

W. J. MURPHY & A. E. CULLEY.  
FURNACE.

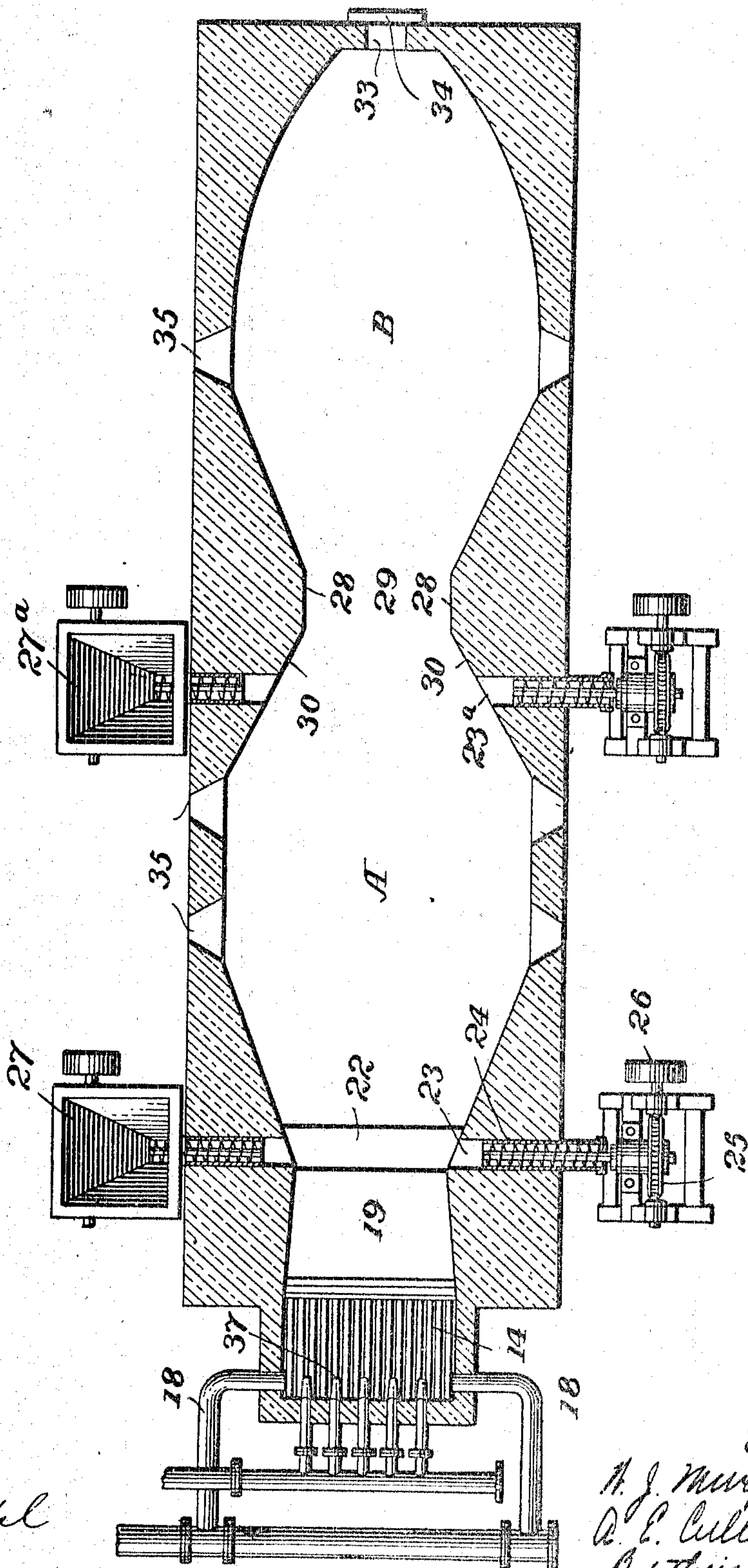
APPLICATION FILED MAY 25, 1910.

Patented Dec. 13, 1910.

3 SHEETS-SHEET 1.

978,621.

Fig. 1.



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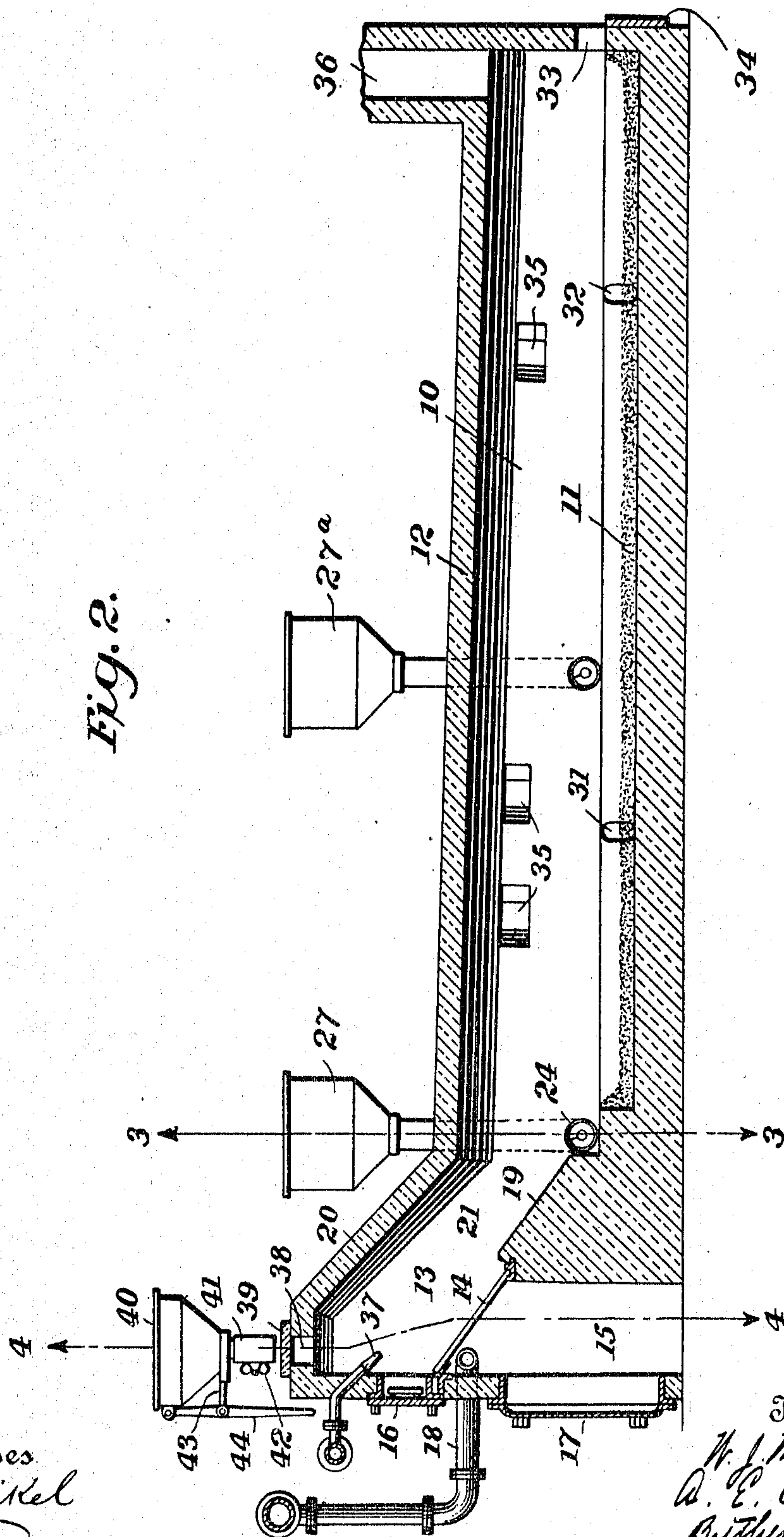
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3 SHEETS—SHEET 2.

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Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

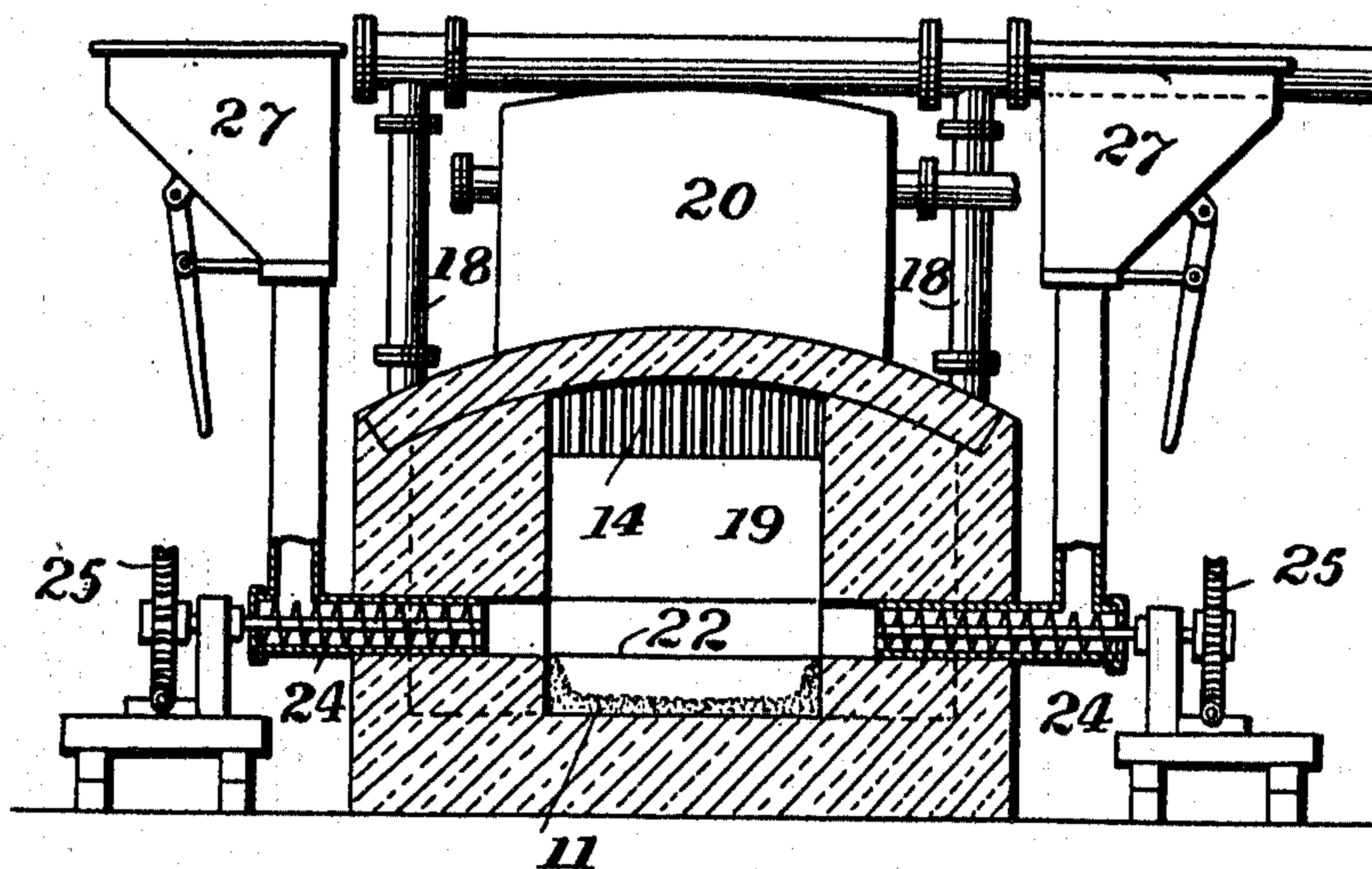
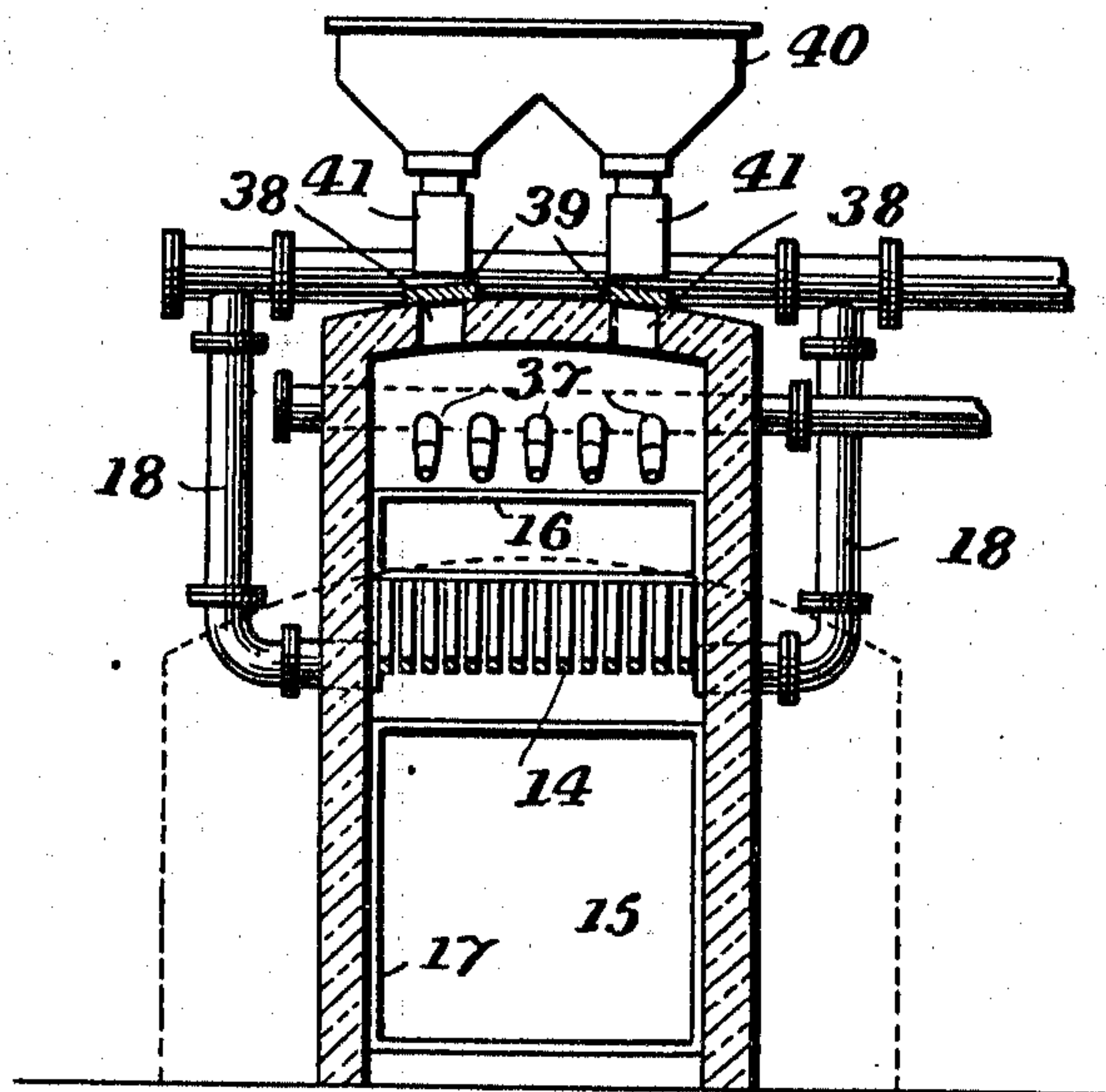


Fig. 4.



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# UNITED STATES PATENT OFFICE.

WILLIAM J. MURPHY AND ALBERT E. CULLEY, OF BUTTE, MONTANA.

## FURNACE.

978,621.

Specification of Letters Patent. Patented Dec. 13, 1910.

Application filed May 25, 1910. Serial No. 563,369.

*To all whom it may concern:*

Be it known that we, WILLIAM J. MURPHY and ALBERT E. CULLEY, both citizens of the United States, residing in Butte, county of Silverbow, and State of Montana, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

This invention relates to furnaces and particularly to furnaces of the reverberatory type.

In reverberatory furnaces as now constructed, the charge is fed from the roof and dropped on the hearth in piles, or fed by hand through the side doors on the middle of the hearth. The fireplace is separated from the hearth chamber by a bridge, and hot gases from the fireplace are drawn over the bridge and against the roof of the hearth chamber. The hot gases are completely burned at the roof and the heat is deflected against the charge on the hearth.

A furnace of the above construction is very inefficient since the heat is all reflected heat and furthermore the gases will encircle the piles of the charge on the hearth resulting in imperfect utilization of the heat in the gases.

The objects of this invention are, therefore, to operate and construct a furnace so that the heat will be fully utilized, resulting in efficiency of fuel consumption, and to provide a simple and efficient method and apparatus for feeding the charge and the fuel.

The invention will be described in connection with the accompanying drawings in which:

Figure 1. is a horizontal longitudinal section of a furnace embodying this invention.  
Fig. 2. is a vertical longitudinal section.  
Fig. 3. is a section on line 3—3 Fig. 2, and,  
Fig. 4. is a section on line 4—4, Fig. 2.

The furnace comprises a hearth chamber provided with a hearth 11, and a roof 12 of refractory material which is inclined downwardly from front to rear, the front being the fireplace and the rear the stack end.

A fireplace 13 is located at the front of the furnace and is provided with a grate 14, an ash pit 15 and fire and ashpit doors 16 and 17 respectively. A forced draft may be supplied by an air pipe 18 which discharges underneath the grate. The grate

bars incline downwardly and rest at one end upon a bridge 19 which inclines downwardly from the grate to the hearth of the hearth chamber. A downwardly inclined roof 20 is located above the bridge and this bridge and roof form together a downwardly inclined passage 21 which connects the fireplace with the hearth chamber.

An offset portion 22 is formed at the foot of the bridge and the furnace walls are provided with feed openings 23 through which the charge may be fed. The charge is fed by means of a screw conveyer 24 constantly driven by a worm wheel 25 and a worm, the power being applied to the worm by means of a pulley 26. The charge is supplied to the screw by means of a hopper 27. The feeding arrangement is preferably duplicated on the opposite side of the furnace so that the charge is fed on the offset portion 22 from opposite sides. In this way the charges from the feed openings will meet in the center and drop off onto the hearth.

The side walls of the furnace extend inwardly as at 28 to form a constricted portion 29 and deflecting surfaces 30. The walls forwardly of the constricted portion are provided with feed openings 23<sup>a</sup> provided with mechanism similar to that described for continuously feeding the charge from the hoppers 27<sup>a</sup> over the hearth. The inwardly extending portions 28 divide the hearth chamber into two chambers A and B which are connected by the restricted portion 29.

The furnace hearth is provided with the usual working bottom and tap holes 31, 32, and a skimming hole 33. The skimming hole 33 is closed by a suitable door. The side walls are provided with side doors 35 closed in the usual way. The gases passing through the hearth chambers are discharged into a stack 36.

A series of downwardly inclined pipes 37 provided with nozzles are arranged to direct a jet of air or steam over the fire so as to complete the combustion and to force the flame and the hot gases directly on the hearth. In order that the fuel may be conveniently supplied, the wall above the grate has formed therein a series of holes 38 which are normally covered by stone slabs 39. The fuel is stored in hoppers 40 provided with telescoping pipes 41 which are arranged to



be let down and locked in position by clamps 42. The hoppers are provided with slides 43 operated by handles 44. By removing the slabs 39 and letting down the pipes 41 the fuel may be fed on the grate by opening the slides 43.

In operation the charge of ore or the like will be fed continuously from the hoppers 27, 27<sup>a</sup> on the offset portion 22 at the foot of the bridge and also forwardly of the constricted portion 29. The hot gases from the fireplace will be drawn by the stack and forced by the jet down the inclined passage and into the hearth chamber. These gases will pass along the bridge 19 and will pass over and through the fresh charge admitted at the foot of the bridge and will strike the hearth bottom. As these gases pass through the furnace chamber they are reflected from the roof and on the charge on the hearth at the bridge and at the constricted portion 29. The inclined walls 30 will reflect the heat forwardly against the fresh charges so as to smelt the same. It will thus be seen that the heat is concentrated in the portion A of the hearth chamber, and the charge in this portion comes fully in contact with the hot gases. This portion of the chamber is the smelting chamber. The gases as they leave the portion A must pass over the charge at the constricted portion where the heat is utilized. As the charge is smelted it passes into the chamber portion B where the slag is skimmed off through the skimming hole or door 33. The roof 12 inclines from front to rear as in ordinary reverberatory furnaces so that the heat is also reflected on the hearth in the chamber portion B. In chamber portion A however the hot gases are first directed directly on the hearth and over and through the charge fed at the foot of the bridge and then reflected.

It will be seen that the feeding screws 24 are back of the mouths of the openings. In this way there is a column of ore between the interior of the furnace and the screws so that these screws are protected against the heat.

By means of the above described arrangement it is insured that the hot gases will come thoroughly in contact with the charge so that the heat in the gases will be fully and efficiently utilized. The process in addition is a continuous one the charge being smelted as fed. The charge is continuously fed from the sides of the furnace and as the charge is smelted the molten material runs into the chamber portion B and the slag is there skimmed off. The molten material is drawn off through the tap holes 31 and 32.

The furnace is especially useful for smelting ores and more especially calcined copper ores, but it is to be understood that this invention is not to be limited to this particular application.

It is obvious that various changes may be made in the details of the method and apparatus without departing from the spirit of this invention, and it is therefore to be understood that this invention is not to be limited to the specific arrangements shown and described.

Having thus described the invention, what is claimed is:

1. The method of operating a reverberatory furnace which comprises the step of continuously feeding the charge on the hearth from opposite sides of the furnace toward the center.

2. The method of operating a reverberatory smelting furnace having a smelting hearth which comprises the steps of feeding the charge from the side at forward and rearward parts of the hearth, passing the hot gases on and past the freshly introduced charge on the forward part of the hearth and directing them on the freshly introduced charge on the rearward part of the hearth.

3. The method of operating a reverberatory smelting furnace having a smelting hearth which comprises the steps of feeding the charge during the smelting operation at forward and rearward parts of the hearth, passing the hot gases on and past the freshly introduced charge on the forward part of the hearth and deflecting them on the freshly introduced charge on the rearward part of the hearth.

4. In a reverberatory furnace, the combination with a hearth and a side wall having a feed opening therein at substantially the hearth level, of means back of the mouth of said opening for positively feeding the charge there through and across the hearth.

5. In a reverberatory furnace, the combination with a hearth and side walls having oppositely arranged feed openings therein at substantially the hearth level, of means back of said openings for positively feeding the charge there through and on and across the hearth.

6. In a reverberatory furnace, the combination with a hearth, of means for positively feeding the charge on and across the hearth from opposite sides toward the center.

7. In a reverberatory smelting furnace, the combination with a hearth chamber having a smelting hearth and a deflecting roof, of a grate above said hearth, a bridge inclining downwardly from the grate to the hearth level, and a downwardly inclined roof over said bridge forming therewith a downwardly inclined passage for passing the heating gases from said grate downwardly on said hearth.

8. In a reverberatory furnace, the combination with a hearth chamber having a hearth, of a fireplace connected to said



chamber, a bridge between said fireplace and chamber inclining downwardly to the hearth level, and means for feeding the charge on said hearth at the foot of said bridge.

9. In a reverberatory furnace, the combination with a hearth chamber having a hearth, of a fireplace connected to said chamber and having a downwardly inclined grate, and a downwardly inclined bridge between said fireplace and chamber and extending from the foot of said grate.

10. In a reverberatory furnace, the combination with a hearth chamber, of side walls therefor, said side walls extending inwardly at a point between the ends of said chamber to form a constricted portion, and means whereby the charge may be fed near said constricted portion.

11. In a reverberatory furnace, the combination with a hearth chamber, of side walls therefor, said side walls extending inwardly at a point between the ends of said chamber to form a constricted portion, and means whereby the charge may be fed forwardly of and near said constricted portion.

12. In a reverberatory furnace, the combination with a hearth chamber, of side walls therefor, said side walls extending inwardly at a point between the ends of said chamber to form a constricted portion, and means whereby the charge may be fed in a forward part of the hearth chamber and also forward of and near said constricted portion.

13. In a reverberatory furnace, the combination with a hearth chamber, of side walls therefor, said side walls extending inwardly at a point between the ends of said chamber to form a constricted portion and forwardly facing deflecting surfaces, said chamber having a downwardly inclined passage at the forward end thereof, and means whereby hot gases may be passed through said passage, into said chamber and against said deflecting surfaces.

14. In a reverberatory furnace, the combination with a hearth chamber, of side walls therefor, said side walls extending inwardly at a point between the ends of said chamber to form a constricted portion, said chamber having a downwardly inclined passage at the forward end thereof, means whereby hot gases may be passed through said passage and into said chamber, means whereby a charge may be fed at a point rearward of said passage and means where-

by a charge may be fed at a point forward of said constricted portion.

15. The method of operating a reverberatory furnace which comprises the steps of continuously feeding the charge on the hearth from opposite sides of the furnace toward the center, and directing the hot gases directly on the hearth and the charge so fed thereon.

16. The method of operating a reverberatory furnace which comprises the steps of feeding the charge from the side at a forward and rearward part of the hearth, directing the hot gases on the charge at the forward part and deflecting them on the charge at the rearward part of the hearth.

17. In a reverberatory furnace, the combination with a hearth chamber having a hearth, of a fireplace connected to said chamber, a downwardly inclined bridge between said fireplace and chamber, and means for feeding the charge from the side at the foot of said bridge.

18. In a reverberatory furnace, the combination with a hearth chamber, of deflecting means extending from the side walls thereof, and means for feeding the charge on said hearth from the side and forwardly of said deflecting means.

19. In a reverberatory furnace, the combination with a hearth chamber, of side walls therefor, said side walls extending inwardly at a point between the ends of said chamber to form a constricted portion, and means for feeding the charge on said hearth from the side and near said constricted portion.

20. In a reverberatory furnace, the combination with a hearth chamber, of side walls therefor, said side walls extending inwardly at a point between the ends of said chamber to form a constricted portion, said chamber having a downwardly inclined passage at the forward end thereof, means whereby hot gases may be passed through said passage and into said chamber, and means for feeding the charge on said hearth from the side at points rearward of said passage and forward of said constricted portion.

In testimony whereof, we have hereunto subscribed our names.

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