March 18, 1941. H. BULLARD 2,235,311

SYSTEM FOR ROASTING ORES

Filed April 8, 1940 3 Sheets-Sheet 1

FIG. 5.

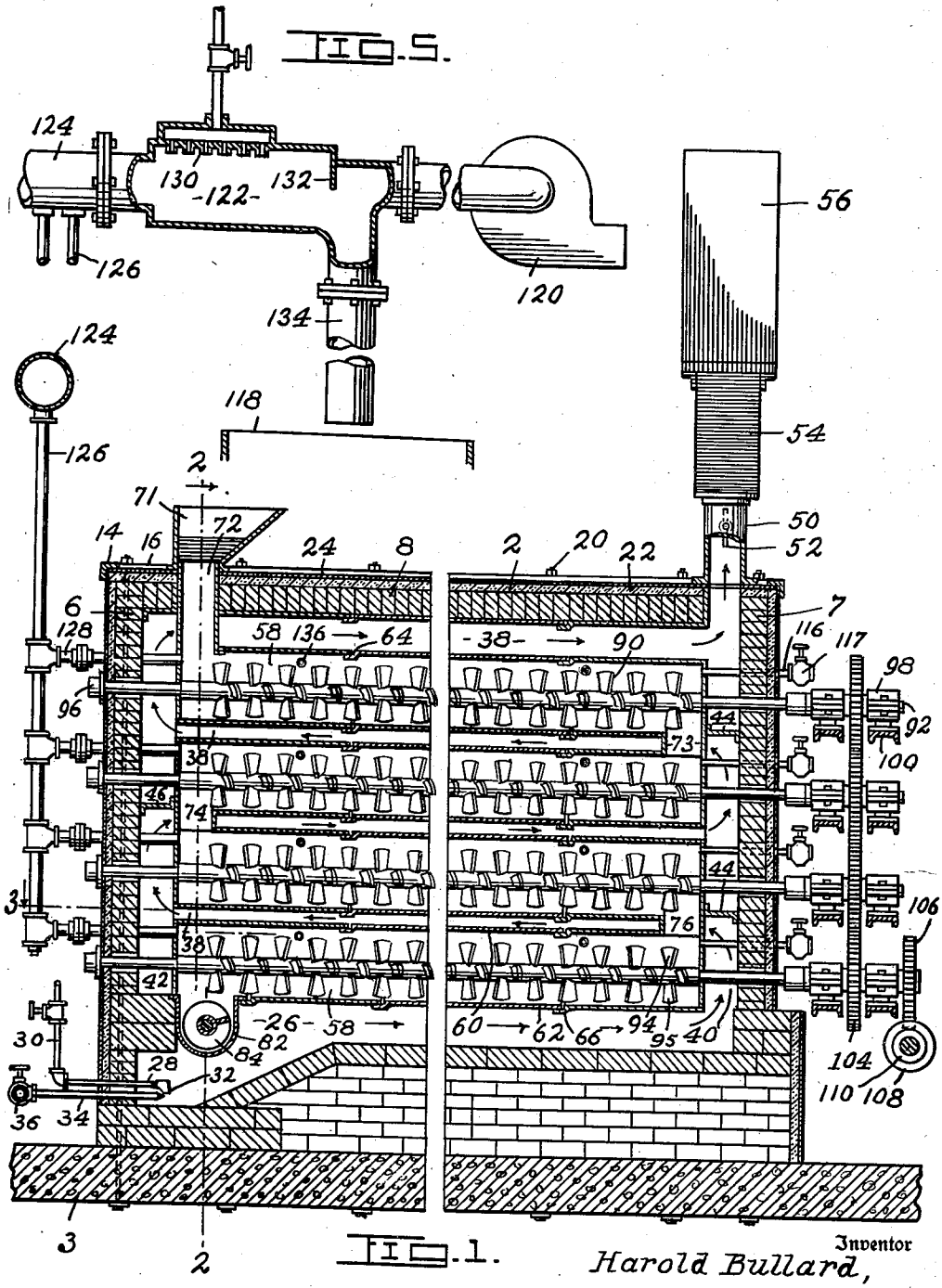


FIG. 1.

Inventor

Harold Bullard,

By

F. G. Fischer,

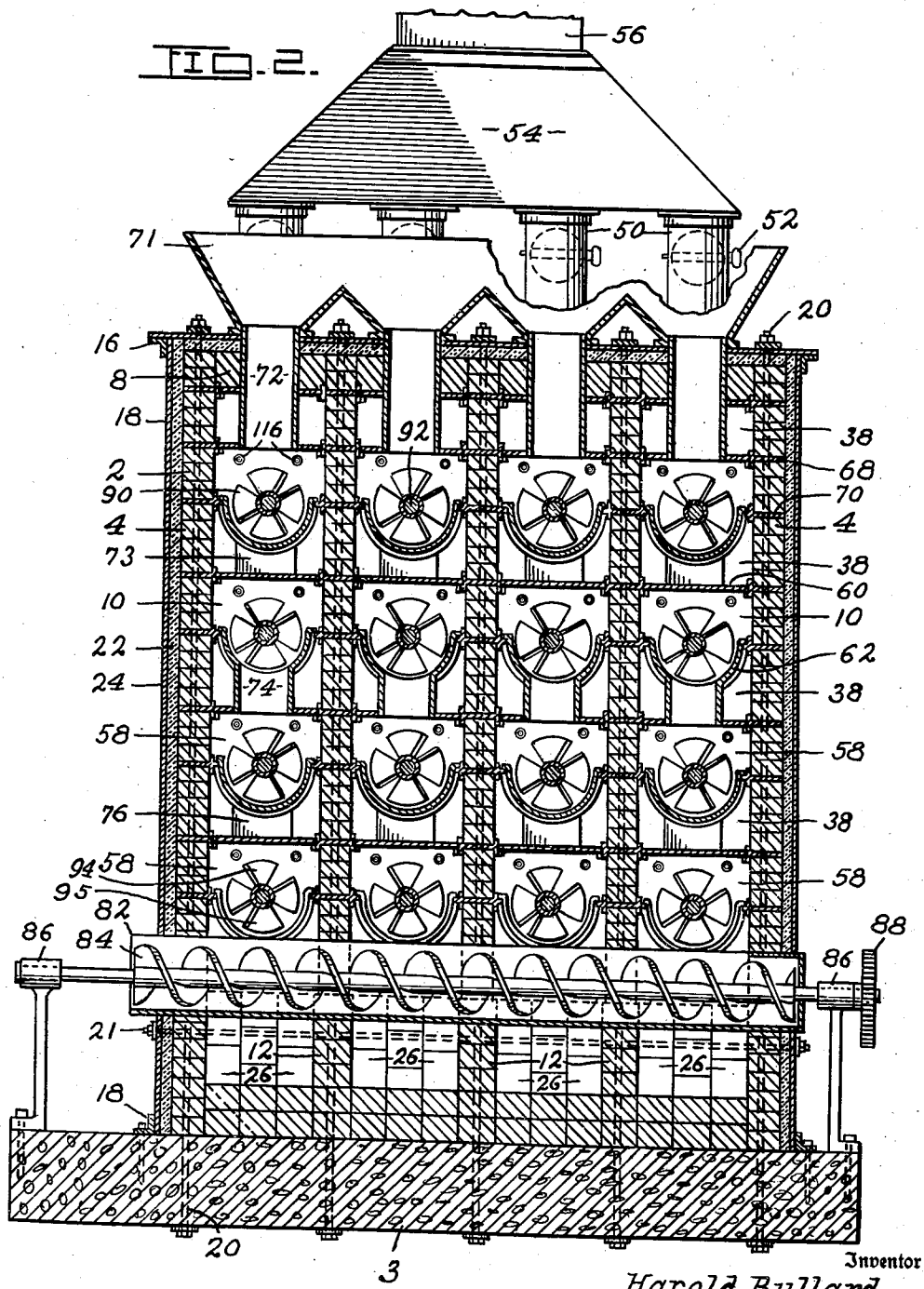
Attorney.

March 18, 1941. H. BULLARD 2,235,311

SYSTEM FOR ROASTING ORES

Filed April 8, 1940 3 Sheets-Sheet 2

FIG. 2.



Inventor

Harold Bullard,

By

F. G. Fischer,

Attorney.

March 18, 1941. H. BULLARD 2,235,311

SYSTEM FOR ROASTING ORES

Filed April 8, 1940 3 Sheets-Sheet 3

FIG. 3.

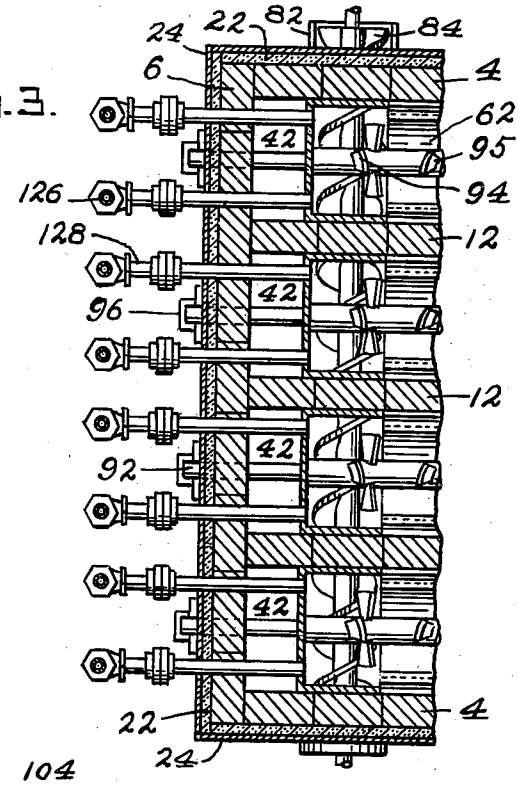
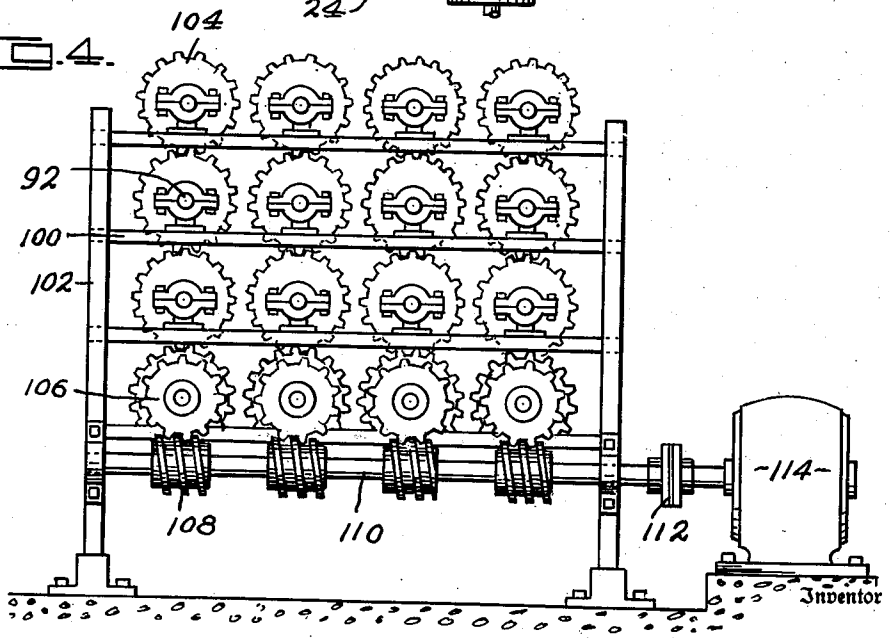


FIG. 4.



Inventor

By Harold Bullard,

F. G. Fischer,

Attorney.

Patented Mar. 18, 1941 2,235,311

UNITED STATES PATENT OFFICE

2,235,311

SYSTEM FOR ROASTING ORES

Harold Bullard, Independence, Mo.

Application April 8, 1940, Serial No. 328,495

1 Claim. (Cl. 263—25)

My invention relates to a system for drying and roasting various materials such, for instance as oil bearing and gold bearing shales, complex gold-silver-lead-antimonical-telluride ores, as well as the more simple gold-silver ores after they have been dry crushed preferably to pulp that will pass through screens varying from sixty to eighty mesh.

In carrying out the invention, I provide a structure having one or more series of retorts alternately arranged with a series of hot air flues. In each series the retorts and the flues are placed one above the other and the lower flue communicates with a combustion chamber from which hot air pursues a tortuous course through the flues to a stack. The pulp is fed into the upper retort and moved by conveyors through the respective retorts and finally discharged from the lower portion of the structure. The operation is continuous and since the pulp is not exposed directly to the flames from the combustion chamber fusion thereof, which would interfere with separation of the various constituents from each other, is prevented.

When passing through the upper retort the pulp is subjected to a temperature of approximately 250 degrees C., which progressively increases to approximately 550 degrees C., in the lower retort. These temperatures are not high enough to fuse the metals and their sulphur bond but, with oxygen drawn into the retorts with atmospheric air, will reduce the sulphur bond from a hard crystallized state to a soft flocculent condition, so that it can be swept out of the respective retorts with the oxygen. Removal of the sulphur bond disassociates the various elements formerly combined with the ores and thus leaves the latter in a free-milling condition so that the values can be readily recovered.

In order that the invention may be fully understood, reference will now be had to the accompanying drawings, in which—

Fig. 1 is a broken vertical longitudinal section of the structure for carrying out the invention.

Fig. 2 is an enlarged vertical cross section on line 2—2 of Fig. 1.

Fig. 3 is a broken horizontal section on line 3 of Fig. 1.

Fig. 4 shows the gear system for operating a plurality of conveyors which move the pulp through the retorts.

Fig. 5 is a vertical longitudinal section of a condenser.

Referring in detail to the different parts, 2 designates a structure preferably of brick, having a concrete foundation 3 and comprising side walls 4, front and rear walls 6 and 7, respectively, and a roof 8.

As shown more clearly by Fig. 2 the structure is divided into a plurality of vertical compartments 10 arranged side by side and divided by vertical partition walls 12 extending from the foundation 3 to the roof 8. Angle irons 14, 16 and 18, and tie rods 20 and 21 are employed to reinforce the structure 2 and in order to conserve fuel the walls and roof of the structure are enclosed in an insulation jacket 22 of asbestos, or other suitable material, protected with an outer covering of metal plates 24.

The compartments 10 are independent of each other and each compartment is provided at its lower portion with a combustion chamber 26 in which any suitable fuel may be burned. In the present instance I have shown each combustion chamber equipped with an oil burner 28 fed from a suitable source of supply, not shown, through a valve controlled feed pipe 30 and provided with a down-turned nozzle 32 terminating in front of an air nozzle 34 through which an air blast is discharged that commingles with and divides the fuel oil into a fine spray to promote combustion. The air nozzle 34 is connected to a pipe 36 leading from a blower, not shown.

Each compartment 10 has a series of horizontal flues 38, four being shown in the present instance, but this number may be increased or decreased according to the capacity desired. As shown by Figs. 1 and 2 the flues 38 are spaced one above the other, the lower one of which communicates at its inlet end with the outlet end of the combustion chamber 26 through a vertical flue 40 and at its discharge end with a vertical flue 42. The remaining flues 38 also communicate at their ends with the vertical flues 40 and 42, the former of which has transverse baffles 44 located just above the entrance to the first and third horizontal flues, respectively. The vertical flue 42 has a transverse baffle 46 located just above the inlet of the second flue 38. The vertical flues 40 and 42 are continuous from the lower to the upper portion of the structure and interposed between the ends of horizontal retorts, hereinafter described, and the front and rear walls, respectively, of the structure. The upper section of the vertical flue 40 communicates with a vertical pipe 50 having a controlling damper 52. All of the pipes 50 communicate at their upper ends with the breeching 54 of a stack

56 which carries off the products of combustion from the structure 2.

From the foregoing it will be understood that the products of combustion pursue a tortuous course from the combustion chamber 26 to the stack 56 thereby insuring economy in the use of fuel. If desired a blower, not shown, may be connected to the stack 56 to provide a forced draft for accelerating the passage of the products of combustion through the flues.

Each compartment 10 is equipped with a series of horizontal retorts 58 arranged alternately with the flues 38 from which they are separated by horizontal partitions 60 and 62 made in sections having loosely connected overlapping joints 64 and 66, respectively, to allow for expansion and contraction. The partitions 60 and 62 rest on supports 68 and 70, respectively, a number of which are carried by the side walls 4 of the structure while the remainder are carried by the partition walls 12 as shown by Fig. 2. The partitions 60 consist preferably of flat cast iron plates. The partitions 62 also preferably consist of cast iron and are of segmental cross section to conform to the peripheries of rotary conveyers hereinafter described.

The uppermost retort communicates at its receiving end with a hopper 71 through a chute 72 and at its discharge end with the receiving end of the upper intermediate retort through a chute 73. The lower intermediate retort communicates at its receiving end with the discharge end of the upper intermediate retort through a chute 74, and the lowermost retort communicates at its receiving end with the discharge end of the lower intermediate retort through a chute 76 and at its discharge end with a horizontal trough 82 which extends transversely through the front portion of the furnace 2 and is equipped with a spiral conveyer 84 which moves the material from the structure and is mounted in bearings 86. The conveyer 84 is provided with a gear wheel 88 whereby it may be geared to and driven from an electric or other suitable motor, not shown.

Each retort 58 is equipped with a rotary conveyer 90 comprising a shaft 92 and helicoidal paddles 94 and 95. The shafts 92 are journaled in bearings 96 and 98, the former of which are secured to the exterior of the front wall 6 of the structure, while the latter are supported at the rear of the structure on cross beams 100 secured to standards 102. A train of intermeshing gear wheels 104 is provided for driving the conveyers 90 in each compartment 10 and each train of gears is driven by worm gears 106 and 108, the former of which are fixed upon the lowermost shafts 92 while the latter are fixed upon a transverse shaft 110 connected by a flexible coupling 112 to an electric or other suitable motor 114. By driving the conveyers as stated the upper conveyer and the lower intermediate conveyer will rotate in a reverse direction to the other two conveyers, so that the materials will be advanced from the receiving end of each retort to its discharge end.

The paddles 94 are set at an angle to advance the material while the paddles 95 are set at an angle to retract the material, but as the latter paddles are less in number than the former the material will be advanced from one retort to another. By arranging the paddles as stated the materials are agitated to a greater extent and separation of their constituents from each other is thereby expedited.

When gold bearing ores with a sulphur bond are being treated, the sulphur is reduced from a hard crystallized state to a soft flocculent condition by the hot air circulating through the flues 38 assisted with oxygen drawn into the retorts 58 with the outer atmosphere through pipes 116 controlled with valves 117 and extending through the rear wall 7 of the structure. The vapor, sulphur and other soluble sulphates when separated from the ores are swept from the retorts with the oxygen and deposited in a leaching tank 118 by means of a vacuum created with suitable means such as a suction fan 120 having its suction inlet connected to the respective retorts 58 through a condenser 122, manifold 124, and branch pipes 126 and 128, which latter extend through the front wall 6 of the structure and communicate with the respective retorts 58. As the vapor and sulphate laden air enters the condenser 122 it is sprayed with water discharged from a spray nozzle 130, to precipitate the sulphates into the leaching tank 118 through a discharge pipe 134. A baffle 132 in the condenser 122 directs the sulphates to the discharge pipe 134.

In order that temperatures of the retorts 58 may be ascertained means are provided for connecting a number to respective pyrometers, not shown, for indicating and recording the temperatures. In the present instance I have shown for that purpose a plurality of tubes 136 extending transversely through the side walls 4 and communicating at their inner ends with the retorts in the two side compartments 10, the outer ends of said tubes being adapted for connection to the respective pyrometers, or other suitable indicating and recording means.

Briefly stated, the ore or shale to be treated, having been previously dry ground to the desired size, is fed to the uppermost retort 58 through the hopper 71 and chute 72 and on being conveyed through the retorts is converted into a free-milling condition and then discharged from the structure 2 by means of the spiral conveyer 84.

As the pulp passes through the series of retorts 58 it is thoroughly stirred and agitated with the paddles 94 and 95, so that all of the particles will be uniformly exposed to the heat thrown off by the products of combustion passing through the flues 38, 40 and 42 from the combustion chamber 26 to the stack 56. I have found that the pulp can be converted to a frangible, brittle condition by action of the paddles and starting with a temperature of approximately 550 degrees C. in the lowermost retort 58, which is reduced to approximately 250 degrees C. by the time the products of combustion reach the uppermost retort, the latter temperature being sufficient to preheat and dry the pulp.

The foregoing temperatures, together with oxygen drawn in from the outer atmosphere, liberate the chemical constituents such, for instance, as sulphur and arsenic which are converted into a flocculent condition and drawn off to the condenser 122 by the suction of the suction fan 120 to be discharged into the leaching tank 118. The temperature may be regulated as desired with the valve controlled burner 28, the valve controlled air blast, the valve controlled pipes 116 and the dampers 52.

From the foregoing it will be understood that I have provided an apparatus which is well adapted for the purpose intended, and while I have shown and described a preferred embodiment of the invention I reserve all rights to such other forms and modifications thereof as properly fall

within the spirit and scope of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

A system of the character described comprising a structure, a series of horizontal flues arranged one above another in said structure, a combustion chamber communicating with the lowermost flue, means connecting the outlet end of one flue with the inlet end of the flue above, a series of retorts arranged alternately with said flues, means for supplying the uppermost retort with material to be treated, means connecting the respective discharge ends of the retorts with the respective receiving ends of the retorts below, a shaft extending longitudinally through each retort, bearings for the shafts, means interconnecting the shafts for simultaneous rotation, and helicoidal paddles fixed to each shaft and the majority of which are inclined to move the material from the receiving end to the discharge end of the associated retorts, the minority being inclined in a reverse direction to retard the movement of the material.

HAROLD BULLARD.