F. R. HILL.

FURNACE.

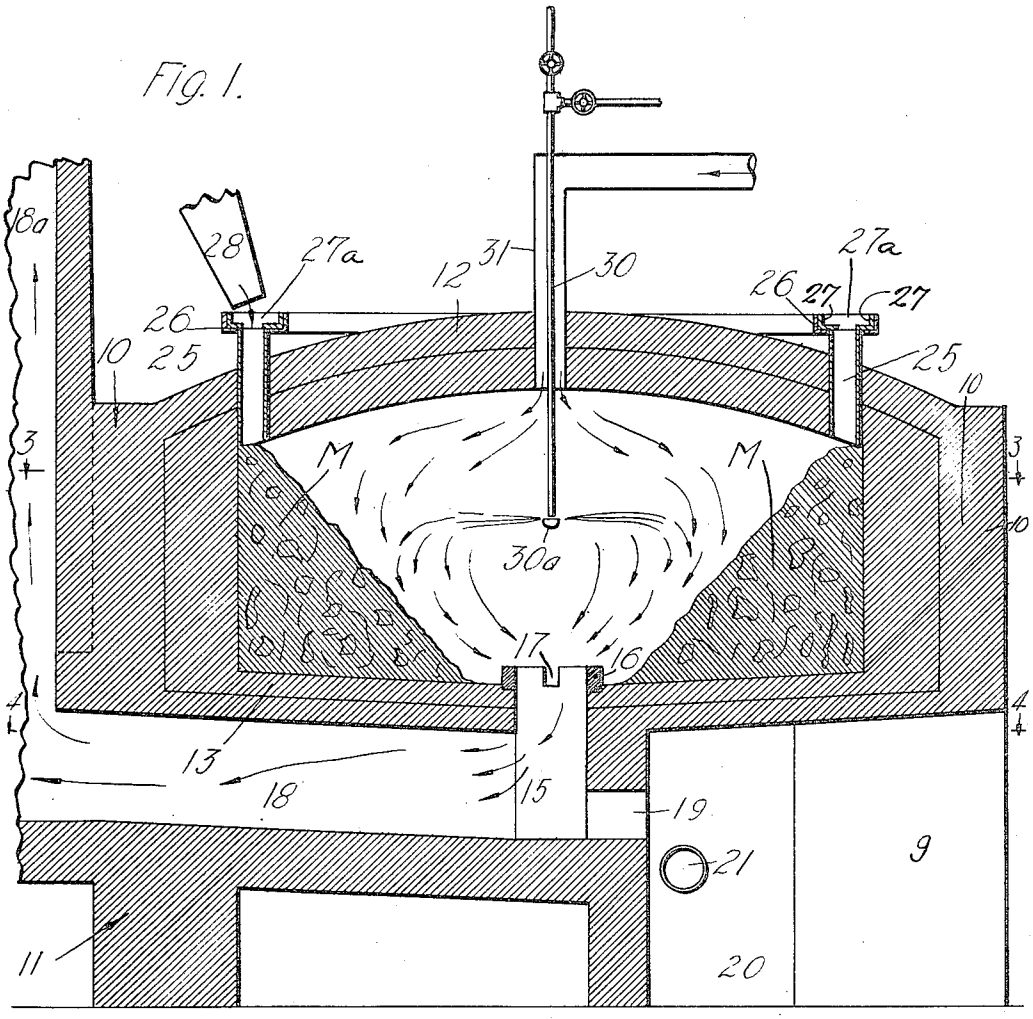
APPLICATION FILED MAR. 5, 1918.

1,283,515.

Patented Nov. 5, 1918.

2 SHEETS—SHEET 1.

Fig. 1.



Inventor
Frank R. Hill
by James T. Barkelew
his Attorney

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2 SHEETS—SHEET 2.

Fig. 2.

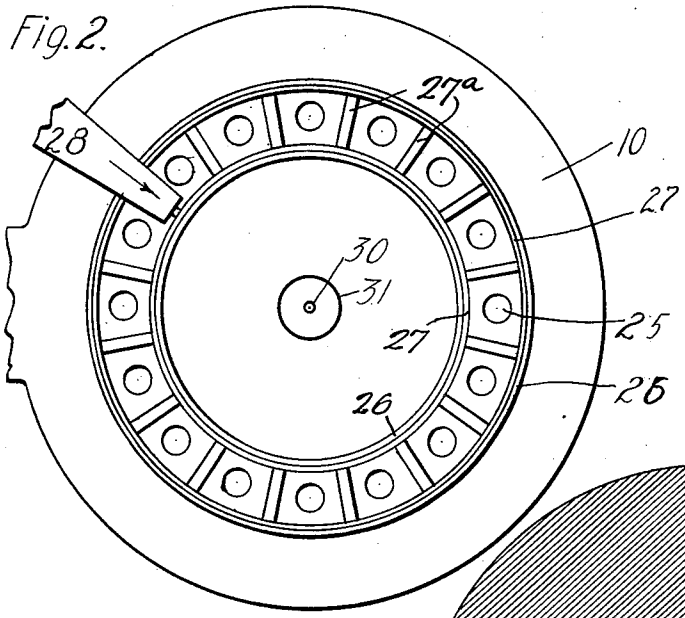


Fig. 4.

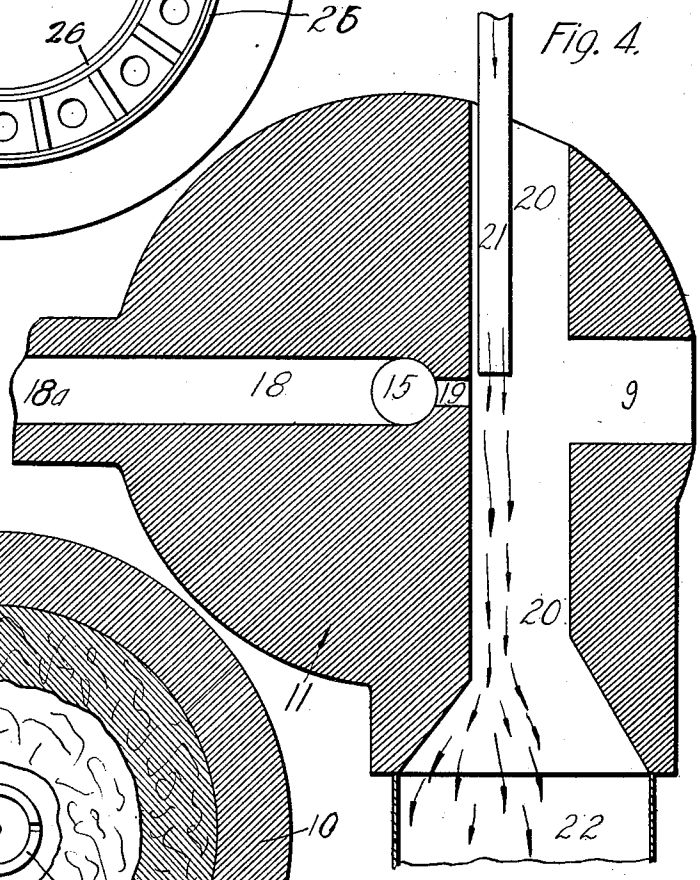
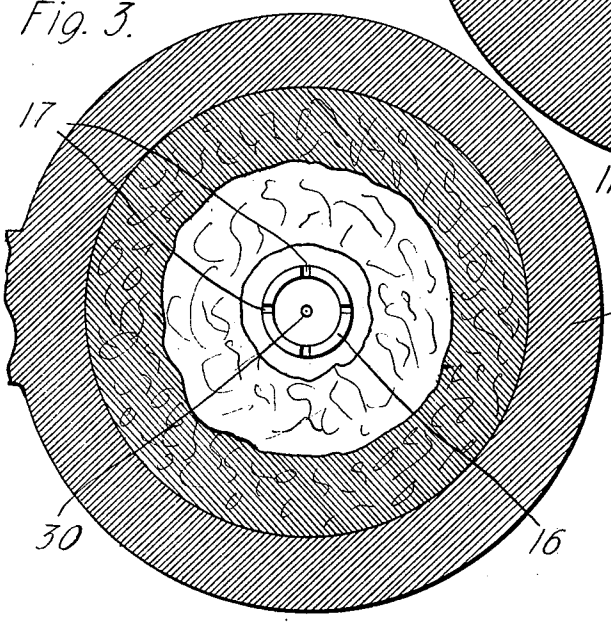


Fig. 3.



Inventor

Frank R. Hill

by Ernest T. Bachelder

his Attorney

UNITED STATES PATENT OFFICE.

FRANK R. HILL, OF KEELER, CALIFORNIA, ASSIGNOR TO WILFRED W. WATTERSON, OF BISHOP, CALIFORNIA.

FURNACE.

1,283,515. Specification of Letters Patent. Patented Nov. 5, 1918.

Application filed March 5, 1918. Serial No. 220,440.

To all whom it may concern:

Be it known that I, FRANK R. HILL, citizen of the United States, residing at Keeler, in the county of Inyo, State of California, have invented new and useful Improvements in Furnaces, of which the following is a specification.

This invention relates generally to furnaces which may be used for smelting, reducing, melting or fusing ores and other minerals or other substances; and there are certain comprehensive objects and accomplishments of the invention which apply generally to the use of the invention for any such purpose, or any similar purpose, all as will be hereinafter set forth. Besides these general objects of the invention, there are certain other more specific objects directed particularly to the use of the furnace for the purpose of melting or fusing such minerals as sodium carbonate and the like. I have developed the particular form of furnace herein described, and illustrated in the accompanving drawings, for the purpose of operating upon sodium carbonate; but it will be readily and clearly understood that my invention is not limited to such use but may, with any necessary modifications or changes, be made suitable for other various uses. Accordingly, the following specific description of the furnace as applied to sodium carbonate etc. will not be taken as a limitation upon my invention.

In devices which have heretofore been used for treating such a mineral as sodium bicarbonate, to convert it into sodium carbonate, difficulty has been experienced in a number of directions. In the first place it is extremely difficult to obtain materials which will withstand the required heat in the presence of the carbonate Furnaces of this character have been of necessity renewed at regular periods at a very large expense. It is one of the objects of this invention to provide a furnace in which the structure and arrangement is such that the furnace walls are protected. Now this object of the invention, although it is one which particularly and specifically bears upon the problem of furnacing sodium bicarbonate, also is a general object as applied to the use of the furnace for any other purpose. In my furnace the walls are protected from the heat, and also from any chemical action or deterioration which might otherwise go on if the heated materials are brought into intimate contact with the heated walls.

It is also a general object of the invention to provide a furnace structure in which there is a very large surface of the material exposed to direct heat action; and in which the heated, fused, or melted material (or the material in its finally treated state) is moved out of the zone of heat and out of the furnace immediately after it has been subjected to the highest heat and immediately upon the completion of the operation desired to be effected. These two objects are general objects of the invention applicable to any use to which the furnace may be put; but the later named object is also a particular and specific one as applied to the furnacing of sodium bicarbonate. In furnacing sodium bicarbonate to change it into sodium carbonate, it is found that if the substances are subjected too long to high heat action, or are subjected to an unnecessarily high temperature, the resulting product will contain an objectionably high percentage of caustic soda. It is a particular object of this invention to provide a furnace in which the formation of caustic is prevented or greatly minimized.

It is a further general object of the invention to provide a furnace of large treating capacity and of great fuel economy; to provide a type of furnace in which continuous operation may be effected, in contradistinction to the previous intermittent or batch operation; and it is also an object to reduce the actual cost of the furnace and to do away as far as possible with the use of a large amount of expensive fire-proof material, and to materially increase the life of the furnace. In fact, I may here say that although furnaces which have heretofore been used for the purposes herein described, have been necessarily renewed every few months, my furnace has a more or less indefinitely long life.

In the accompanying drawings I illustrate a specific preferred form of furnace adapted particularly for operations upon the materials herein specified; and in these drawings—

Figure 1 is a vertical central section of the furnace; Fig. 2 is a plan of the same; Fig. 3 is a horizontal section taken on line 3—3 of Fig. 1; and Fig. 4 is a horizontal section taken on line 4—4 of Fig. 1.

In the drawings I show a furnace struc-

ture having a circular outer wall 10 supported upon any suitable sub-structure 11; and the whole furnace and sub-structure is preferably composed of brick or other suitable material. The furnace is roofed with an arch 12 and has a floor 13 which preferably drops on all sides toward the center of the furnace. The various sizes of the parts are shown in approximately correct proportions of the drawings. In a furnace which is approximately thirteen feet internal diameter, I have about a four-inch drop on the floor from the outer edge to the center. The inner facing of the furnace may be made of heat resistant material, such as ordinary fire brick; but the body of the furnace walls, foundation, etc., are made of ordinary red brick, or of any other suitable material. In the center of the furnace floor there is an outlet well 15 and around this well I preferably place a ledge 16 which is for the purpose of preventing any solid material from rolling into the well 15. This circular ledge 16 may have notches or cuts 17 therethrough for the purpose of allowing ready and immediate outflow of the melted or fused material from the space immediately surrounding the ledge. However, this protective ledge may or may not be used, as best suits the particular purpose to which the furnace is put.

A draft flue 18 leads off from the lower part of the well and through this draft flue the heated air and products of combustion are drawn off. In the process of treating sodium bicarbonate I may take these products of combustion to apparatus in which the bicarbonate is dried previous to putting the material into this furnace; but the present invention is not concerned particularly with such procedures, and so I illustrate a draft stack at 18^a which will typify any suitable means for drawing off the products of combustion and for causing the operations hereinafter described. However, I may here explain that it is one of the specific advantages of my invention that the draft flue is low down (due to the draft coming out of the bottom of the furnace), and that this position of the draft flue enables me to conveniently pass the products of combustion through other apparatus (as heating or drying apparatus) before finally passing them to the atmosphere through a stack.

A tap hole 19 leads out from the well 15; and through this tap hole the melted or fused material is drawn off. In using the furnace for melting ores and the like, the melted metal may be handled in any desired manner when it is withdrawn from the tap hole; but in the particular and specific use which I herein describe, I make arrangements for atomizing the stream of melted carbonate which issues from the tap hole 19. For this purpose the tap 19 discharges into a tunnel 20 and the melted material drops down immediately in front of an air blast pipe 21, through which an air blast is maintained at a suitable pressure, say 8 or 10 ounces per square inch or more. The air blast through this pipe blows the stream of material into fine particles so that the material is blown in finely divided state out through the tunnel 20 and thence into any suitable receiver which is indicated at 22 in Fig. 4. An observation tunnel 9 is provided for the purpose of observing the action of the air blast on the stream of molten material.

The material to be treated is fed into the furnace through its roof and around its wall so that the material forms an annular pile against the circular wall of the furnace, with an inverted conical open space within the annular pile of material, and the material presenting an inner inverted conical surface to the action of flame and heat within the furnace. The particular material of which I herein speak, bicarbonate of sodium, piles at about the angle illustrated in the drawings. In the drawings the material is indicated at "M". It will be seen that the circular wall of the furnace is amply protected by the thickness of material in front of it. The furnace is so designed that the foot of the annular pile of material will stand about four or six inches from the circular ledge 16; or, in any case preferably just far enough from the circular ledge to prevent any solid material which might roll down the face of the pile going over into the well 15. For the purpose of feeding the material I may use any suitable means; but I preferably use means which will feed the material evenly around the periphery of the furnace, and will also feed it continuously; so as continuously to keep an even annular pile of material in the furnace. I may provide a plurality of feeding tubes 25 which are fed at their upper ends from an annular trough 26 by the action of an annular feeder or spreader which rotates around in the trough, the material being delivered into the trough in any suitable manner, as through a chute 28. The feeder may be rotated in any suitable manner. It may comprise two annular members 27 lying in the trough 26 against its inner and outer walls, joined by cross members 27^a which act as scrapers to move the material along the trough, filling any of the feeding tubes 25 which are not full of material. However, any suitable means may be used for evenly feeding material to the several feed tubes 25; or, in general, I may use any means for evenly and continuously feeding the material into the furnace around its upper edge, or for feeding the material into an annular pile surrounding the burner.

The burner, which uses fuel oil, is shown at 30, and projects down into the furnace centrally through the arch 12. The burner may be of any suitable type and preferably one that will spread the fuel, and the flame, out more or less horizontally and circularly around the head 30ª of the burner. Such a burner may be operated with fuel oil and with air under pressure. Air for combustion in the furnace is admitted through an air pipe shown at 31. This air pipe admits air to the upper center of the furnace. The action of the burner throwing the fuel outwardly horizontally, has a tendency to cause the air to flow in the direction indicated by the arrows; causing the cool incoming air to spread out in the furnace under the arch and then causing the air to be drawn down into the combustion which then takes place in a more or less well defined inverted cone over the inverted conical exposed surface of the material. The furnace arch is effectually protected from deterioration by heat by this direction of flow of the incoming cool air. Air may be supplied to pipe 31 under a suitable pressure; in the present instance about two ounces to the square inch. The flame and products of combustion are directed and drawn by the draft into the well 15, and the products of combustion then pass out through the flue 18. I have hereinbefore explained that the draft in flue 18 may be created by any desired means. The burner is so regulated that, in the present instance, the hottest part of the flame is approximately at or near the upper open end of the well. The flame plays downwardly upon the sloping conical surface of the material and the material is fused and melted, and the melted material runs down the sloping surface and immediately passes into the well. The highest temperature employed is of course regulated to suit the material being operated upon. In the present instance this temperature may be approximately 1200 to 1400 degrees F. Immediately the material has been subjected to the highest temperature, it passes directly out of the zone of highest temperature and passes quickly out of the furnace by a very short route.

From the foregoing description the application of my invention to the treatment of sodium carbonates, and the advantages accruing therefrom, are to be readily understood. Speaking now more generally of the advantageous features of my furnace, without restriction as to its use, it will be seen that there are various improvements of some importance. The feature of utilizing an annular pile of material exposing its inner surface to the action of flame is a feature which leads to many good results. In the first place, a comparatively large area of material is exposed efficiently to a single flame. The arrangement is such that all of the portions of the flame come into very close proximity, or into actual contact with the surface of the material; and that the whole of the exposed surface of the material may be very readily acted upon by the flame. Consequently, a great increase in efficiency is to be expected; and I find by actual practice that this expectation is realized in so far that I have been already able to obtain from a furnace of this character about twice the output as from an old style furnace of the same size; and to obtain this doubled output with the use of approximately one-half the fuel necessary in the older kind of furnace.

Another generally advantageous feature of the furnace lies in the fact that a free and unchoked surface of the material is presented at all times to the action of the flame. This is a feature which is not only particularly desirable in the specific use of the furnace herein set forth, but is also particularly desirable in the smelting or melting of ores and metals with the use of petroleum or similar fuel. One of the difficulties so far encountered in the smelting, etc. of ores and metals with hydrocarbonaceous fuels has been the clogging of the mass of material after a certain amount of heat treatment, prevent further access of the heating flame to the material, and thus stopping further action. In my furnace this action cannot take place; for as fast as the material is fused and melted, it passes directly out of the furnace; and new material is continuously exposed on the exposed inner face of the annular pile.

Aside from the great increase in efficiency of this furnace, the decreased initial cost and the decreased cost of repair or replacement is a very material and important thing in the industries to which the furnace appertains. It is readily to be seen without further detailed explanation, that my furnace may be built with cheaper materials, or with a less quantity of high priced heat resisting materials; and is consequently much more inexpensive to begin with. Furthermore this furnace does not need periodic renewal, which is an item of very large expense in the older kinds of furnaces. In my improved furnace, although I have explained that the inner facing of the furnace may be of firebrick, even this may not in some cases be necessary. In the older kind of furnaces the inner facing has been constructed of magnesite, which is an expensive material and expensive of installation. In the present case I preferably make the annular ring 16 of magnesite; and under some circumstances it may be necessary to renew this ring 16; but such renewal is easily, quickly and inexpensively made.

The continuous nature of operation is also an advantage, not only because it leads to increased output but because it keeps the fur-

nace continuously heated. No loss occurs from the alternate cooling and reheating of the furnace, and the usual furnace deterioration due to the alternate heating and cooling is done away with.

I have now proceeded to describe a preferred form of my invention in some particularity and detail; but it will be fully understood that I do not thereby limit my invention to the specific details herein set forth; but rather do I believe my invention to be broad in its nature and scope, and I accordingly reserve to myself any changes and modifications such as may suggest themselves to those skilled in the art or such as may fall within the scope of the following claims.

Having described a preferred form of my invention, I claim:

1. A furnace embodying a structure having a chamber with an outlet in its floor, means to feed material into the furnace to stand in an annular pile with its foot around the outlet, and means to apply heat to the inner sloping surface of the annular pile.

2. A furnace, embodying a structure having a substantially circular chamber with a substantially central outlet in its floor, means to feed material evenly and continuously around its upper part into the furnace chamber to stand in an annular pile around the wall of the furnace chamber, the proportions of the chamber being such that the pile standing against the wall has its inner surface on all sides sloping toward and has its foot around the lower outlet, and means to apply heat to the inner surface of the annular pile.

3. A furnace embodying a structure having a chamber with an outlet in its floor, means to feed material into the furnace to stand in an annular pile with its foot around the outlet, and means to apply heat to the inner sloping surface of the annular pile, said means embodying a central liquid fuel burner projecting a flame outwardly toward the inner surface of the pile somewhat above its foot.

4. A furnace embodying a structure having a chamber with an outlet in its floor, means to feed material into the furnace to stand in an annular pile with its foot around the outlet, combustion means to apply heat to the inner surface of the annular pile, and a draft flue connected to the outlet to draw the heat downwardly and the products of combustion out of the chamber through the outlet.

5. A furnace embodying a structure having a chamber with an outlet in its floor, means to feed material into the furnace to stand in an annular pile with its foot around the outlet, combustion means to apply heat to the inner surface of the annular pile, said means embodying a central liquid fuel burner projecting a flame outwardly toward the inner surface of the pile somewhat above its foot, and a draft flue connected to the outlet to draw the heat downwardly and the products of combustion out of the chamber through the outlet.

6. A furnace, embodying a structure having a substantially circular chamber with a substantially central outlet in its floor, the floor sloping from all sides to the outlet, means to introduce material to the upper part of the chamber around its outer wall so as to form an annular pile of material in the chamber banked against the outer wall with its foot around the central outlet, and means to apply heat to the inner surface of the annular pile of material.

7. A furnace embodying a structure having a substantially circular chamber with a substantially central outlet through its floor, means to introduce material to the upper part of the chamber around its outer wall so as to form an annular pile of material in the chamber banked against the outer wall with its foot around the central outlet, a raised rim around the outlet, and means to applying heat to the inner surface of the annular pile of material.

8. A furnace, embodying a structure having a chamber with an outlet in its floor, means to feed material into the furnace to stand in an annular pile around the outlet, combustion means to heat the inner exposed surface of the pile, means to admit air to the upper part of the furnace over the combustion means, and draft means connected to the outlet.

9. A furnace, embodying a structure having a chamber with an outlet in its floor, means to feed material into the furnace chamber to stand in an annular pile in the furnace chamber around the outlet, means to apply heat to the inner surface of the annular pile, said means embodying a central liquid fuel burner projecting a flame outwardly toward the inner surface of the pile, a draft flue connected to the outlet to draw the heat downwardly and the products of combustion out of the furnace chamber, and means to admit air to the chamber above the liquid fuel burner.

In witness that I claim the foregoing I have hereunto subscribed my name this 20th day of February, 1918.

FRANK R. HILL.

Witness:
A. T. SMITH.