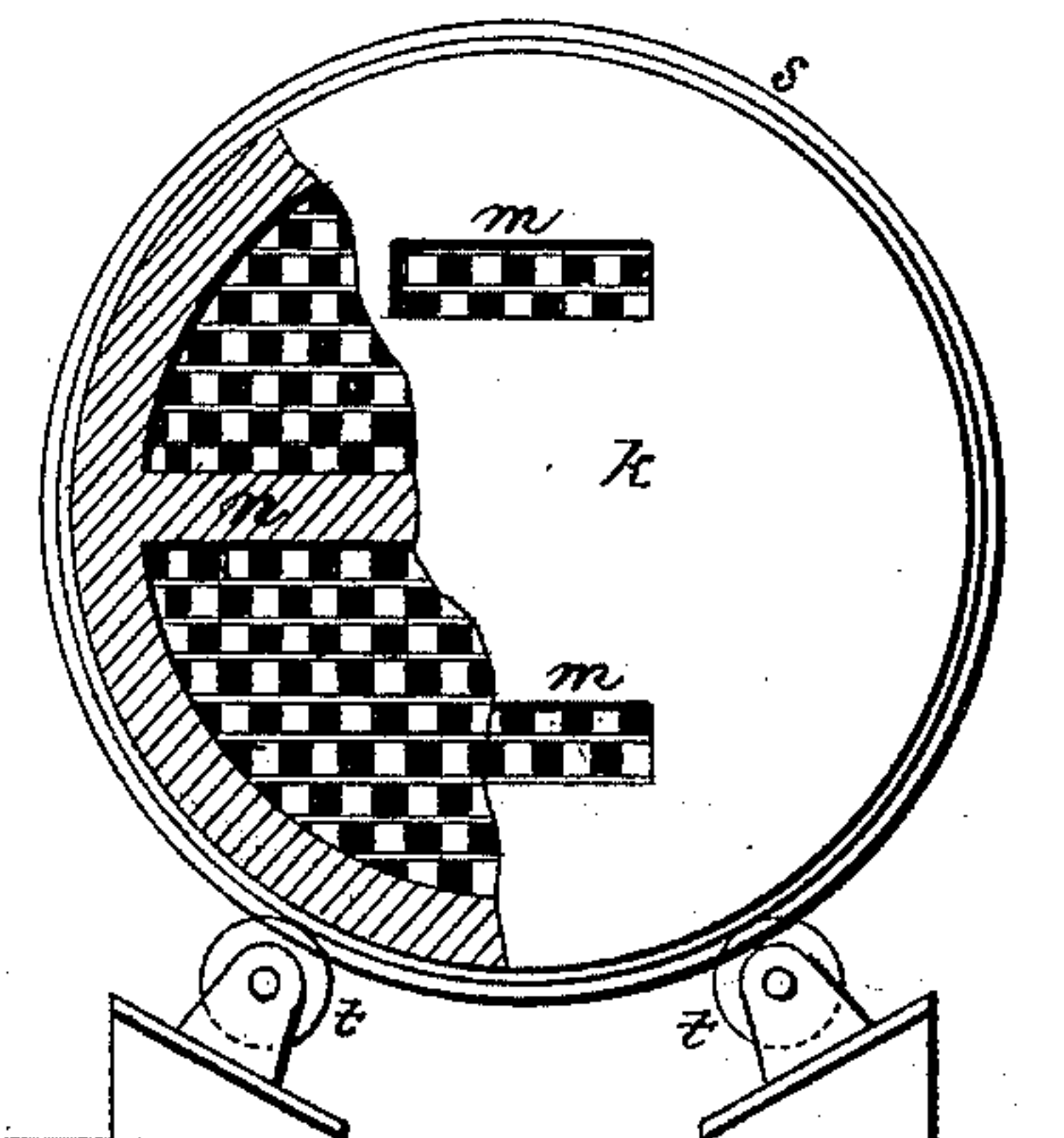


Fig. 5.



Witnesses.

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UNITED STATES PATENT OFFICE.

SIMEON BISSELL, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THOMAS
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METALLURGICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 286,110, dated October 2, 1883.

Application filed December 15, 1882. (No model.)

To all whom it may concern:

Be it known that I, SIMEON BISSELL, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and Improved Metallurgical Furnace, of which the following is a specification.

The object of my invention is to provide a superior means whereby crude iron may be rapidly melted, purified, and converted into various grades of steel or fibrous wrought-iron; and for the accomplishment of my purpose it is better that the furnace should be so constructed as to obtain the greatest amount of heat from a given quantity of fuel, and that such heat should be as free as possible from matter that may act injuriously upon the iron. To this end I prefer a furnace that is constructed to make and consume gaseous fuel, and is provided with one or more "regenerators" applied to receive the waste heat and subsequently communicate the same to the air supporting combustion.

My invention relates, among other things, to a furnace provided with a suitable chamber for producing gaseous fuel by a slow combustion or dry distillation of carbonaceous matter, which gaseous fuel, on being eliminated, is conducted directly into a melting or metal-working chamber, mingled with a requisite quantity of air heated to a degree of temperature necessary for bringing about a perfect combustion and generating an intense flame, the superfluous heat or unused products of combustion passing from thence into and through a regenerator or third chamber filled with openly-arranged fire-brick or other refractory material, eventually escaping by way of the chimney. Heretofore all such regenerators have been constructed rigidly immovable, requiring an intricate system of flues, dampers, valves, and valve-chests to bring about a change in the current of air from a cool regenerator to one containing greater heat, which transfer reverses the direction of the current of air, so that it enters first at one end of the furnace and then at the other, which for many purposes is disadvantageous and inconvenient.

The first part of my invention consists of a stationary furnace, in combination with a double-chambered regenerator, so constructed

as to admit of being rotated the requisite distance to bring one of its chambers into that position whereby the air for supporting combustion shall pass through it on its way to the furnace, and the other chamber in such position that the flame and heated products of combustion escaping from the furnace shall go through it before entering the chimney, and when such chamber becomes intensely hot the regenerator may be turned or rotated till its chambers reciprocally change places with relation to the furnace and the chimney, so that the current of ingoing air is caused to traverse the heated chamber, and the flame through the one which the air previously passed through, and thus the chambers are alternately heated and impart their heat to the air without requiring an alteration in the direction of the current.

The second part of my invention consists in a combination, with the melting or working chamber of a gas-burning regenerative metallurgical furnace, of one or more tuyeres so arranged with respect thereto that a powerful blast of air, either by itself or mingled with other matter, may be forced upon and into a body of molten metal contained within such chamber, which blast, by means of suitable valves, may be regulated, controlled, and adapted to the requirements of making steel, or admitted with a force sufficient to disturb and agitate the molten iron enough for reducing it to a condition known as "puddle-ball," thus avoiding physical labor incident to the making of fibrous wrought-iron by the ordinary puddling process.

To enable others to fully understand my invention, I will proceed to describe it by reference to the accompanying drawings, wherein—

Figure 1 represents a side elevation of my improved metallurgical furnace; Fig. 2, a central longitudinal vertical section thereof; Fig. 3, a top view, partly in horizontal section; Fig. 4, a transverse vertical section taken through the melting or working chamber and one of its tuyeres; Fig. 5, an end view of the regenerator, its shell partly broken away to exhibit the interior.

My invention is applicable to a furnace burning solid fuel; but I prefer to apply it to one

wherein a gaseous fuel is used, and to that end I erect a gas-producer, *a*, of suitable size and form, and connect therewith a furnace, *b*, having a circular basin, *c*, and provide the same with the usual port or passage-way, *d*, for the gas and outlet *e* for the waste products of combustion, and in addition thereto with a horizontal airway, *f*, extending from the rear end of the furnace underneath the basin of the combustion-chamber *b* into a vertical flue, *g*, communicating with the gas-inlet *d*. Back of this furnace, between it and the chimney *h*, is arranged my improved regenerator, the shell of which is constructed of strong iron plates riveted together to form a large drum-shaped vessel, *k*, through each head of which are two oblong holes, *m m*. This shell is lined with highly refractory material, and is provided with a strong wall, *n*, extending from side to side across its axis to form two semicircular chambers, *p*, each being filled with fire-brick, arranged in open order to leave small interstices between them, arranged in such a manner as to constitute a number of sinuous and tortuous passage-ways throughout. Care should be taken to have the bricks well secured to prevent displacement by rotation of the regenerator. Around this drum-shaped vessel *k*, and near each end thereof, is a stout iron band, *s*, or circular tread corresponding with the grooves in four small anti-friction wheels, *t t*, upon which the vessel rests, moves, and is guided while being rotated, which rotation may be brought about by suitable gearing or any means found in practice more effective or expeditious by which a partial or complete rotation may be given. This regenerator is to be arranged with relation to the furnace, so that when working one of the holes *m* nearest its axis shall coincide with the exit-flue *e* of the combustion-chamber *c* and the other hole *m* with the air-passage *f* underneath. One of the holes *m* in the opposite end of the regenerator, when brought to that point, will correspond to the flue of the chimney *h*, while the other hole will be open to the atmosphere.

The regenerator having been constructed and combined with the furnace, as shown and set forth, and a fire built in the producer or gas-retort *a*, and its walls brought to a proper heat, fresh coal is to be introduced through the hopper *w*, and sufficient air admitted to sustain a slow combustion of the coal, and thereby generate rich combustible gases, which pass through the gas-channel *d* and enter the combustion-chamber *c* at a low heat, mingling with the air entering by way of the vertical passage *g*, producing a flame that, after traversing the combustion-chamber, passes out by the exit-flue into that portion of the regenerator in a position to receive it, and, after coursing through the sinuous interstices between the bricks, escapes by way of the chimney. As soon as these bricks become highly heated, the regenerator may be revolved to change the relative position of its chambers,

whereby the ingoing air is compelled to traverse the heated mass of brick-work, and by this means have its temperature raised to nearly the same degree, which, on reaching the inflammable gases leaving the producer, brings about a better combustion and intensifies the flame, causing the interior of the melting and working chamber to become highly heated. Upon the superfluous products of this violent combustion entering the regenerator, the second pile of bricks are in turn heated, but to a greater degree and sooner than the first, so that by the time those through which the air is passing have somewhat cooled, the second chamber may be brought into action and made to do duty in imparting their increased temperature to the ingoing air.

This furnace is provided with a door, *x*, that leads into its melting and working chamber, the basin *c* of which is circular and preferably saucer-shaped, and through each side thereof is arranged at a downward inclination a water-tuyere, *y*, located above the molten metal and at right angles to a line drawn through the center of the basin and lengthwise of the furnace, and otherwise so placed that the blast issuing therefrom will take a forced circular direction around the sides of the basin. These tuyeres *y* are provided with the usual inlet, *i*, and outlet *i*—pipes for supplying them with a running stream of water—and in that respect, outside of the use I make of them, are nowise different from those of ordinary construction. Inserted in each tuyere is the nozzle *j* of a blast-pipe, *l*, that is furnished with a valve, *q*, for admitting and controlling the quantity and force of blast. And, in addition to the air-pipe *l*, the nozzles are severally provided with a small steam-supply pipe, *z*, and valve *v*, for purposes hereinafter set forth. To lessen or stop the current of heated air passing into the furnace, a sliding damper, *o*, is arranged in the air-passage *f* at any convenient point between the regenerator and the combustion-chamber.

The several parts of my improved metallurgical furnace having been constructed, combined, and arranged with respect to each other as shown and set forth, and the melting or working chamber having attained the necessary degree of heat, pig-iron or other character of ferruginous metal to be operated on is to be introduced within the melting-chamber in a quantity sufficient to make a "charge" consistent with the size of the furnace, which metal will soon be brought to a molten condition so fluid as to be readily penetrated by a concentrated strong blast of air directed upon its surface. When the metal is in this condition, if a sufficiently strong blast of air be forced through the tuyeres, it will not only penetrate the molten mass, but, owing to their peculiar arrangement thereto, will cause such molten iron to circulate around the furnace-basin with a lively agitated swirl, thereby so disturbing and stirring it up that every par-

5 ticle of the iron will in a short time be brought
 under the influence of the flame; and such is
 the affinity of oxygen for highly-heated car-
 10 bon that the full force of the blast cannot be
 continued very long before most of the carbon
 and foreign matter contained within the iron
 is either dissipated or converted into gaseous
 oxide that passes away. As this takes place
 the metal becomes finer by degrees, reduced,
 15 as it were, to a state of incoherent sand. When
 in this condition, if the blast be shut off or
 lessened and the heat augmented, the particles
 of metal will begin to agglutinate, and nothing
 remains but to gather the iron into balls, which
 20 are subsequently removed and taken away to
 undergo the usual operation of squeezing and
 rolling necessary to condense, shape, and fit it
 for the market as fibrous wrought-iron. When
 low-grade steel is to be the product, the fluid
 25 mass of molten metal may be gently or vio-
 lently stirred by means of either a hot or cold
 blast, and a small jet of steam may be momen-
 tarily admitted, either by itself or with the
 blast, which, on coming in contact with the
 30 molten iron, will combine with the sulphur
 contained therein and form sulphureted-hy-
 drogen gas that escapes on being disengaged;
 and when at any period of the process a smoky
 or carbonizing flame is desirable, the same
 35 may be had by closing the hot-air passage lead-
 ing from the regenerator to the combustion-
 chamber. As crude iron contains much more
 carbon than is found in steel, the blast is prin-
 cipally employed to combine with and elimi-
 40 nate the excess; but as no rule has been estab-
 lished or plan laid down for determining the
 precise period when the amount of carbon
 has been removed from the molten iron to
 leave it with the exact quantity suitable for
 steel, it becomes wholly a matter of test and
 experience, varying greatly with the charac-

ter and quality of iron, and for that reason
 cannot be described or set down with any de-
 gree of certainty in this specification.

It is apparent that when natural gas or gas 45
 previously produced and stored in a reservoir
 is used the producer, in connection with the
 working-chamber, may be dispensed with.
 The purpose of revolving the generator is
 merely to change the position of its chambers 50
 when the one through which the air passes be-
 comes cool, so as to effect a transfer of the
 same from one position to the other; and while
 I prefer the construction shown, I claim,
 broadly, the combination by which this result 55
 may be obtained.

Having thus described my improved metal-
 lurgical furnace and the mode of treating iron
 therein, I claim—

1. The combination, with a gas-producer 60
 and the working-chamber of a furnace, of a
 revoluble regenerator and means of rotating
 the same, substantially as described.

2. The combination, in a metallurgic furnace,
 of a gas-producer, a metal-working chamber 65
 provided with side tuyeres, and a revoluble
 regenerator connected with the producer and
 working-chamber, substantially as described.

3. The combination of a gas-producer, a
 metal-working chamber provided with side 70
 tuyeres, a regenerator and means for rotating
 it, and connections, as described.

4. The combination of the working-chamber
 of a furnace with a movable regenerator capa-
 ble of having its chambers shifted to afford 75
 passage for the inflowing air and outflowing
 products of combustion alternately, substan-
 tially as and for the purposes described.

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Witnesses:

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