

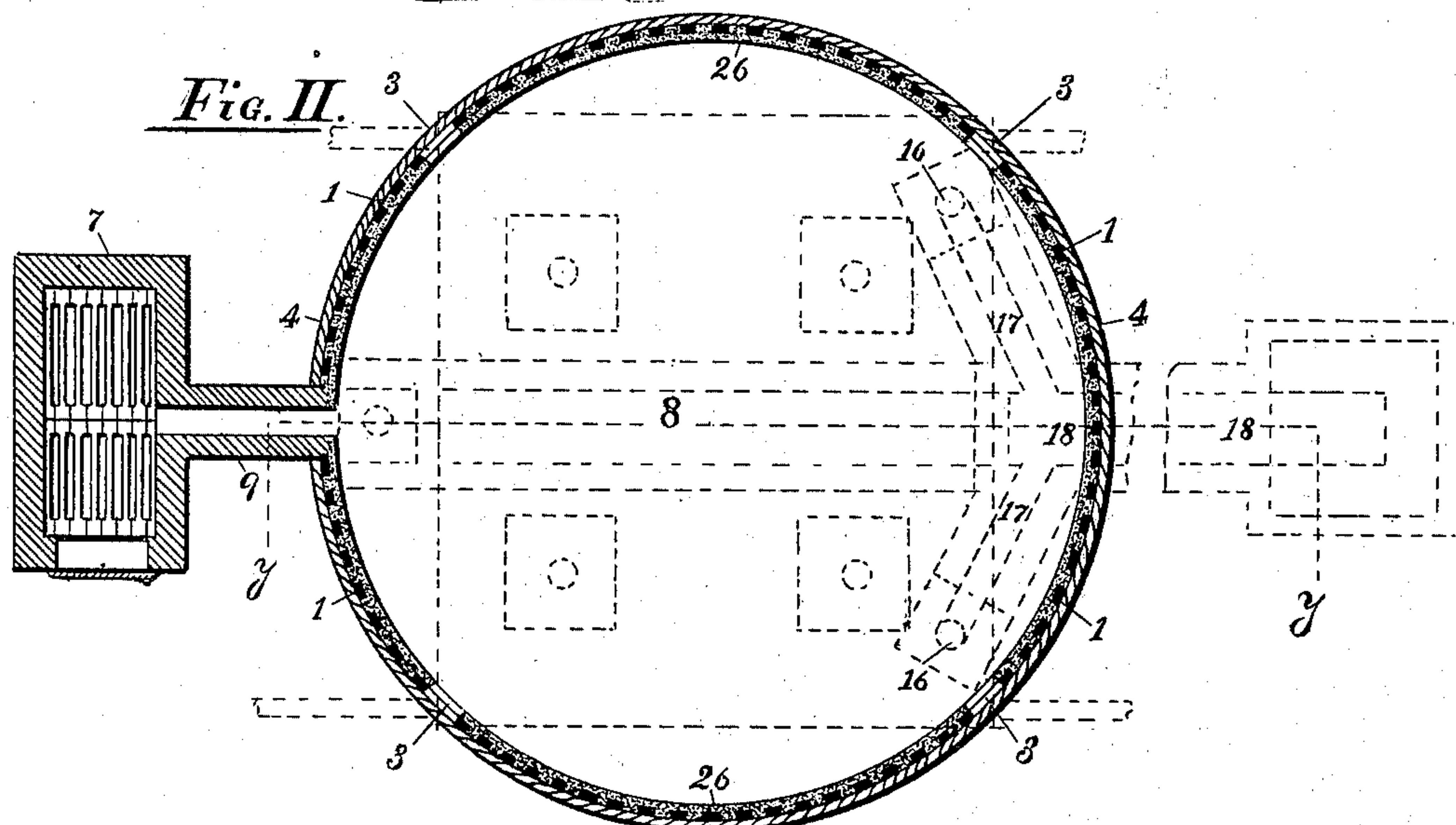
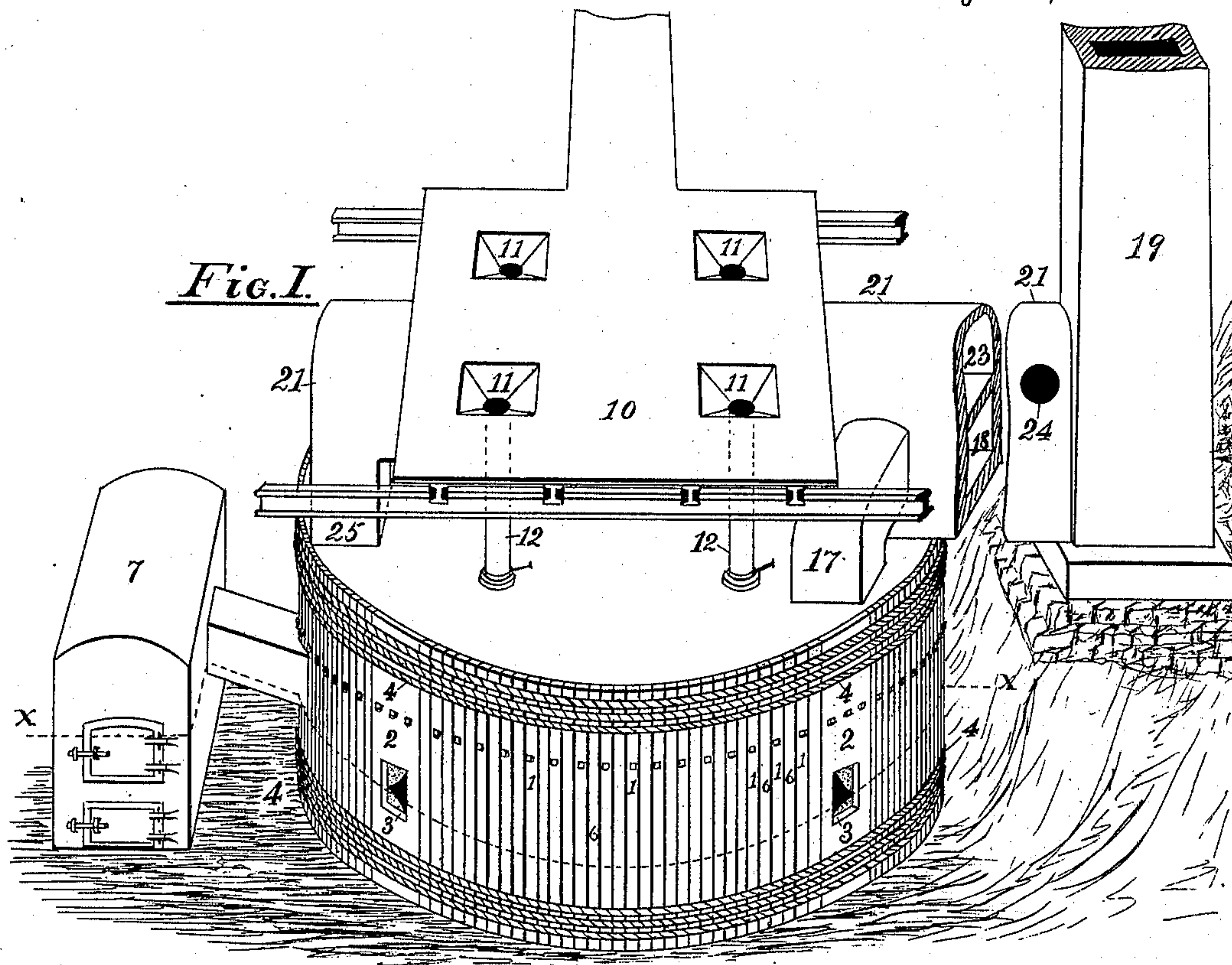
(No Model.)

2 Sheets—Sheet 1.

H. LANG.
SMELTING FURNACE.

No. 604,054.

Patented May 17, 1898.



Witnesses

Inventor

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K. Lockwood-Nevers.

H. Sanderson

Herbert Lang

Richards
Attorney

Attorney

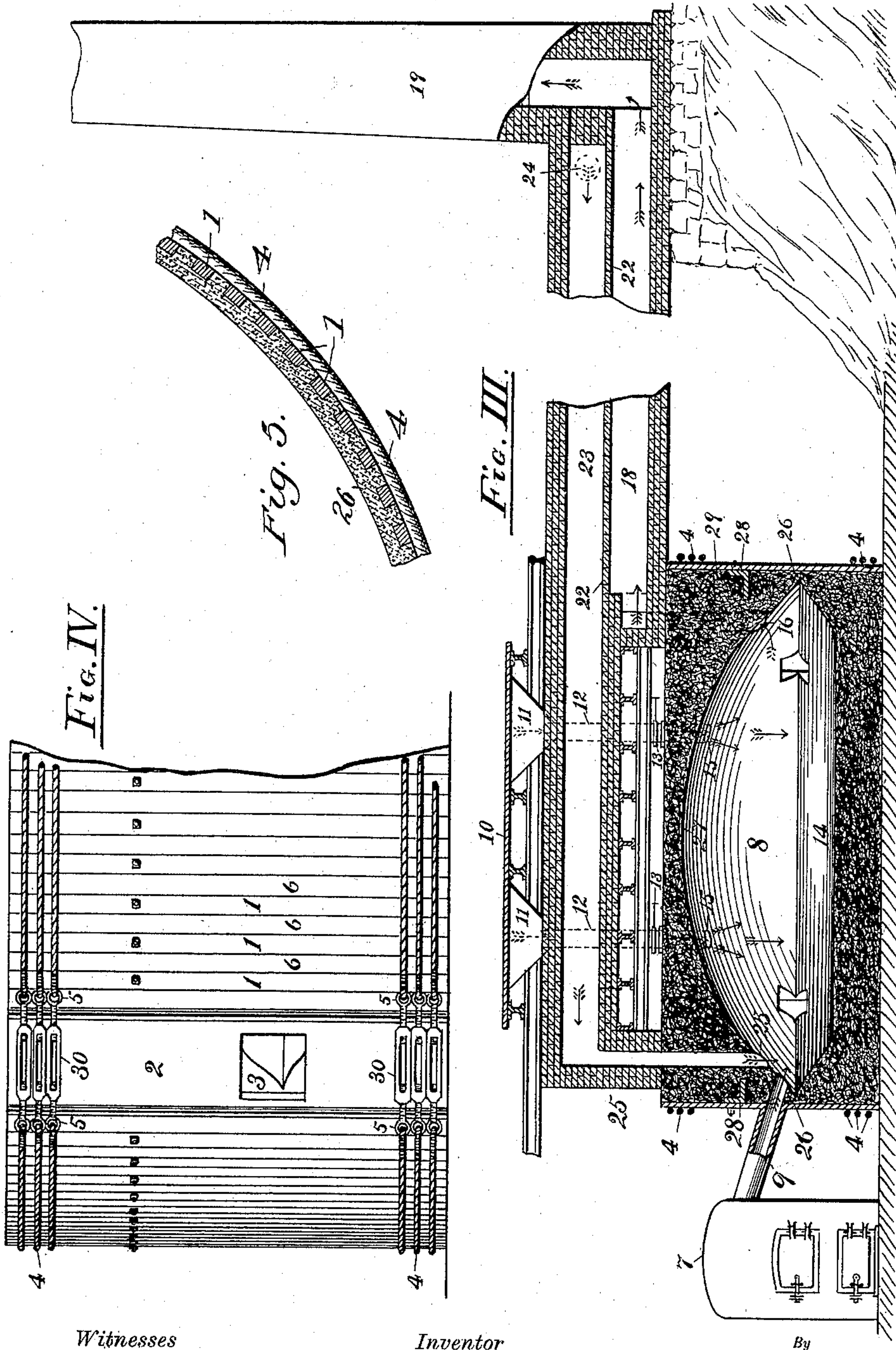
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UNITED STATES PATENT OFFICE.

HERBERT LANG, OF OAKLAND, CALIFORNIA.

SMELTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 604,054, dated May 17, 1898.

Application filed February 18, 1897. Serial No. 624,068. (No model.)

To all whom it may concern:

Be it known that I, HERBERT LANG, a citizen of the United States, residing at Oakland, county of Alameda, and State of California, have invented certain new and useful Improvements in Smelting-Furnaces, of which the following is a specification.

My invention relates to furnaces for smelting mineral ores such as contain gold, silver, copper, nickel, and the like, also to heating and puddling furnaces in which iron and other metals are treated by heat, and to that type of furnaces commonly called "reverberatory."

My improvements consist, first and essentially, in constructing such furnaces in cylindrical form, thereby saving in area occupied and attaining complete and compensating support by encircling bands; in providing support for the roof or arch of the furnace independent of the sides thereof, thus enabling the latter to be made thin enough to lower the temperature and prevent erosion at the sides of the hearth; in an improved method of heating and supplying air to the furnace; in increasing the area and convenience of the working space in the furnace and avoiding dead spaces, and the avoidance of projecting or obstructing corners that permit impingement of the hot gases that prevent the even heating of the whole working space.

My invention further consists in constructing the arch or roof of such furnaces of grouted or plastic concrete, of quartz, clay, or other refractory material without layers or courses, but as a homogeneous mass held and supported from the exterior of the furnace, and in various other features and details that will be more fully pointed out in connection with the drawings forming a part of this specification.

The objects of my invention are to provide for systematic form of construction, the convenient removal and replacement of such parts as are exposed to destructive wear or accident, an increased efficiency in product and convenience in working, a greater endurance of all parts, and economy of fuel. To this end I construct my furnaces as shown in the accompanying drawings, in which—

Figure I is a perspective view of a smelting-furnace constructed according to my in-

vention. Fig. II is a plan view in section on the line xx in Fig. I, the dotted lines indicating some parts above this line. Fig. III is a longitudinal section through the furnace and air-flues on the line yy in Fig. II. Fig. IV is an elevation of a portion of the furnace, showing the connections of the bands that encircle and support the whole. Fig. V is a view showing a portion of the walls of the hearth in enlarged detail.

Like references indicate corresponding parts in the several figures.

The furnace as a whole is disposed in a true circular form surrounded by vertical staves or stays 1 set equidistant around the perimeter between the wider plates 2, through which are doorways 3, the whole being encircled or hooped by bands 4, preferably of wire rope, attached to the shackle 5 and adjusted by turnbuckles 30. These encircling bands 4, unlike cross-stay rods, act uniformly at all points around the furnace and are compensating as to expansion and contraction, also permit of uniform adjustment by means of turnbuckles, as shown, or other like devices, placed at one or more points around the furnace. These bands 4, when made of wire rope, possess a degree of elasticity, insuring a uniform inward and sustaining pressure at all points, and are thus less liable than solid rods to cause disturbance of the inclosed masonry bound thereby. They can be in separate bands, as shown, or may be continuously wound in a manner too obvious to require illustration.

The spaces 6 between the staves expose the masonry, so as to discover and repair any fracture or disturbance of the masonry-wall that may occur. Such spaces can be enlarged, if desirable, by increasing the depth or radial section of the bars 1 or making them of a channel or other angular section and of less width.

At the side of the furnace is placed a combustion-chamber 7, connecting to the furnace-chamber 8 by a flue 9, conveying the flame and hot gases that act upon the metals or ores being treated on the hearth 14.

Ore is supplied to the furnace from the platform 10 through the hoppers 11 and pipes 12, the latter being provided with cut-off slides 13 or other suitable closing device to

prevent the escape of heat and gases up the pipes 12 after a supply of ore has been admitted. The inlet-ways 15 are four or more in number, so as to distribute the ore over the hearth 14, and are preferably placed as indicated in Fig. I.

The gases of combustion escape from the furnace at 16, pass up through the conduits 17 and into the flue 18, as seen in Figs. I and III, and then on to the chimney 19, as indicated by arrows in Fig. III.

The conduit 21 crosses the furnace centrally over the top and is divided longitudinally by a diaphragm or division 22, thus forming the two flues 18 and 23, the latter providing an air-supply for the furnace. Air is admitted at the inlet-way 24 into the flue 23, and by reason of the larger area of the flue moves slowly over the heated diaphragm 22, is raised to a high temperature, and passes on to the downtake-flue 25 and enters the furnace-chamber 8, there mingling with and intensifying the flame and hot gases from the flue 9 and fire-chamber 7.

In order to complete the combustion of the fuel-gases, the air preheated in the flue 23 enters the hearth at 25 in a downward direction, whereby it is forced into contact with the gases and smoke from the fire-box 7 and, mixing with them, causes a vivid combustion at the point of contact. Also the incoming air being forced under pressure upon the hearth has its current spread outward in the shape of a fan, whereby it is driven into all parts of the furnace and heats all of the hearth instead of drifting straight across the bottom, as it would do if it were not under pressure. By directing it downward the extreme heat of combustion is diverted from the roof or sides, where the flames would converge if the ordinary construction were followed, and is concentrated upon the bottom where the ore lies, and a better effect is produced.

Reverting now to the operation of the furnace and the conditions that arise out of its cylindrical construction, I will first point out that the masonry can be of any refractory material—such as clay, quartz, sand, or combinations of these—built in on forms to support the roof until the material sets or hardens. The whole being a homogeneous mass, as indicated in the drawings, is disposed uniformly all around the furnace-chamber 8, taking the same temperature at each zone or radius and is subjected to uniform heat within such zones.

To provide for sustaining the roof or arch 27 of the furnace and other weights thereon, I employ a series of angular brackets 28, bolted to the braces or stays 1 and 2 and are thus embedded in and support the masonry 29, so that but little, if any, weight falls on the narrow section of the sides at 26. For this reason and others to be hereinafter explained I am able to uniformly reduce the thickness of the sides at 26 to such degree as to lower the

temperature there, harden the slag, and prevent the usual cutting and erosion, which forms a formidable objection and loss in operating smelting-furnaces of the common form.

In ordinary reverberatory smelting-furnaces repairs to the edges of the hearth, which are continually demanded, are effected by introducing clay, quartz, or other refractory material through doors in the sides of the furnace by means of long implements, the work of the furnace being suspended when such repairs are made. This operation, technically called "fettling," is seldom necessary in a furnace constructed according to my invention. In any case the work can go on, because the circular form permits all parts of the interior to be reached from the doors 3, and repairs, if any are required, can be made while the furnace is in operation. Fettling is, however, seldom required.

The thickness of the sides at 26 may be only a few inches and much less than in furnaces as usually constructed. The furnace-chamber 8 is by this means enlarged in dimensions and capacity to this extent, amounting to ten to twenty per cent. more than in a common furnace of equal outside dimensions. There is also the further gain in this feature of thin side walls, the before-mentioned advantage of avoiding the cutting effect of the slag, which ceases as soon as the temperature falls, by conduction through the thin wall at 26, so there is no danger of the furnace being cut through at the sides. There is also the further gain in my form of constructing furnaces that the flames and heat from the combustion-chamber 7 reach equally all parts of the furnace-chamber, avoiding dead spaces, consequently no erosion of certain parts by direct impingement of hot gases and flame on certain parts of the masonry and lining.

The method of external support by adjustable encircling bands 4 is quite different from the usual means employed in respect to equalization and compensation throughout. These bands when made of wire rope are in a degree elastic and can, if required, be in single wraps and be drawn at any time by turnbuckles 30 or other suitable device of the kind placed at one or more points around the furnace. The number of ropes or wraps can be in proportion to requirements or the size of the ropes used and the rigidity of the staves or stays 1.

By the circular construction shown the top of the furnace is flat and does not, like an arch, raise when expanded by heat, causing derangement of the feeding or other apparatus thereon or connected thereto, the expansion and contraction being horizontal.

Having thus described the nature and objects of my invention, what I claim is—

1. In a smelting-furnace, a circular hearth having an inclined or sloping margin, a circular arch over the said hearth, dome-shaped within and flat without, said dome meeting the sloping margin of the said hearth at an

acute angle, a series of vertical stays surrounding the structure and supporting the arch, and elastic encircling bands with means for adjusting the same, in combination with means for supplying heat and suitable flues for carrying off the waste products of combustion and for supplying air, substantially as specified.

2. In a smelting-furnace, a circular hearth having an inclined or sloping margin, a circular arch over the said hearth, dome-shaped within and flat without, said dome meeting the sloping margin of the said hearth at an acute angle, vertical stays surrounding the structure and supporting the arch, and elastic encircling bands surrounding the stays, said hearth and arch being formed of a homogeneous material without courses or layers, whereby joints in the structure are avoided, substantially as specified.

3. In a smelting-furnace, a circular hearth having an inclined or sloping margin, a circular arch over the said hearth, dome-shaped within and flat without, said dome meeting the sloping margin of the said hearth at an acute angle, vertical stays surrounding the structure and supporting the arch by means of brackets or ledges affixed to said stays, and elastic adjustable bands surrounding and supporting the stays, substantially as specified.

4. In a smelting-furnace, a circular hearth having an inclined or sloping margin, a circular arch over the hearth, dome-shaped within and flat without, said dome meeting the sloping margin of the said hearth at an acute angle, forming a furnace-chamber, a separate combustion-chamber, a conduit connecting the said combustion-chamber with the said furnace-chamber, a chimney-flue for carrying off the waste products of combustion, and passages from the furnace-chamber to the said chimney-flue, substantially as specified.

5. In a smelting-furnace, a circular homogeneous structure formed of molded refractory material, without joints, comprising a hearth having a sloping margin, an arch over said hearth, flat without, dome-shaped within, meeting said sloping margin at an acute angle, the whole surrounded by a series of vertical supporting-stays encircled by elastic metallic constraining-bands, substantially as specified.

6. In a smelting-furnace, a circular structure comprising a hearth having an inclined or sloping margin and an arch over the said hearth, dome-shaped within and flat without, forming a furnace-chamber, said dome meeting the sloping margin of the said hearth at an acute angle, an inlet-conduit for conveying hot products of combustion to said furnace-chamber, outlet-passages remote from said conduit for waste products of combustion, a conduit with a double flue passing over the top of the structure, one flue for the waste products of combustion and the other

for the admission of air to the furnace-chamber, and downtake-passages 25 through the arch near the margin thereof, substantially as specified.

7. In a smelting-furnace, a circular structure comprising a hearth and an arch over the said hearth, dome-shaped within and flat without, forming a furnace-chamber, an inlet-conduit for conveying hot products of combustion to said furnace-chamber, an inlet-passage for heated air near said conduit, outlet-passages remote from said conduit, for waste products of combustion, a chimney-flue, and a horizontal conduit over the top of the structure, separated by a horizontal diaphragm into upper and lower flues, one for the conveyance of the waste products of combustion and the other for the conveyance of heated air to the furnace-chamber, substantially as specified.

8. In a smelting-furnace, a circular structure comprising a hearth, and an arch over the said hearth, dome-shaped within and flat without, forming a furnace-chamber, outlet-passages at one side of the said furnace-chamber, an inlet-passage at the other side of the said chamber, a chimney-flue, a double conduit over the structure comprising two horizontal flues, one above the other, the lower flue connecting the furnace-chamber by the said outlet-passages with the chimney-flue, the upper flue communicating with the external air at one end, and with the furnace-chamber at the other end by the said inlet-passage, and means for supplying the said furnace-chamber with ore in suitable quantities at various points, substantially as specified.

9. In a smelting-furnace, a circular homogeneous structure formed of molded refractory plastic material, comprising a hearth and an arch over the said hearth, dome-shaped within and flat without, said hearth having an inclined or sloping margin, and meeting said dome at the joining-line at an acute angle supported entirely from the outside by means of vertical stays and supporting-brackets affixed thereto, and encircling adjustable elastic bands, in combination with an inlet-conduit for products of combustion, an inlet-passage for hot air, inlet-conduits for supplying ore, outlet-passages for waste products of combustion, and a chimney-flue, substantially as specified.

10. In a smelting-furnace, a circular hearth, a circular arch over the said hearth, dome-shaped within and flat without, forming a furnace-chamber, a combustion-chamber, a conduit connecting the said combustion-chamber with the said furnace-chamber, an inlet-passage for hot air near the said conduit, inlet-conduits and hoppers for supplying ore, outlet-passages for waste products of combustion, a chimney-flue, a horizontal conduit along the top of the structure, comprising two flues, one above the other, the upper flue communicating with the external air at one end and with the chimney-flue at the other end, and open-

ings in the periphery of the furnace-chamber, substantially as specified.

11. In a smelting-furnace, a chamber provided with a dome-shaped roof or arch 27, a
5 separate combustion-chamber 7, with downwardly-inclined conduit 9 for conveying hot products of combustion to the said furnace-chamber, and vertical passages 25 in said arch 27 near the conduit 9, whereby the burning

gases are thrown down upon the hearth, substantially as specified.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

HERBERT LANG.

Witnesses:

K. LOCKWOOD-NEVINS,
H. SANDERSON.