March 6, 1928. 1,661,742

A. W. WAERN

REDUCING AND SMELTING FURNACE

Filed Dec. 19, 1923 3 Sheets-Sheet 1

Fig. 1.

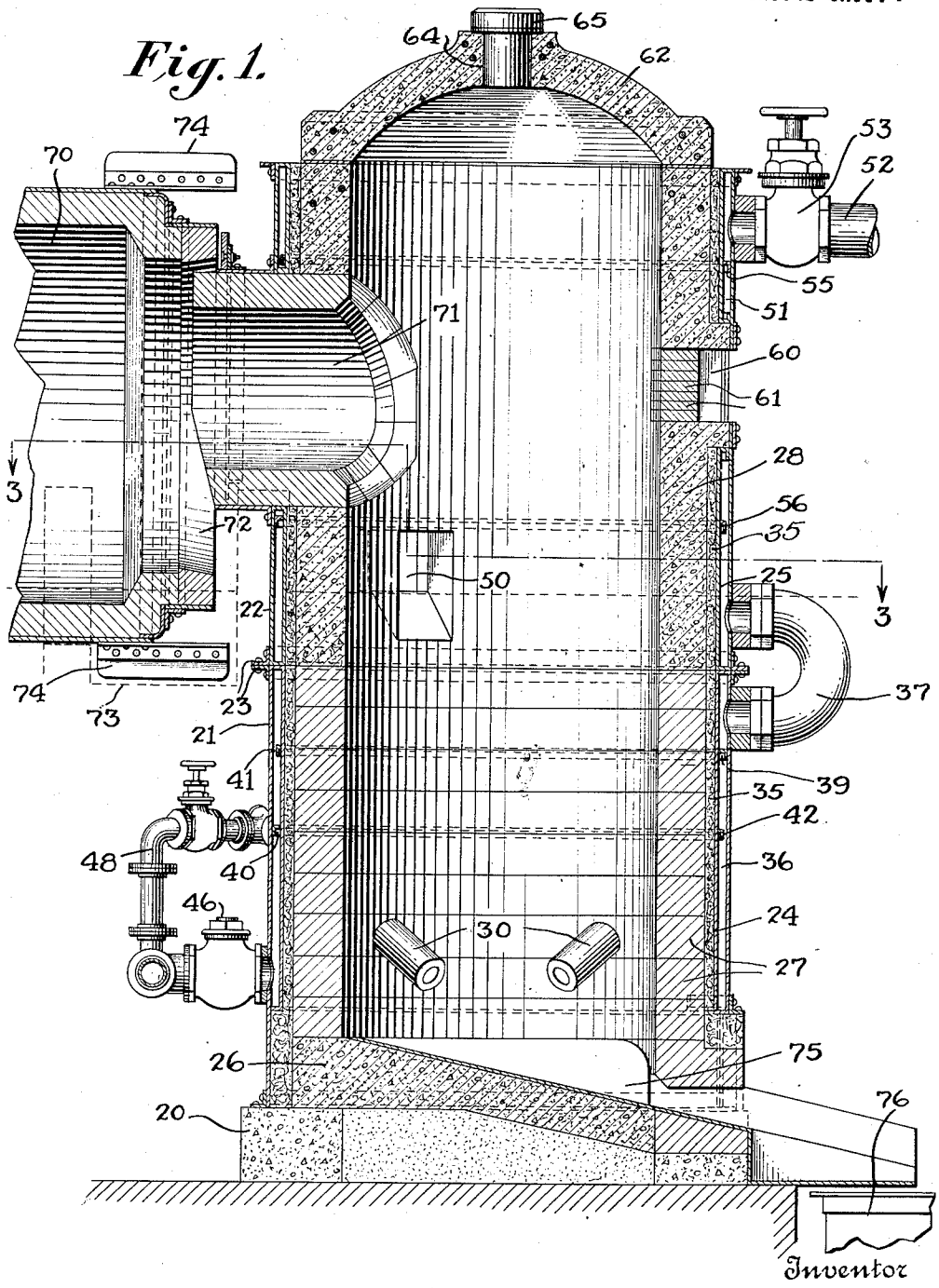

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Fig. 2.

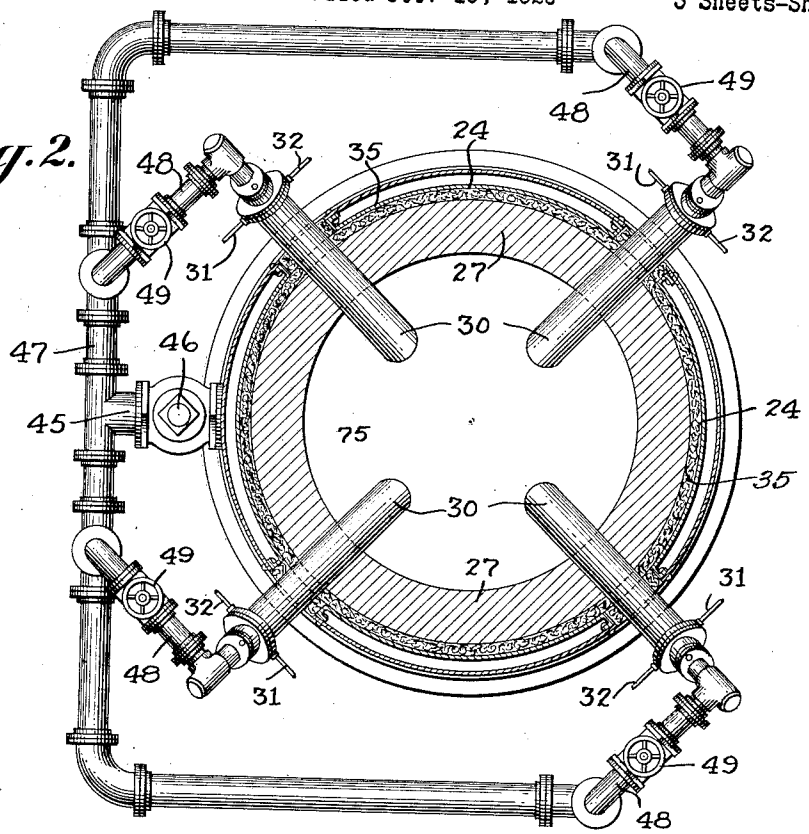

Fig. 3.

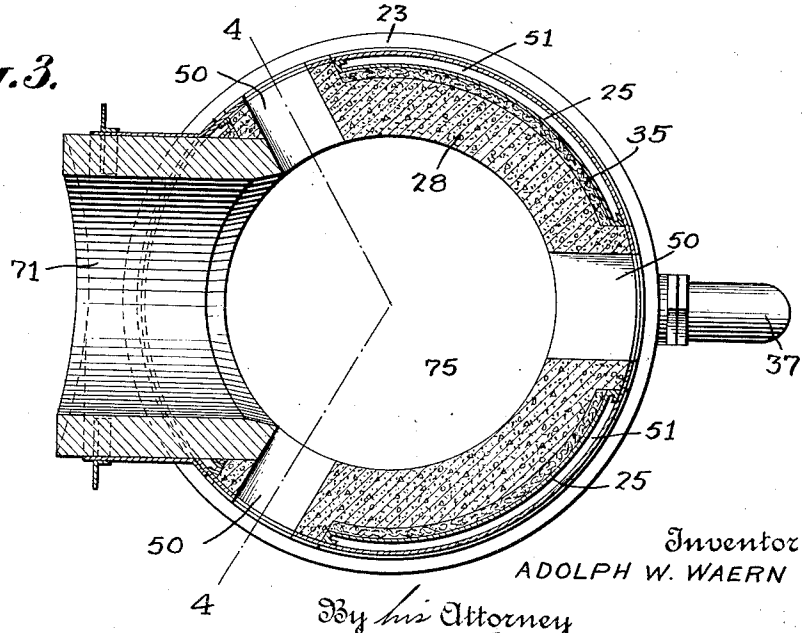

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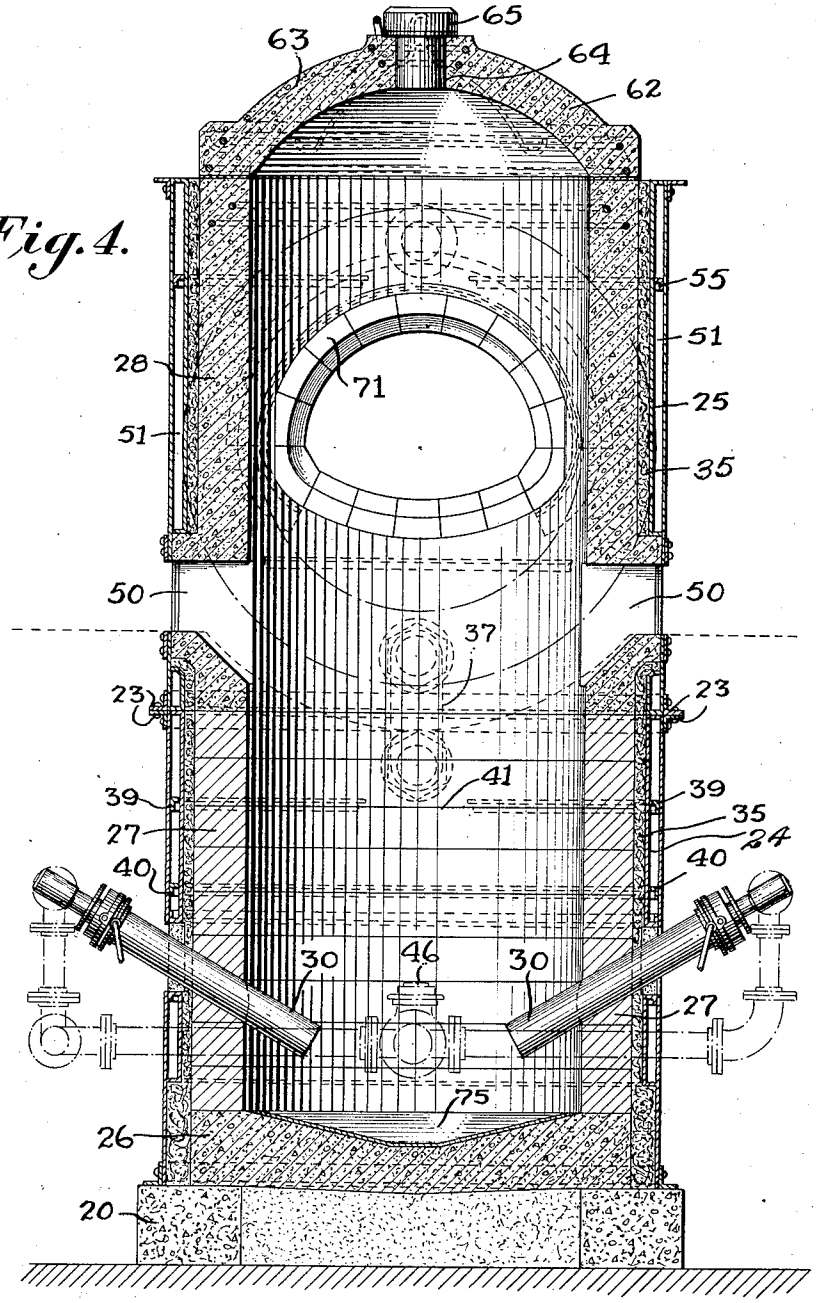
Fig. 4.



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Patented Mar. 6, 1928. 1,661,742

UNITED STATES PATENT OFFICE.

ADOLPH W. WAERN, OF ONTONAGON, MICHIGAN, ASSIGNOR TO PINE-WASTE PRODUCTS, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

REDUCING AND SMELTING FURNACE.

Application filed December 19, 1923. Serial No. 681,592.

This invention relates to furnaces and particularly to reducing and smelting furnaces for reclaiming the process chemicals used in the sulphate process for preparing wood pulp.

This reclamation process involves the following steps:

The spent cooking liquor is evaporated to dryness, the dry product being called "black ash." This black ash is mixed with new chemicals in the form of sodium sulphate to make up for the process losses and the mixed product is charged into reducing and smelting furnaces. The black ash containing the non-cellulose portion of the original wood is rich in fuel and when the ash is fed into the reducing and smelting furnace, a rapid combustion takes place without the addition of other fuel.

The air required for the combustion in the smelters is supplied through nozzles preferably water-cooled and projecting inside the furnaces, a blower being used to force the air through the nozzles.

The chemicals in the black ash are melted due to the heat of combustion and are discharged by gravity through a spout at the bottom of the smelter and flow into a dissolving tank to again be properly treated and used in the process of cooking pulp.

This invention relates particularly to the construction of the smelting furnaces. Such furnaces as now constructed for this purpose are square in section and have a heavy outside shell of brick work, reinforced and are lined with soapstone, or other refractory material, which structures are very heavy, occupy a considerable space, are expensive to construct and last only a comparatively short time due to the excessive heat and the chemical action taking place therein.

This invention has for its object to provide a reducing and smelting furnace of the character described that will be stronger and more durable than the existing type and will have a maximum capacity for the space occupied.

Another object of the invention is to provide means for cooling the furnace lining at the same time heating the air used for the air blast.

Another object of the invention is to provide a furnace of the character described having provision made for expansion due to the heat.

Further objects of the invention will appear from the following specification taken in connection with the drawings, which form a part of this application, and in which

Fig. 1 is a vertical sectional view of a smelting furnace constructed in accordance with the invention.

Fig. 2 is a transverse sectional view of the structure shown in Fig. 1.

Fig. 3 is an irregular transverse sectional view taken substantially on line 3—3 of Fig. 1, and

Fig. 4 is a vertical sectional elevation taken at right angles to Fig. 1 and substantially on line 4—4 of Fig. 3.

The invention briefly described consists of a reducing and smelting furnace comprising an outer shell preferably of sheet metal, such as steel, a lining of suitable material, such as soapstone, or a combination of soapstone and concrete, the shell and lining being spaced from each other. The furnace is provided with nozzles for introducing an air blast therein and the air for these nozzles is forced around the furnace lining in the space between the shell and lining, thereby cooling the lining and heating the air utilized for the air blast. In the particular form of the invention illustrated, the shell or casing surrounding the lining is provided with inner and outer walls, the inner wall being spaced from the lining and suitable material, such as asbestos, being interposed between the inner wall of the shell and the lining. This asbestos allows for expansion of the lining due to the excessive heat within the smelter. The furnace is preferably cylindrical instead of square in section, thus providing a maximum capacity for the space occupied by the furnace. The cylindrical construction is also preferable since square furnaces are more liable to cave in and have more corners and edges and require more repairing. Further details of the invention will appear from the following description.

Referring to the drawings, the furnace illustrated is mounted on a base 20 preferably of concrete and has an outer shell comprising a lower section 21 and an upper section 22, these sections having flanges 23 which are secured together in any suitable manner. This shell is preferably formed of sheet metal, such as steel.

The shell of the furnace also includes an

inner wall comprising sections 24 and 25, this wall being spaced from the outer wall as clearly indicated in the drawings.

The furnace is provided at its lower end with a hearth 26 preferably formed of a combination of soapstone and concrete. A lining 27 is mounted in the shell above the hearth, the portion of the lining disposed within the lower section of the shell preferably being formed of soapstone and the portion of the lining indicated at 28 disposed within the upper portion of the shell being formed of a combination of soapstone and concrete.

For the purpose of introducing an air blast into the furnace, a plurality of nozzles 30 extend through the shell and lining into the furnace, these nozzles discharging the air above the hearth 26. The nozzles 30 are preferably water-cooled, conduits 31 and 32 being provided for conducting the cooling liquid to and from the nozzles.

In order to provide for expansion of the lining due to the excessive heat in the smelter, the inner wall 24, 25 of the shell is spaced from the lining and the space between these parts is filled with asbestos 35 which is rammed into this space.

The short life of the furnace lining is due primarily to the excessive heat within the furnace and the action of the chemicals thereon and in order to lengthen the life of this lining, means is provided for cooling the lining. To accomplish this, air is introduced into the space 36 between the inner and outer walls of the shell and this air is conducted around the inner wall of the shell and the lining. The air is introduced into the space 36 through a conduit 37.

In order to insure the circulation of the air around the furnace lining, partitions 39 and 40 are provided in the space 36. These partitions are provided with diametrically opposite openings, the opening in the partition 39 being indicated at 41 in Figs. 1 and 4, and the opening in the partition 40 being indicated at 42 in Fig. 1.

The air from the space 36 passes outwardly through a conduit 45 having a check valve 46 therein to a conduit or air main 47. The air main 47 delivers the air through conduits 48 to the air nozzles 30. Conduits 48 have control valves 49 therein for regulating the air passing through the nozzles.

The smelting furnace has charging openings 50 formed therein through which the charges of black ash are introduced.

The upper section of the furnace lining is also cooled by means of an air jacket, the air entering the space 51 between the inner and outer walls of the shell through a conduit 52, having a control valve 53, and leaving this space through the conduit 37, the air being forced under pressure around the lining and through the space 51. Baffles 55 and 56 are provided as in the lower section for insuring circulation of the air.

The structure just described has a double function of cooling the furnace lining and of preheating the air used in the air blast, thereby obtaining a more efficient and complete combustion of the black ash.

An opening 60 is provided in the upper section of the furnace for the purpose of giving access to the furnace, this opening being normally closed by any suitable means, such as bricks 61.

A cap 62 closes the upper end of the furnace, this cap being preferably formed of a combination of soapstone and concrete and reinforced as shown in Fig. 4 by rods 63. These rods can be extended through the upper end of the cap, thereby facilitating the removal of the cap. An opening 64 is formed in the cap which is normally closed by a plug 65.

The smelting furnace illustrated in the drawings is usually used in conjunction with an incinerator, a portion of which is illustrated in Fig. 1, at 70. The hot combustion gases from the smelting furnace enter the incinerator through a mouth 71 thereof and pass through the incinerator, thereby evaporating the black liquor to dryness forming the black ash. This black ash is discharged through a discharge opening 72 into an ash pit 73. From the ash pit, the black ash is discharged by scrapers 74 to the charging floor, the piles of black ash being disposed adjacent the charging openings 50 of the smelting furnace. The ash after being mixed with new chemicals, such as sodium sulphate, is fed through the openings 50 into the smelting furnace. After the combustion of the black ash in the air blast, the chemicals in the black ash are melted and are discharged from the smelting furnace through a discharge conduit or spout 75 into a dissolving tank 76 for further treatment.

From the foregoing description, it will be seen that means has been provided for simultaneously heating the air from the air blast and cooling the lining of the furnace, thereby lengthening the life of the furnace lining. Furthermore, by constructing the furnace in cylindrical form, a stronger structure has been developed and the furnace has a maximum capacity for the space occupied thereby. The steel shell of the furnace acts as a support for the inside soapstone lining and the asbestos and the spacing of the shell from the lining provides for expansion of the lining due to the heat.

Although one specific embodiment of the invention has been particularly shown and described, it will be understood that the invention is capable of modification and that changes in the construction and in the arrangement of the various cooperating parts may be made without departing from the

spirit or scope of the invention, as expressed in the following claims.

What I claim is:

1. A furnace comprising a shell having inner and outer walls, the walls being spaced from each other, air directing baffles between said spaced walls, a lining within the shell and spaced from the inner wall thereof, compressible material between said lining and said inner wall, an air nozzle extending into the furnace and means for forcing air through the space between the walls of the shell, around said baffles and through said air nozzles.

2. A furnace comprising a shell having inner and outer walls, the walls being spaced from each other, air directing baffles between said spaced walls, a lining within the shell and spaced from the inner wall thereof, compressible material between said lining and said inner wall, an air nozzle extending into the furnace and air conduits connected to said nozzle and to the outer wall of the shell and receiving air from the space between the outer wall and the inner wall and lining.

3. A furnace comprising a pair of cylindrical metallic shells of unlike diameters spaced to form an air jacket between them, a refractory lining spaced from the inner shell and a body of compressible material between said lining and said inner shell.

4. A furnace comprising a pair of cylindrical metallic shells of unlike diameters spaced to form an air jacket between them, a refractory lining spaced from the inner shell, the lower part of said lining being formed of soapstone and the upper part thereof of soapstone and concrete, a body of compressible material between said lining and said inner shell, an air nozzle extending into the lower part of the furnace, and means for forcing air through the air jacket and the nozzle.

In witness whereof, I have hereunto set my hand this 9th day of October, 1923.

ADOLPH W. WAERN.