March 6, 1951

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2,543,982

KETTLE FURNACE

Filed Jan. 20, 1950

2 Sheets-Sheet 1

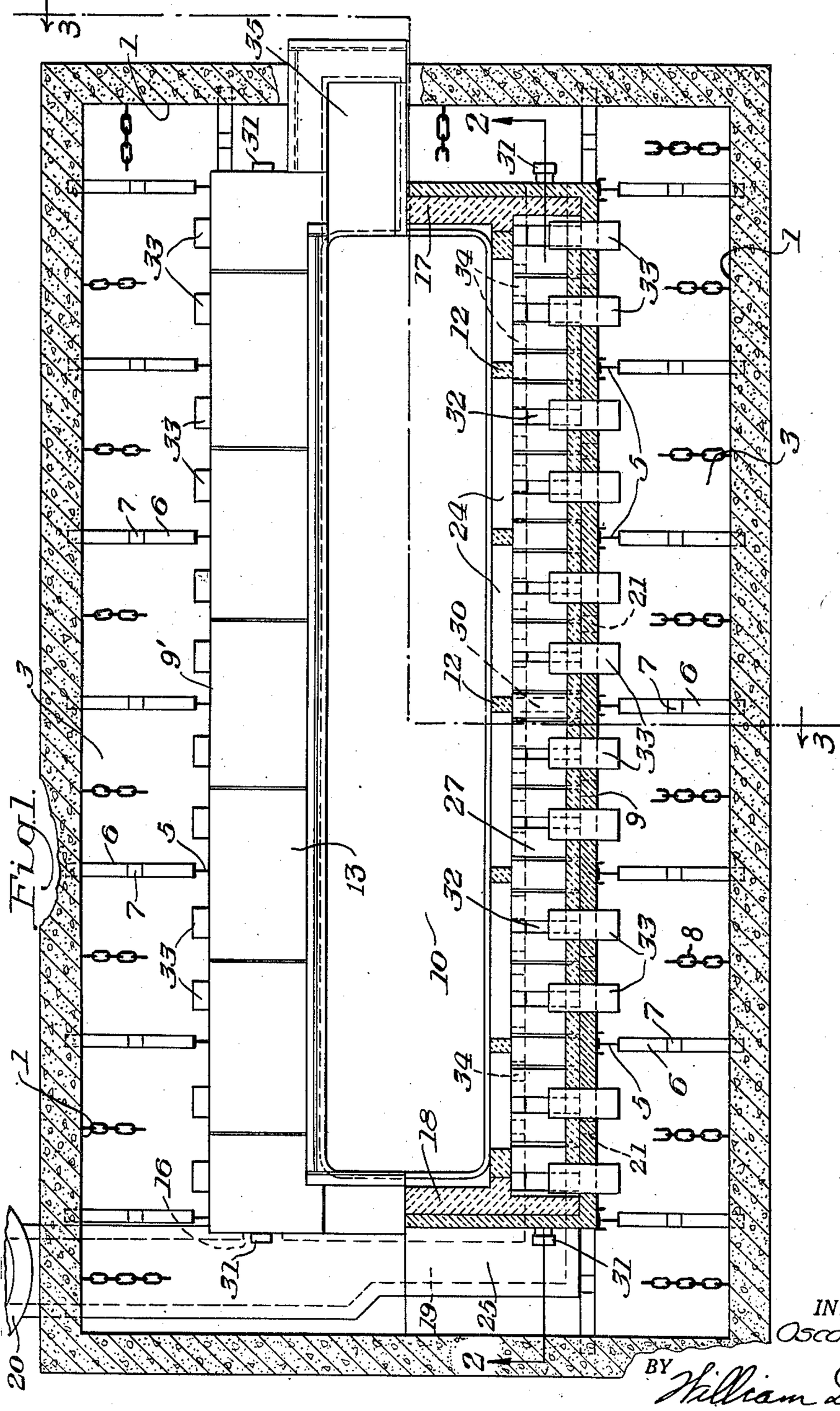

Fig. 1.

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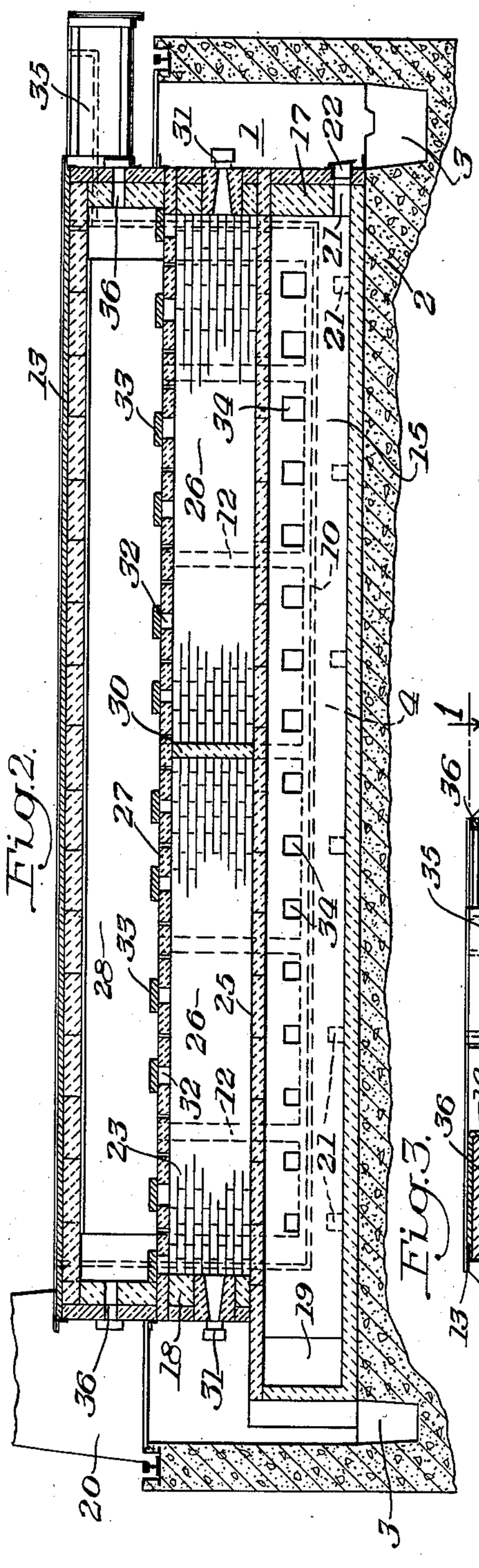

Fig. 2.

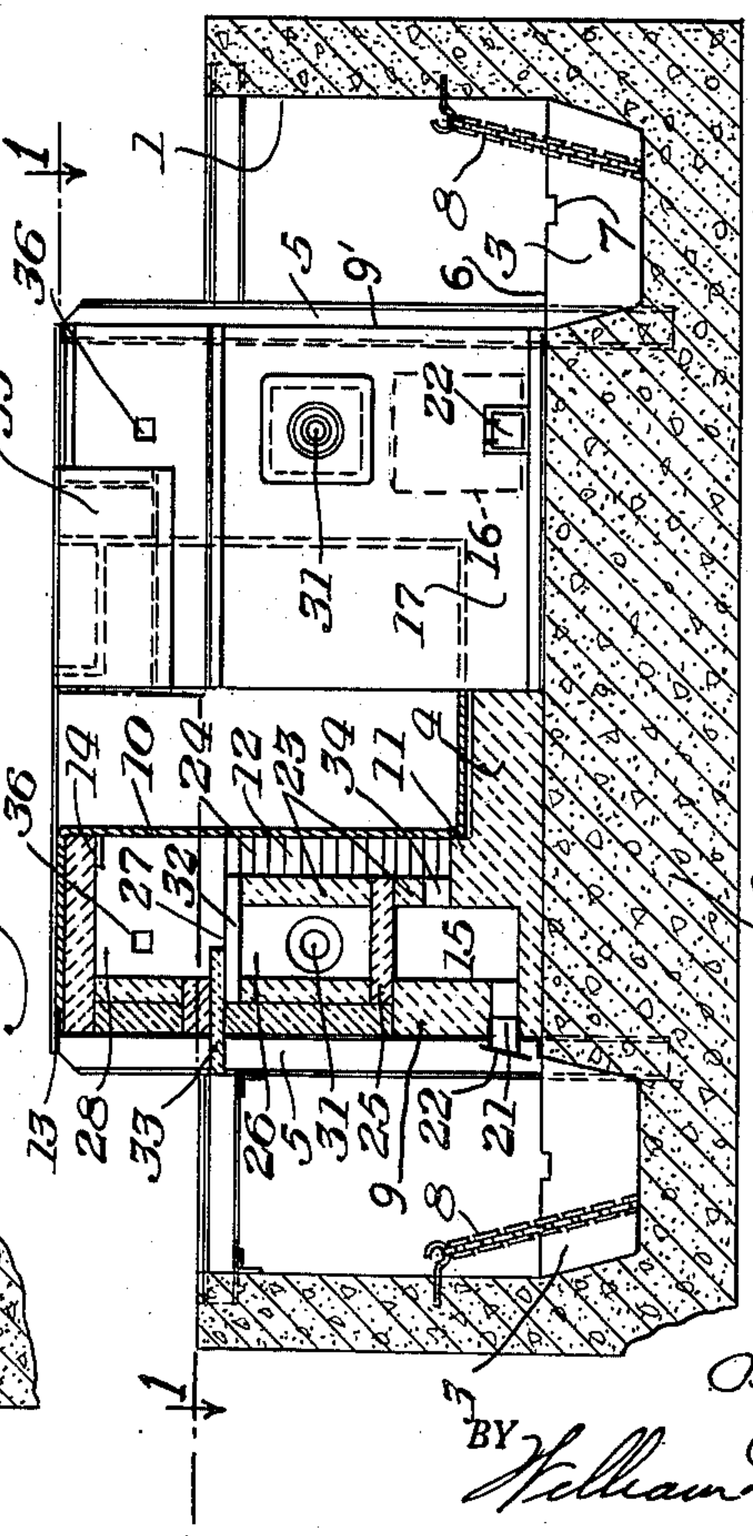

Fig. 3.

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KETTLE FURNACE

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3 Claims. (Cl. 263—11)

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This invention relates generally to improvements in kettle furnaces and more particularly to kettle furnaces heated by slow burning fuels.

Kettle furnaces are provided with a large tank containing a liquid bath such as Houghton salt solution, lead, tin or zinc for heating or coating metals by immersion therein. Kettle furnaces heretofore have been constructed to utilize a fast burning fuel such as natural gas, gasoline, or a very light oil quickly transformed into a gas and discharged from a series of burners placed closely adjacent one another along the sides of the tank. These highly volatile fuels are directed into a bed of ceramic particles that glow and maintain very fast and continuous combustion. Such a structure is disclosed in my kettle furnace patent, No. 2,460,392, of February 1, 1949.

Such a structure could not utilize a slow burning fuel such as powdered coal, tar, fuel oils or slow burning gases that produce luminous flames. These fuels are more economical than the highly volatile fuels. The heavier liquid fuels require preheating but they provide a constant uniform heat when properly prepared and controlled. In order to utilize these qualities of slow burning fuels an entirely different method and kettle furnace structure is necessary. The same general character of furnace foundation and flue may be employed but the combustion chamber is required to be large and preferably elongated in which to confine the burning fuel. Such an enclosed combustion chamber must be provided with regulated ports that control the flow of the burning fuel from the combustion chamber to the secondary combustion chamber where combustion is completed and the gases flow through the downtake where it heats the tank and is discharged through graduated openings to the flues. The ports from the combustion chamber are best graduated as well as regulated by valves to control and retard the flow of unburned fuel that is not properly transformed for quick and complete combustion in the secondary chamber. The relatively long combustion chamber receives the fuel at one end and after partial combustion and adequate transformation for complete combustion in the auxiliary chamber and the gases are then discharged laterally to the downtake where efficient heat transfer is made to the tank. The graduated size of the ports, together with their valved control, permits the uniform distribution of heat along the kettle. It prevents the fuel from being discharged prematurely which would result in combustion being carried on in the downtake and flue.

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To obtain these objects and advantages it is preferable to construct a bridge wall between the furnace side walls and the tank. These bridge walls extend the full length of the furnace being connected to the end walls. Upper and lower slabs supported between the bridge wall and the furnace side walls divide the space into a long flue at the bottom and a long combustion chamber thereabove. The top slab forms the top of the combustion chamber and provides a suitable surface on which to support the valves regulating the ports from the combustion chamber to the secondary chamber, thence to the downtake. These valves extend through the furnace side wall to be readily adjusted for the character of fuel selected to fire the furnace.

Other objects and advantages appear in the following description and claims.

The accompanying drawing shows, for the purpose of exemplification without limiting the invention or claims thereto, certain practical embodiments of the invention wherein:

Fig. 1 is a top view of the kettle furnace showing part in plan and part in section on the line 1—1 of Fig. 3;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1; and

Fig. 3 is an end view of the kettle furnace, partly in vertical section and partly in elevation on the line 3—3 of Fig. 1.

Referring to the drawings the furnace is built within the pit defined by the walls 1 which is lined with reinforced concrete and is provided with a foundation as indicated at 2. The pit 1 forms a moat 3 that extends along both sides of the furnace and is connected at least one end thereof. As shown in Fig. 3, the furnace mat 4 is constructed on the foundation 2 and is arranged to support the furnace and the furnace walls. A plurality of buckstays 5 are embedded upright in the foundation 2 and are employed to support the side walls 9 and 9' and end walls 17 and 18 of the furnace. Adjacent each of the buckstays and at other selected positions the moat 3 is provided with a plurality of partitions 6 having weir openings 7 in the upper portion thereof. The moats 3 are prepared to receive the contents of the kettle if the latter becomes ruptured during operation in order to save the furnace tile structure. The moat 3 is lower than any other portion of the furnace including the flues and prevents the contents of the kettle from stopping up the flues. The partition walls 6 and the side walls of the moat 3 are provided with a batter for the purpose of readily remov-

ing the solidified material in the moat. A chain, such as indicated at 8 in Fig. 3, may be suspended from the wall into the compartments formed by the partition 6 for the purpose of moving solidified materials such as lead or zinc.

The kettle or tank 10 is ordinarily constructed of heavy steel plate and is rectangular in shape. This tank is seated upon the mat 4 supported on the foundation and a small retaining wall 11 extends therearound for the purpose of properly anchoring the tank in position. A series of piers 12 extend from the wall 11 to more than half way up the side walls of the tank for the purpose of supporting the same in the position of the buckstays 5. These piers are made from a ceramic material such as fire brick and represent the only support of the side walls of the tank with the exception of that provided by the roof 13 which extends from the top of the buckstays to the upper rim of the tank. It will be noted that the tank may be provided with an annular shelf such as indicated at 14 to receive the inner edge of the roof structure and support the same.

Immediately adjacent and below the level of the bottom of the tank the furnace is provided with a flue on each side thereof as indicated at 15 and 16. These flues extend the full length of the furnace starting from the end wall 17 and extending through the end wall 18 where they are connected to a lateral flue 19 that runs to the stack indicated at 20.

As shown in Figs. 2 and 3, each flue is provided with a series of lateral openings 21 that extend from the bottom of the flue to the moat 3 and which are closed by the flap valves 22 for the discharge of the heated liquid to the moat if the tank ruptures. On the opposite side of the flue the vertical bridge wall 23 separates the flue from the tank and provides the downtake passages 24 between the piers 12. Part way up the bridge wall 23 is a series of slabs 25 that form the top of the flues and the bottom of the primary combustion chambers 26. The combustion chambers are closed at the top by the slabs 27 that form the bottom of the secondary combustion chamber 28 which opens to the downtake passages 24.

The combustion chambers 26 may extend the full length of the furnace. However, it is deemed preferable to divide them in two thus providing four combustion chambers, two on each side of the furnace. These four combustion chambers are made by the transverse partition walls 30 as shown on Fig. 2. Each of the elongated combustion chambers 26 is supplied with fuel from the burners 31 disposed in the end walls of the combustion chamber. The combustion chamber is completely closed to the rest of the furnace except through the graduated series of ports 32 in the combustion chamber roof slabs 27. The ports 32 are graduated in size, being larger adjacent the burner and smaller adjacent the other end of the combustion chamber. Thus, when two combustion chambers are formed on one side of the furnace there are two sets of graduated ports 32, the largest port being adjacent the burners and the next and other ports being consecutively smaller in size toward the center of the furnace. Not only are these ports graduated in accordance to the size of their opening, but they are also controlled by the slide valve 33 which may be slid over the slabs 27 to regulate the extent of each port opening. The slide valves extend through the furnace wall as indicated in Fig. 1 so that they may be adjusted, thereby controlling the amount of fuel passing from the combustion chamber through each of the ports.

Thus, by providing elongated combustion chambers, one is able to employ a slow burning fuel such as powdered coal, tar, oil or a luminous gas and control the combustion thereof within the combustion chambers 26, permitting only that portion of the fuel that is prepared for complete combustion, to discharge through the ports 32 so that it may freely burn in the secondary combustion chamber 28 and be discharged through the downtakes 24 to supply heat to the tank 10. The downtakes 24 have a series of openings through the bridge wall 23 as indicated at 34. These are flue openings that connect the downtake with the flue. These openings are preferably graduated from one end of the flues to the other. Owing to the fact that the stack 20 is adjacent one end of the flues, it is necessary to place the smallest of the flue openings 34 adjacent the stack end of the flue or a short circuiting draft would result from the secondary combustion chamber 28 to the flue. Thus, the openings 34 are graduated from the left to the right as shown in Fig. 2 which is a feature of my previously mentioned patent.

A bay 35 is formed in the right end of the tank as shown in Figs. 1, 2 and 3. The secondary combustion chamber 28 is provided with a covered burner inspection hole 36 at either end of the secondary combustion chambers 28 to permit inspection of the flame passing from the ports 32 to the downtakes 24.

Thus, by providing a relatively long and confined combustion chamber, one is enabled to discharge the slow burning fuel therein and control its combustion within the primary combustion chamber and the escape of the burning fuels and prepared fuel for combustion in the secondary combustion chamber may be determined at the proper time to effect the greatest heat transfer to the open kettle tank. The ports from the primary to the secondary combustion chamber are more readily controlled by the valves 33 if they are graduated in size as shown, thereby preventing a short circuit from the primary to the secondary combustion chamber. The greatest pressure of combustion is remote of the burner and it is therefore necessary to provide the larger ports 32 connecting the primary to the secondary combustion chamber closely adjacent the burner.

I claim:

1. A kettle furnace comprising a foundation, an open top tank supported on the foundation, furnace end walls supported on the foundation and extending laterally beyond both sides of the tank, furnace side walls supported on the foundation and connecting the end walls but spaced from the sides of said tank, a roof closing between the walls and the rim of said tank, a bridge wall on each side of said tank spaced from the roof and connecting the end walls to longitudinally divide the space between the furnace side walls and the tank to form a connected secondary combustion chamber and a downtake adjacent the tank, upper and lower slabs connecting each bridge wall and the adjacent furnace side wall to form a primary combustion chamber under the secondary combustion chamber and a flue therebelow, a stack connected to one end of each flue, a burner connected to one end of each primary combustion chamber for discharging a slow burning fuel therein, a series of graduated openings through each bridge wall from each flue to its

respective downtakes which openings are smaller in size adjacent the stack end of said flue, and a series of graduated ports from each primary combustion chamber to its respective secondary combustion chamber which ports are larger in size adjacent the burner.

2. A kettle furnace comprising a foundation, an open top tank supported on the foundation, furnace end walls supported on the foundation and extending laterally beyond both sides of the tank, furnace side walls supported on the foundation and connecting the end walls but spaced from the sides of said tank, a roof closing between the walls and the rim of said tank, a bridge wall on each side of said tank spaced from the roof and connecting the end walls to longitudinally divide the space between the furnace side walls and the tank to form a connected secondary combustion chamber and a downtake adjacent the tank, upper and lower slabs connecting each bridge wall and the adjacent furnace side wall to form a primary combustion chamber under the secondary combustion chamber and a flue therebelow, a stack connected to one end of each flue, a burner connected to one end of each primary combustion chamber for discharging a slow burning fuel therein, a series of graduated openings through each bridge wall from each flue to its respective downtakes which openings are smaller in size adjacent the stack end of said flue, a series of graduated ports from each primary combustion chamber to its respective secondary combustion chamber which ports are larger in size adjacent the burner, and valve means regulating the extent of opening of said graduated ports.

3. A kettle furnace comprising a foundation, an open top tank supported on the foundation,

furnace end walls supported on the foundation and extending laterally beyond both sides of the tank, furnace side walls supported on the foundation and connecting the end walls but spaced from the sides of said tank, a roof closing between the walls and the rim of said tank, a bridge wall on each side of said tank spaced from the roof and connecting the end walls to longitudinally divide the space between the furnace side walls and the tank to form a connected secondary combustion chamber and a downtake adjacent the tank, upper and lower slabs connecting each bridge wall and the adjacent furnace side wall to form a primary long combustion chamber under the secondary combustion chamber and a long flue therebelow, a stack connected to one end of each long flue, a lateral baffle wall dividing each long primary combustion chamber into two short primary combustion chambers, a burner connected to one end of each short primary combustion chamber for discharging a slow burning fuel therein, a series of openings through each bridge wall from each flue to its respective downtakes, and a series of regulatable valved ports from each short primary combustion chamber to its respective secondary combustion chamber.

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