

No. 827,498.

PATENTED JULY 31, 1906.

G. H. BENJAMIN.
METALLURGICAL FURNACE.

APPLICATION FILED MAY 20, 1903.

3 SHEETS—SHEET 1.

FIG. 1.

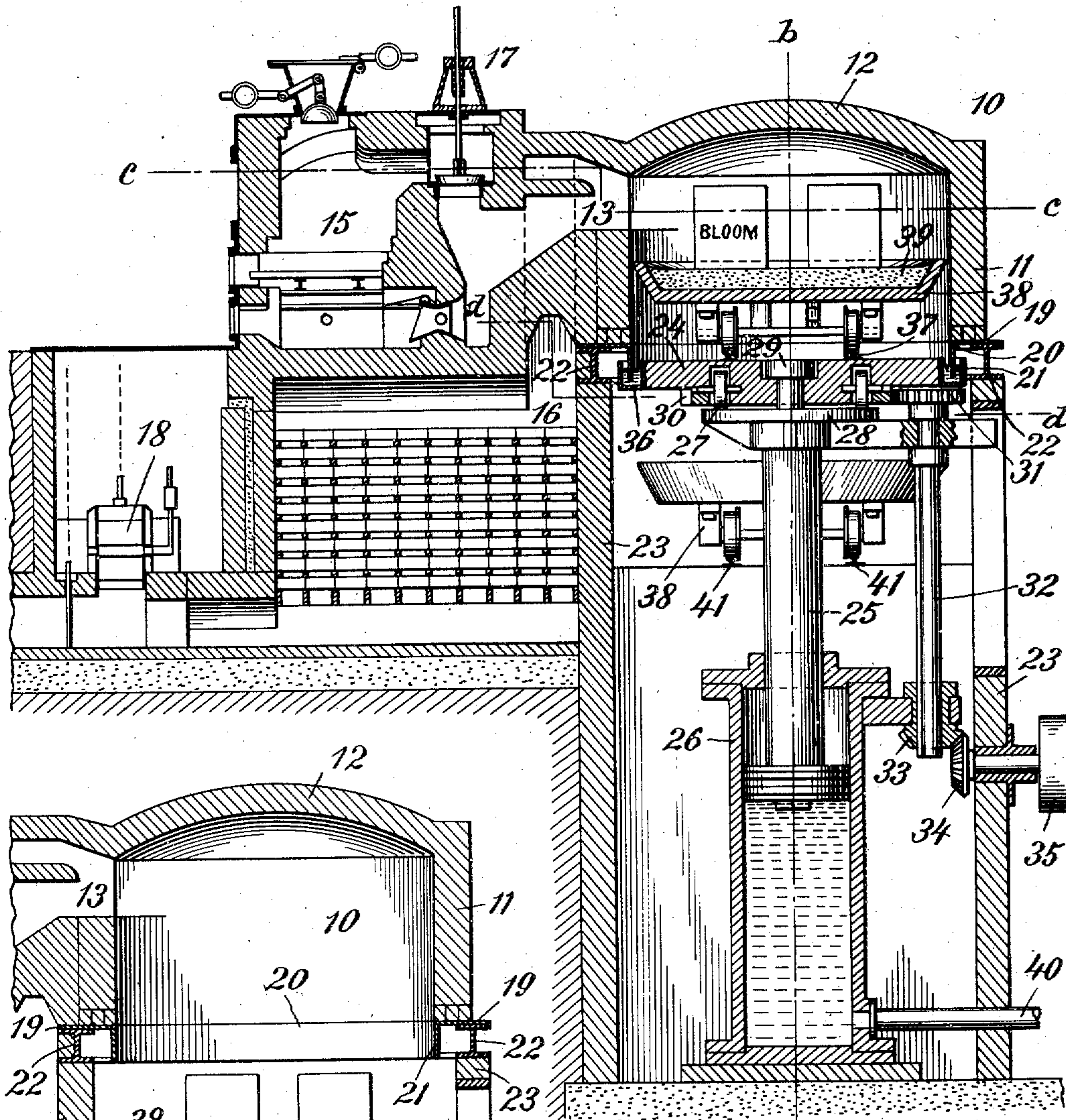
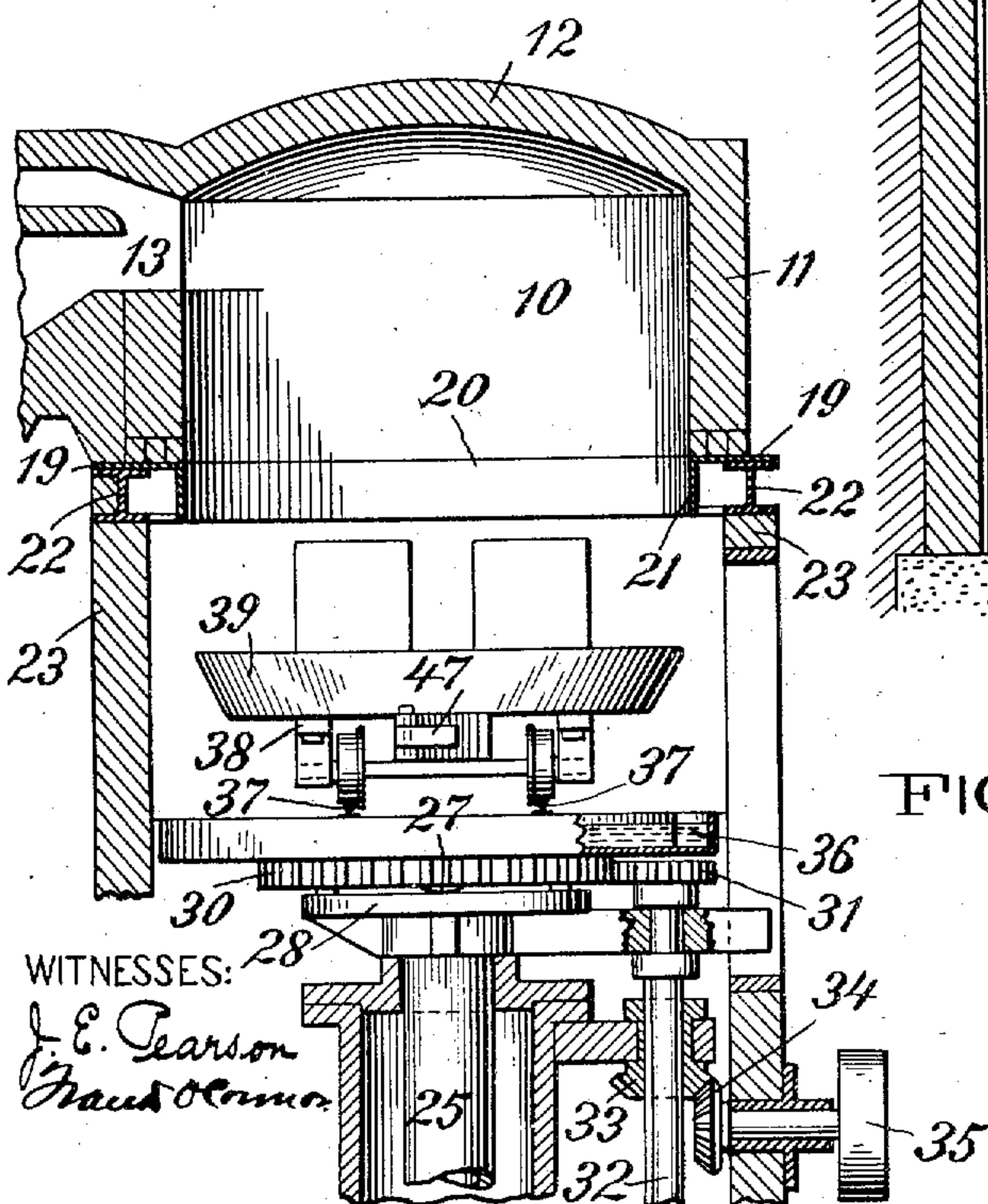


FIG. 2.



WITNESSES:
J. E. Pearson
H. O. O'Connor

INVENTOR

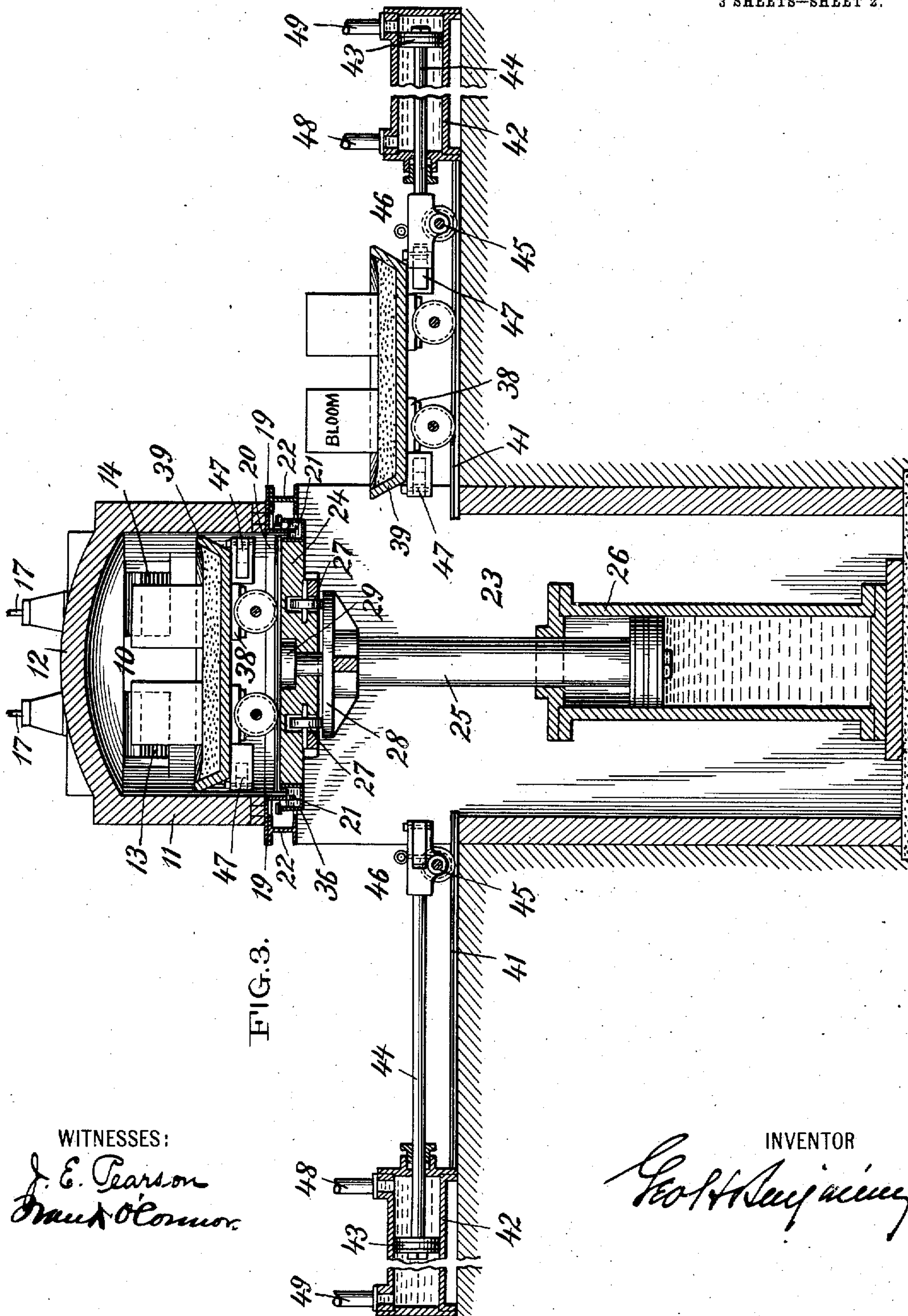
G. H. Benjamin

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3 SHEETS—SHEET 3.

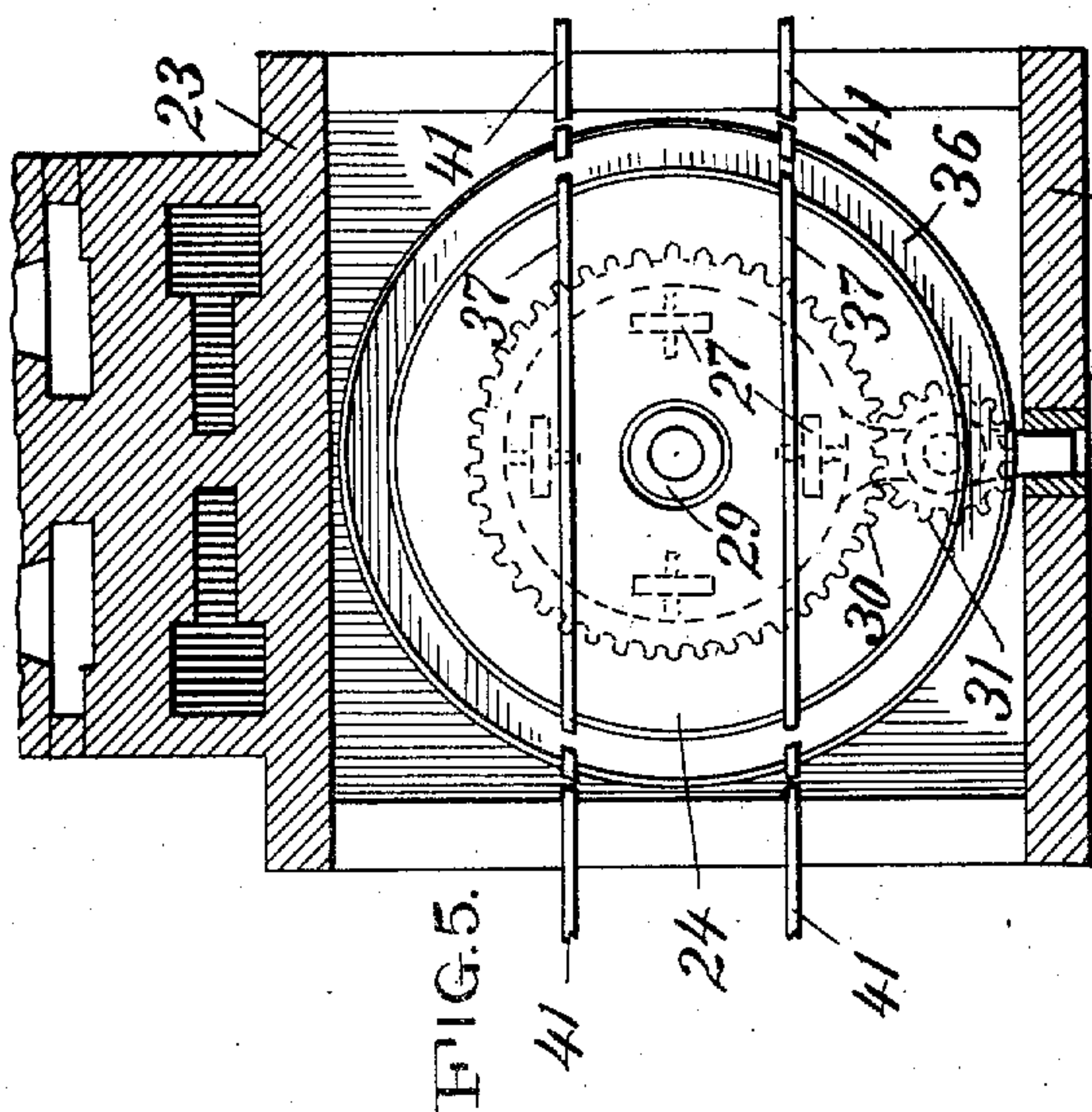


FIG. 5.

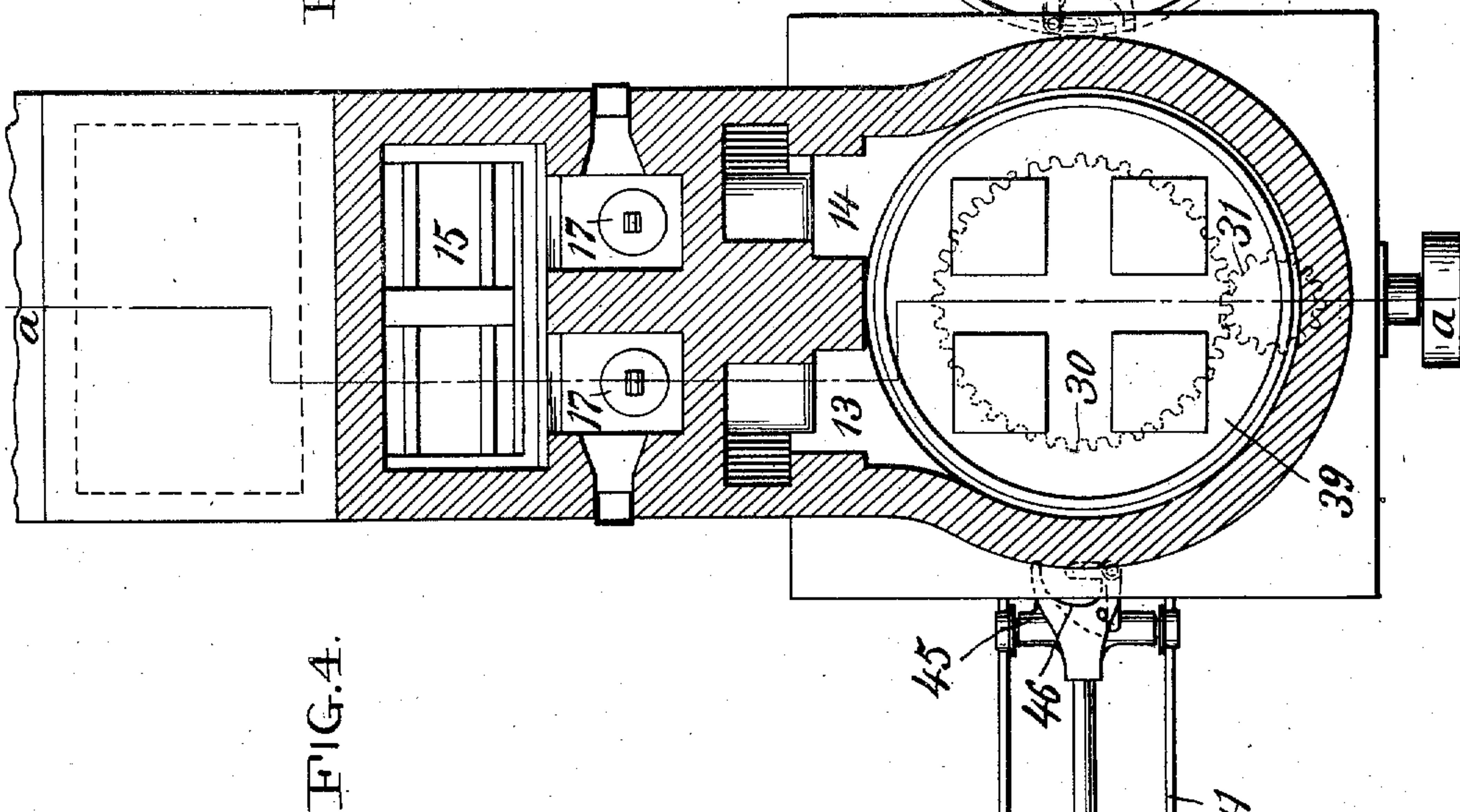


FIG. 4.

WITNESSES:

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UNITED STATES PATENT OFFICE.

GEORGE H. BENJAMIN, OF NEW YORK, N. Y.

METALLURGICAL FURNACE.

No. 827,498.

Specification of Letters Patent.

Patented July 31, 1906.

Application filed May 20, 1903. Serial No. 157,923.

To all whom it may concern:

Be it known that I, GEORGE HILLARD BENJAMIN, a citizen of the United States, residing at New York city, county and State of New York, have invented certain new and useful Improvements in Metallurgical Furnaces, of which the following is a specification.

This invention relates to metallurgical furnaces generally, and especially to metallurgical furnaces of the type used for reheating heavy blooms, billets, or the like.

Considered in its broadest sense, my improved furnace consists of a heating-chamber with fixed top and sides and a bottom portion vertically movable as regards the top and sides, and means for producing the required heat in the heating-chamber.

Considered in a more limited or constructional sense, my improved furnace consists of a heating-chamber with imperforate top and sides, except where such sides are connected to the source of heat, a bottom portion vertically adjustable and rotatable as regards the heating-chamber, a removable hearth mounted on such bottom portion, means for drawing one hearth off of the bottom portion when the bottom portion is in its lowest position and for introducing another hearth, means for forming an atmospheric seal between the heating-chamber and its movable bottom portion, and means for producing the required atmosphere in the heating-chamber.

The objects of the invention may be stated as follows: First, the construction of a heating-chamber wherein the heat will be retained within the top of the chamber and not lost or reduced by reason of openings in the top or sides of such chamber communicating with the atmosphere; second, a construction of the bottom of the furnace by reason of which heavy masses of metal may be readily raised into the heating-chamber and, if desired, rotated in said chamber and withdrawn therefrom; third, a construction of the bottom of the furnace by reason of which when the bottom is in its upper position the interior of the furnace will be closed to the external atmosphere except in so far as air may be introduced in connection with the heating-flame; fourth, a construction of the bottom of the furnace in connection with trackways by reason of which a movable hearth carrying bodies to be heated may be moved onto said movable bottom and carried by said movable bottom into the zone of heat in the heating-chamber and out of said zone of heat

and off of said movable bottom; fifth, the employment of removable hearths by reason of which one hearth may be repaired and loaded while the other hearth and its load is being heated; sixth, the combination in a single structure of all the elements necessary to handle and heat or otherwise treat a body and generally to make an efficient easily-handled furnace for the purpose described.

The accompanying drawings will serve to illustrate my invention. I wish it understood, however, that I do not limit myself to the precise details of construction shown, as they may be considerably varied. For instance, it is not at all essential that the gas-generating and air-regenerating apparatus be connected to the furnace structure. The heating, as is well known, may be accomplished by producer or natural gas drawn from a distance or through the employment of hydrocarbon fuels. Further, the mechanism employed for vertically moving or rotating the bottom may be altered or modified, as well as the mechanism for moving the movable hearths onto or off of the movable bottom. The drawings, however, show a structure which is well adapted to carry out my invention.

Referring to the drawings, Figure 1 is a vertical section through the furnace structure, taken on the line *a a* of Fig. 4. Fig. 2 is a vertical section through a portion of the furnace and shows the movable bottom in its lowest position. Fig. 3 is a longitudinal section through the furnace structure and its cooperating parts, taken on the line *b b* of Fig. 1. Fig. 4 is a sectional plan taken on the line *c c* of Fig. 1 looking downward. Fig. 5 is a horizontal section taken on the line *d d* of Fig. 1.

In the drawings, 10 indicates the furnace-chamber, which may be of any suitable construction. Preferably this chamber is circular in section, with vertical walls 11 and an arched crown 12. The furnace-chamber is connected, through ports 13 14, with the gas-producer 15 and regenerator 16.

17 18 indicate valves for controlling the direction of flow of the gas and air.

The gas-producer shown is identical with that illustrated in United States Letters Patent No. 501,107, granted to Frederick Siemens for regenerative gas furnace and producer on July 11, 1893. A further description of the gas producer and regenerator either as regards their construction or mode

of operation is therefore unnecessary, as such is fully disclosed in the above-mentioned patent.

As before stated, any device for generating or transmitting gaseous fuel may be used in place of that shown.

The walls 11 of the chamber 10, as well as the top 12, are shown as imperforate, except where connected to the producer 15. The object of this arrangement is to prevent the escape of heat from the interior of the furnace to the atmosphere and the access of the atmosphere into the furnace-chamber. The furnace or heating chamber 10 is mounted upon the horizontal portion 19 of a cylindrical angle-iron 20, whose vertical portion 21 depends downward. The angle-iron 20 is mounted upon or carried by T-beams or channel-irons 22, situated on the top of vertical walls 23.

The particular means shown and described for supporting the heating-chamber is not essential except as to one feature, which will hereinafter be mentioned.

24 indicates the bottom of the heating-chamber. This bottom is shown as mounted upon the top of a piston 25, located within a cylinder 26, and such piston adapted to be actuated by water-pressure or other motive fluid. The bottom portion 24 is shown as mounted upon the wheels 27, which move over a plate 28 on the top of the cylinder and is secured to the piston by means of a collar 29. This arrangement is to permit of rotation of the bottom of the furnace, which may be accomplished by means of the gear 30, pinion 31, spline-shaft 32, bevel-gears 33 34, and source of power 35, in the present case a belt-wheel. By reason of the spline on the shaft 32 this shaft may be moved vertically within the hub of the beveled gear 33 at the same time that the bottom is moved vertically.

Instead of mounting the bottom 24 as shown in the drawings, it may be secured directly to the top of the piston 25—that is, the mechanism for rotating may be dispensed with. This mechanism is very convenient for use where it is desired to produce an absolutely uniform heating of the body in the heating-chamber—as, for instance, in reheating steel blooms, wire coils, &c.

Arranged in the periphery of the bottom 24 is a trough 36, which coöperates with the depending flange 21 of the angle-iron 20. This trough is arranged to contain water or any fluid, semifluid, or granular body, such as sand, which will act as a seal to prevent the ingress of atmospheric air into the interior of the furnace-chamber.

The particular construction of the parts constituting the seal may be altered. Any form of seal may be employed. As stated, the purpose of the seal is to prevent the ingress of atmospheric air during the time that

the seal is closed. The result of using such a seal is to reduce materially the losses due to oxidation within the furnace, as owing to the fact that the top and sides and bottom of the furnace are closed against the atmosphere practically no free atmospheric air is admitted, and hence oxidation is reduced to a minimum.

Situated on the top of the bottom 24 are the tracks 37, and on these tracks is mounted a car 38, the upper portion of which is formed in the manner of an ordinary furnace-hearth—that is, it is formed of a dish-like body 39, which may be of metal or any suitable resisting material and provided with a lining such as is common in metallurgical operations and suitable to the operation to be conducted on the hearth, for I wish it understood that my improved furnace may be used as a melting-furnace, a puddling-furnace, a heating-furnace, or for conducting any metallurgical operation. Of course where the use of the furnace is changed the character of the hearth will be correspondingly altered. This will be understood by those skilled in the art without further explanation.

Preferably the diameter of the hearth should closely correspond to the diameter of the furnace-chamber. The object of this is to prevent as far as possible the radiated heat acting under the hearth, as it is desirable to keep the bottom of the hearth relatively cool as regards the top, so as to prevent destruction or injury to the carriage portion of the hearth.

I do not limit myself in any wise to the employment of a wheeled hearth. Any form of hearth will be within the intent of my invention which may be pushed upon and drawn from the bottom of the heating-chamber.

In the operation of my furnace I may use two or more hearths. Two are shown in the drawings.

40 represents a pipe, through which a motive fluid may be introduced to move the piston 25.

In Fig. 1 of the drawings the bottom and hearth are shown in the top position within the furnace-chamber and the seal between the heating-chamber and the bottom closed.

In Fig. 2 the parts are shown in the lowest position and the seal broken. When the bottom is in the lowest position, the rails 27 on the bottom 24 register with the rails 41 at the opposite sides of the furnace. Arranged in relation to these rails are the cylinders 42, containing the pistons 43 and rods 44. The end of the rods 44 are supported on carriages 45, which move on the rails 41, and each rod carries one-half of an automatic coupler 46 of any type, preferably what is known as the "Janney" type. One-half of a similar coupler 47 is mounted on each end of a hearth-carriage 38.

48 49 are pipes through which a motive

fluid may be allowed to enter alternately on opposite sides of the pistons 43. Preferably this motive fluid is water, although steam or electricity may be used.

5 The operation of this portion of the device will be readily understood. Assuming the parts to be in the position shown in Fig. 3, the hearth-carriage at the right is connected to a rod 44 through an automatic coupler and is in the position to be pushed upon the bottom 24. When the bottom 24 reaches the position shown in Fig. 2, the rod 44 at the left moves forward, the coupler-sections 46
 5 47 are brought in position and automatically coupled. The direction of movement of the rod is reversed, which draws the hearth-carriage off of the bottom 24 and onto the track-way 41, leaving the bottom free to receive the hearth-carriage at the right.

o A particular feature of importance in the construction of the furnace and to which I wish to call attention is found in the fact that when the bottom is in its lowest position the furnace-chamber is not cooled, but main-
 5 tains its temperature. This is due to the fact that the gaseous flame is maintained in the top of the furnace-chamber, and, further, as the specific gravity of the heated gases is less than air they completely fill the
 o furnace-chamber and prevent the ingress of air from below, so that when the bottom moves upward to lift the bodies to be heated into the furnace-chamber it in a sense acts as a piston to compress in or force the contained
 5 gases through the ports of the chamber. This condition results in great economy as well as uniformity of action within the furnace-chamber.

I have illustrated my improved furnace as
 o circular in section and arranged to heat four blooms. Manifestly the contour of the furnace could be changed—that is, it could be made oblong—and arranged to heat any required number of blooms.

5 I have described my improved furnace as arranged to completely exclude the external atmosphere, except so far as may relate to the air introduced to support combustion. In certain metallurgical operations air is nec-
 o essary, and of course means may be provided for introducing such air.

Having thus described my invention, I claim—

1. A metallurgical furnace comprising a
 5 heating-chamber permanently closed to the atmosphere at its top and sides, a vertically-movable bottom portion, and an atmospheric seal between said chamber and bottom portion.

o 2. A metallurgical furnace, comprising a heating-chamber permanently closed to the atmosphere at its top and sides a separable bottom, means for vertically moving said bottom, a removable hearth on said bottom,
 5 together with means situated on opposite

sides of said bottom for moving said hearth onto and off of said bottom.

3. A metallurgical furnace, comprising a heating-chamber circular in section and permanently closed to the atmosphere at its top
 70 and sides, a separable bottom, and means for vertically reciprocating said bottom.

4. A metallurgical furnace comprising a heating-chamber having permanently-closed top and sides, a separable bottom, an atmos-
 75 pheric seal between said bottom and sides, together with means for vertically reciprocating said bottom.

5. A metallurgical furnace comprising a heating-chamber having permanently-closed
 80 top and sides, means for introducing a heating-flame through the side of said furnace, a separable bottom, together with means for reciprocating said bottom.

6. A metallurgical furnace, comprising a
 85 heating-chamber permanently closed at its top and sides to the atmosphere, means for introducing gaseous fuel through the side wall of said chamber near its top, a separable bottom, together with means for vertically
 90 moving said bottom.

7. A metallurgical furnace, comprising a heating-chamber permanently closed to the atmosphere at its top and sides, ports
 95 through which heating-flames and the products of combustion may be introduced into and drawn from the furnace near its top, a separable bottom, together with means for vertically reciprocating said bottom.

8. In a metallurgical furnace the combina-
 100 tion of a heating-chamber permanently closed to the atmosphere at its top and sides a separable bottom therefor, means for reciprocating said bottom, a plurality of movable hearths, and means for moving said
 105 hearths onto and off of said bottom.

9. In a metallurgical furnace, the combina-
 110 tion of a heating-chamber permanently closed to the atmosphere at its top and sides a separable bottom, means for vertically reciprocating said bottom, a plurality of hearths, together with fluid-pressure means located on opposite sides of said bottom for moving said hearths onto and off of said
 115 bottom.

10. In a metallurgical furnace, the combina-
 120 tion of a heating-chamber permanently closed to the atmosphere at its top and sides a separable bottom, means for vertically reciprocating said bottom, and a movable hearth mounted on said bottom, said hearth conforming in contour to the shape of the heating-chamber.

11. In a metallurgical furnace, the combina-
 125 tion of a heating-chamber, a separable bottom, a gear on said bottom, a pinion coacting with said gear, a spline-shaft, a gear through which said spline-shaft may be moved vertically, means for reciprocating said bottom, said spline-shaft and coacting parts, and
 130

means for rotating said spline-shaft and bottom.

12. A metallurgical furnace, comprising a chamber having permanently-closed top and sides, and a separable vertically-movable bottom, the construction and arrangement of the elements of the furnace being such as to prevent the ingress of air into the heating-chamber when the bottom is removed.

13. A metallurgical furnace, comprising a heating-chamber permanently closed at the top and sides, a separable bottom therefor, means for vertically moving said bottom relative to said heating-chamber, a gas-producer located at the side of said heating-chamber, together with communicating ports and passages between said chamber and gas-producer.

14. A metallurgical furnace, comprising a heating-chamber permanently closed at the top and sides, a separable bottom therefor, means for vertically moving said bottom relative to said heating-chamber, a gas-producer located at the side of, and at the same level as, the heating-chamber, together with communicating ports and passages between said chamber and gas-producer.

15. A metallurgical furnace, comprising a heating-chamber permanently closed at the top and sides, a separable bottom therefor, means for vertically moving said bottom relative to said heating-chamber, together with means for maintaining a defined temperature in said heating-chamber and irrespective of whether the lower portion of said chamber is closed or open to the atmosphere.

16. A metallurgical furnace, comprising a heating-chamber permanently closed at the top and sides, a separable bottom therefor, means for vertically moving said bottom relative to said heating-chamber, a gas-producer located at the side of said heating-chamber, said gas-producer divided into two sections, each section comprising a producing-chamber and an air-regenerator, ports and passages between said producing-chambers and air-regenerators, and a reversing-valve.

17. A metallurgical furnace comprising a heating-chamber permanently closed at the top and sides and having a vertical depth approximately equal to its diameter, a separable bottom portion therefor, and means for vertically moving said bottom portion relative to the heating-chamber.

18. A metallurgical furnace comprising a heating-chamber permanently closed to the atmosphere at the top and sides, a separable bottom therefor, means for vertically moving

said bottom relative to said heating-chamber, a gas-producer occupying the same horizontal level as the heating-chamber, and gas and air flues between said heating-chamber and gas-producer and located in the same plane near the top of the gas-producer.

19. A metallurgical furnace comprising a heating-chamber permanently closed at the top and sides, a separable bottom therefor, together with means for maintaining the interior of the heating-chamber full of flame and irrespective of whether the bottom of said furnace is open or closed.

20. A metallurgical furnace comprising a heating-chamber permanently closed at the top and sides, gas and air flues located at one side of the chamber and below the top thereof, a reversible gas-producer and air-regenerator connected to said flues, a vertically-movable bottom for said chamber, together with means for sealing the bottom when in a closed position.

21. A metallurgical furnace comprising a heating-chamber permanently closed at the top and sides, gas and air flues located at one side of said furnace and below the top thereof, a reversible gas-producer and air-regenerator connected to said flues, a vertically-movable and revoluble bottom for said chamber, together with means for moving said bottom into and out of position and revolving it when in position.

22. A metallurgical furnace comprising a heating-chamber, a vertically-movable bottom portion, and means for heating the interior of such chamber and maintaining a constant temperature therein irrespective of the position of said movable bottom portion.

23. A metallurgical furnace comprising a heating-chamber closed to the atmosphere at the top and sides, a vertically-movable bottom portion, and means for heating the interior of such chamber and maintaining a constant temperature therein irrespective of the position of said movable bottom.

24. A metallurgical furnace comprising an open-bottom chamber, means for heating the interior of the chamber and maintaining a constant body of flame therein, and means for carrying the articles to be heated into and out of said chamber.

In testimony whereof I affix my signature in the presence of two witnesses.

GEORGE H. BENJAMIN.

Witnesses:

J. E. PEARSON,
FRANK O'CONNOR.