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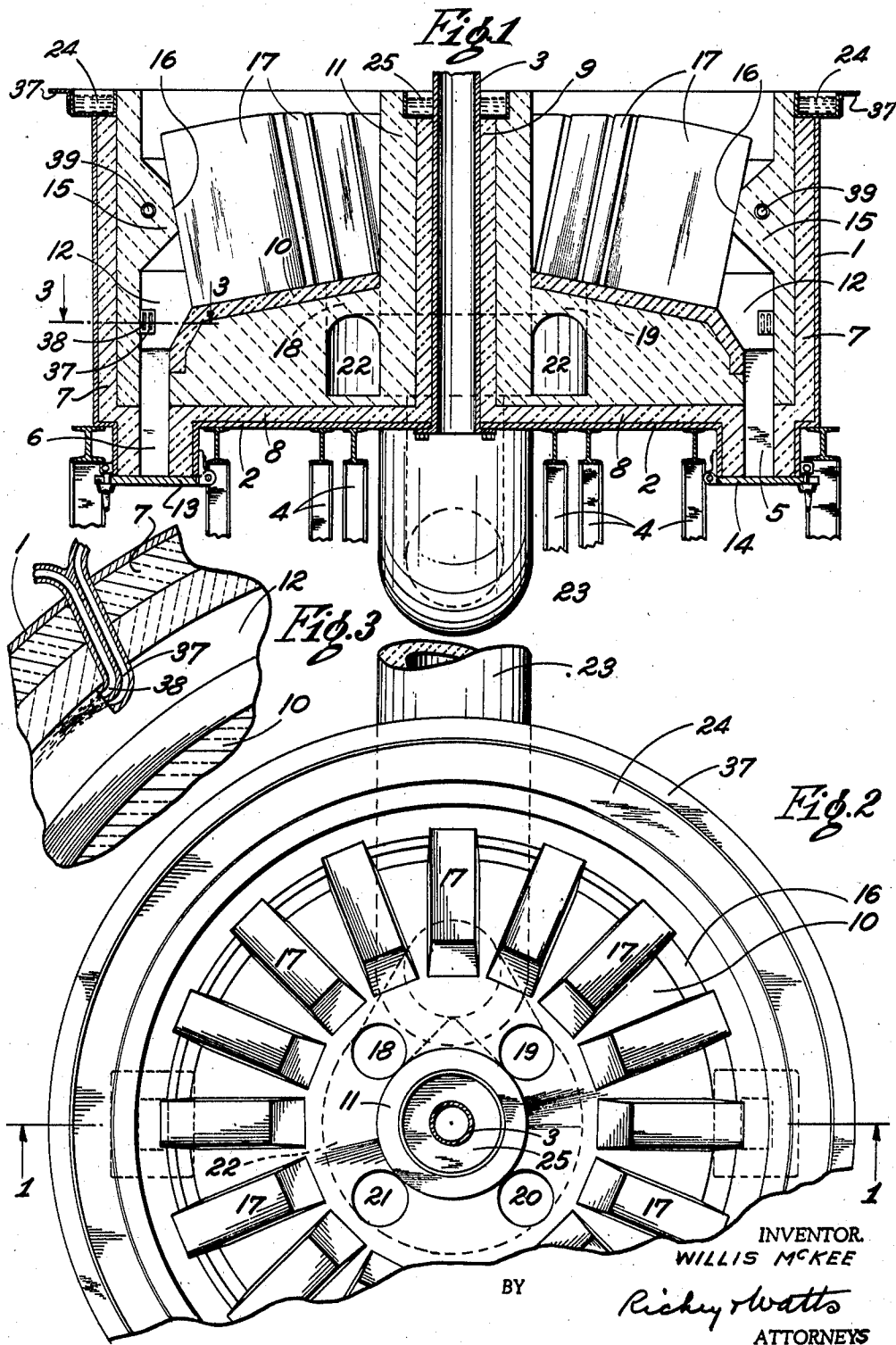
W. McKEE

2,097,932

SOAKING PIT

Filed March 20, 1937

4 Sheets-Sheet 1



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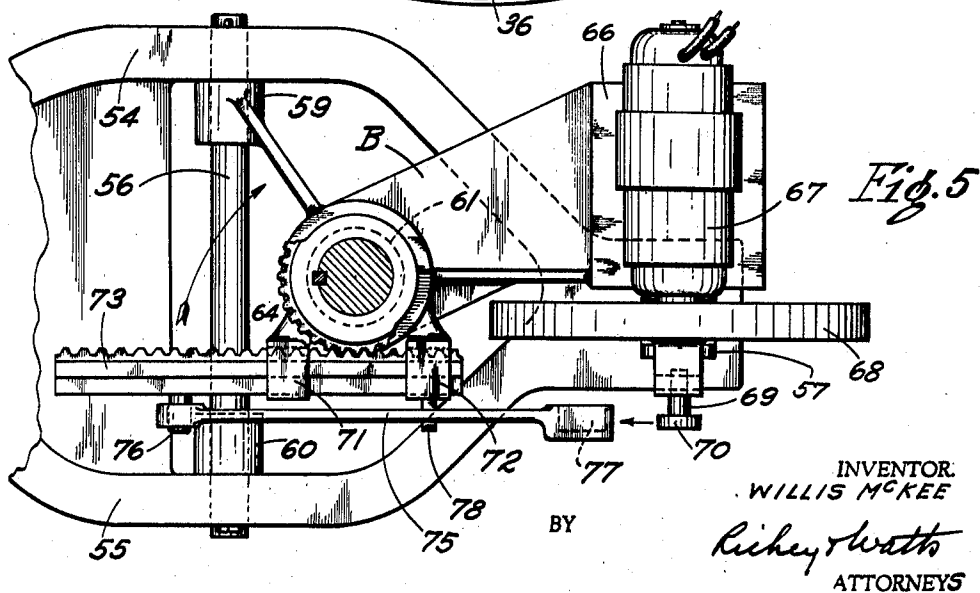
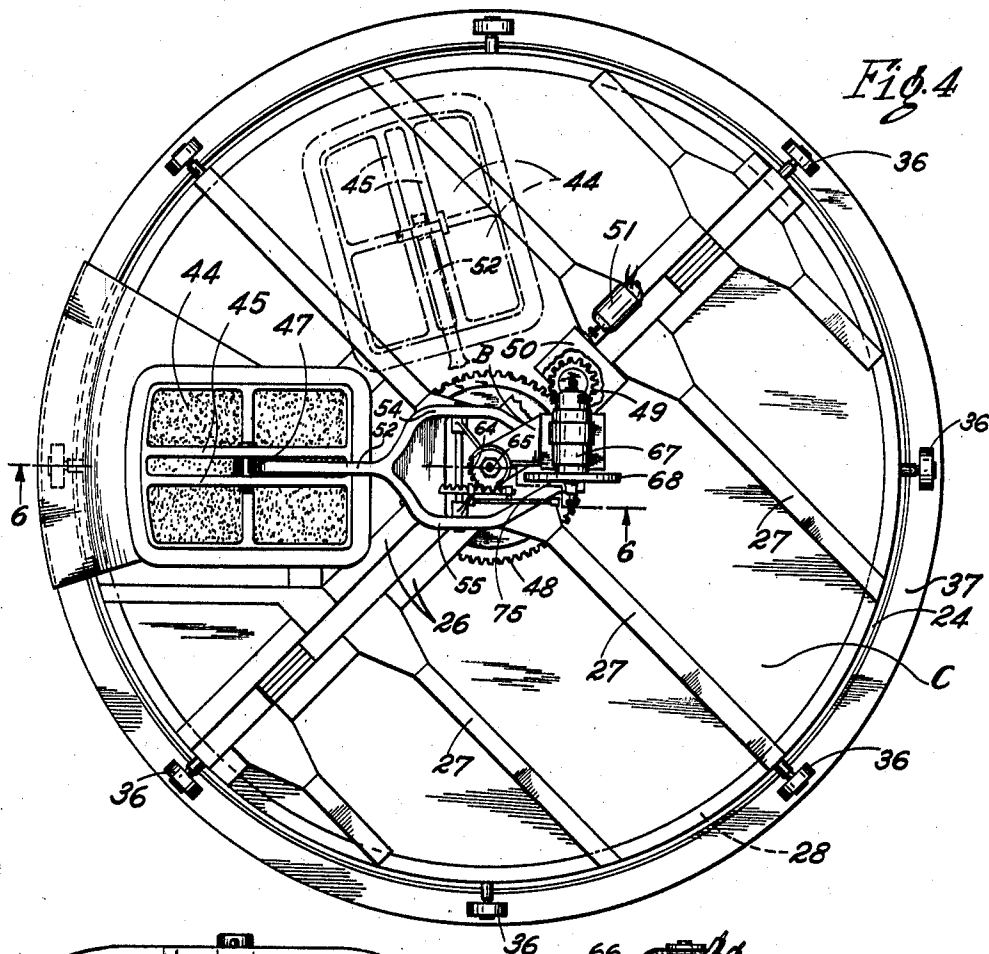
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SOAKING PIT

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4 Sheets-Sheet 2



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SOAKING PIT

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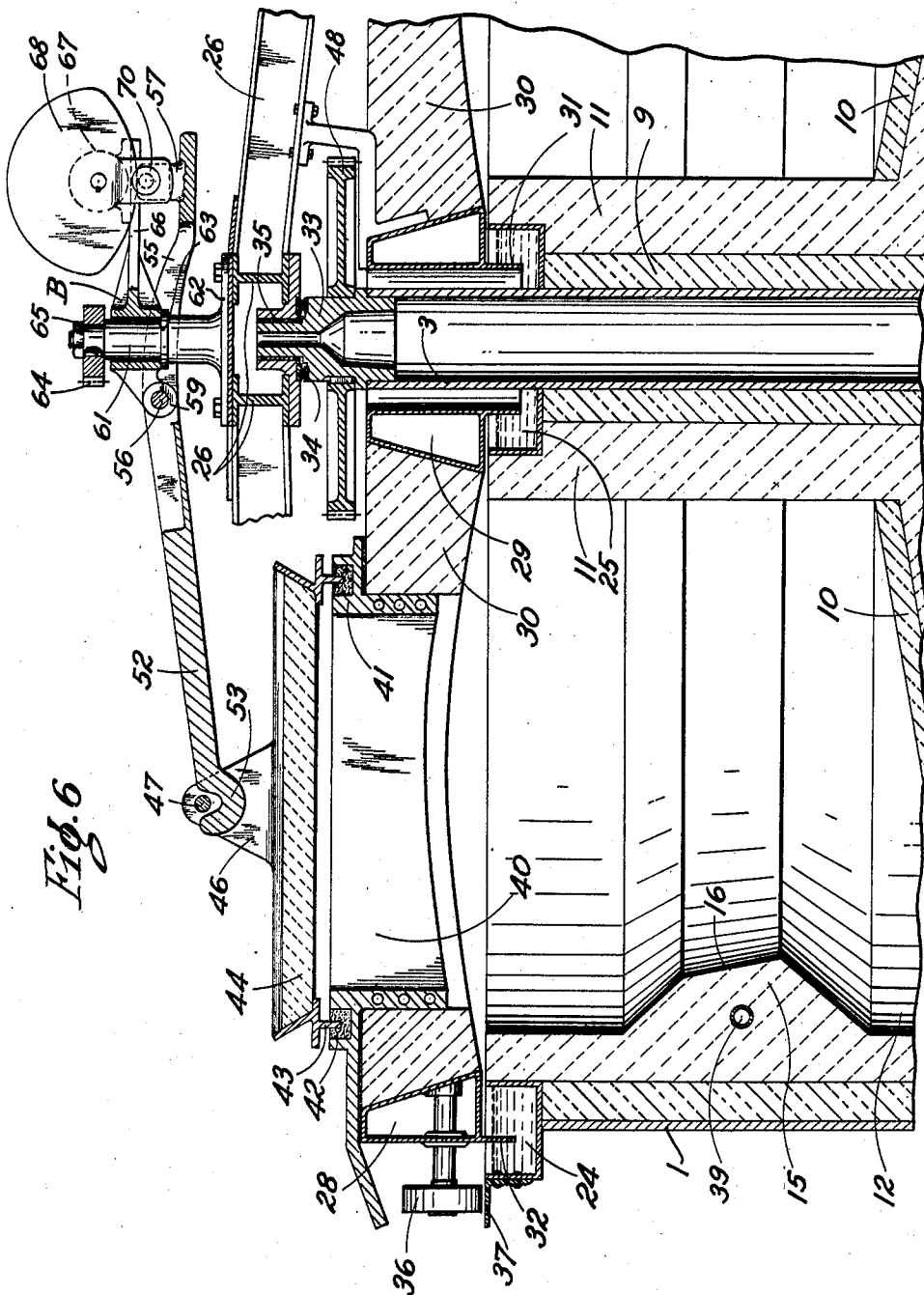


Fig. 6

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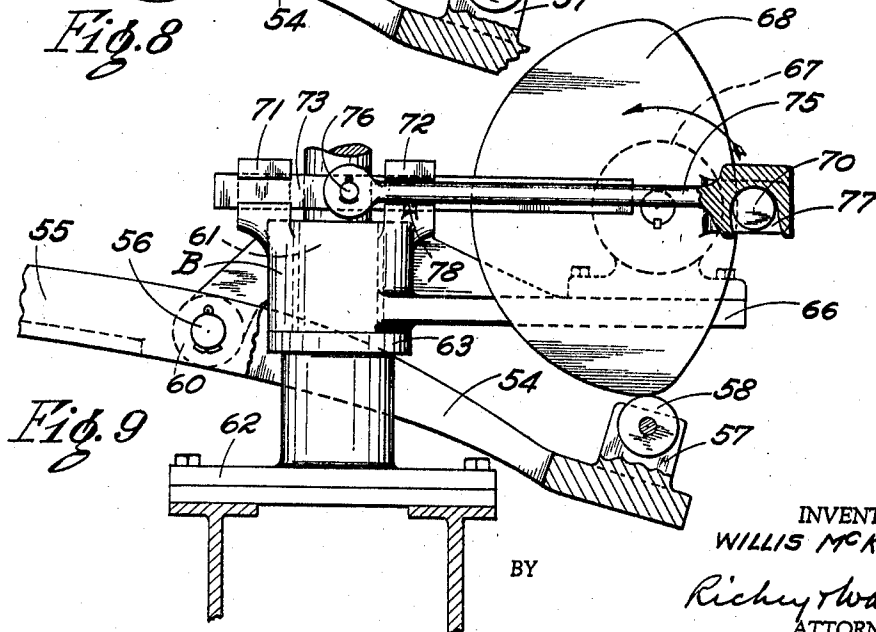
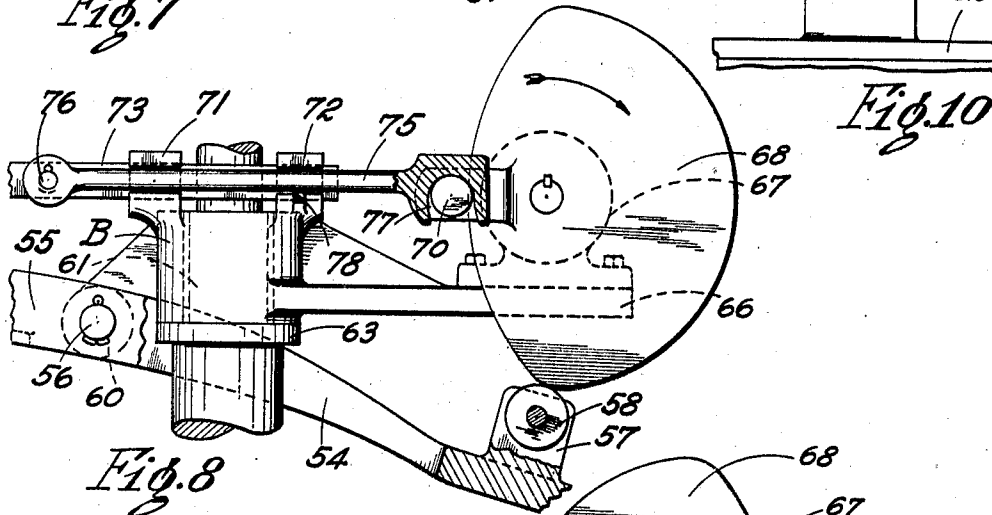
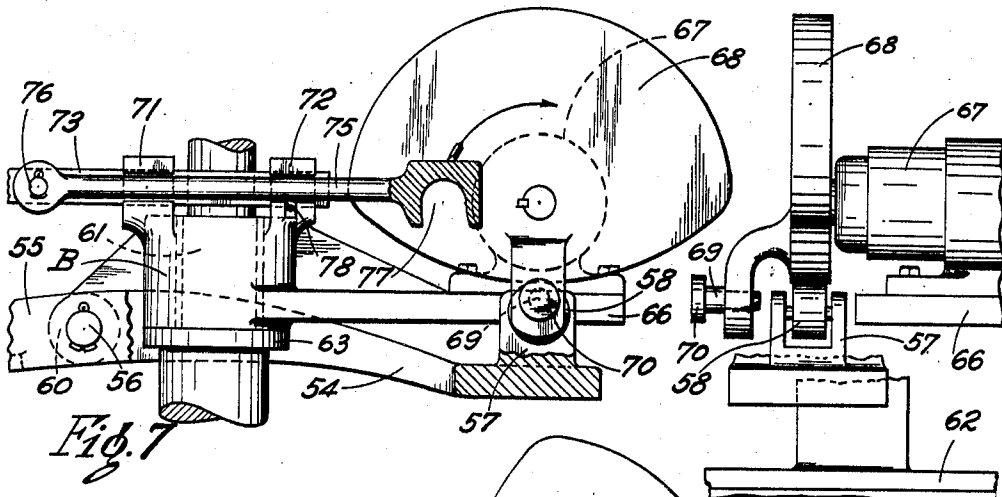
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4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,097,932

## SOAKING PIT

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Application March 20, 1937, Serial No. 132,106

10 Claims. (Cl. 263—9)

This invention relates to heating furnaces and more particularly to an improved soaking pit structure for bringing steel ingots to the proper heat conditions for rolling.

5 In the manufacture of steel the molten metal is poured into ingot molds and the cast ingots are removed from the molds, usually before complete solidification, and placed in heating furnaces, commonly called soaking pits, wherein the  
10 ingots are brought to the proper temperature conditions for rolling. It is important that all parts of the ingot be at the same temperature when it enters the rolling mill and this is accomplished by placing the ingot, or a number of  
15 ingots, in a heating chamber where the heat of the mass of the ingots is permitted to become equalized throughout and, as necessary, heat is added to bring the temperature up to the desired value. The usual soaking pit in use today comprises a generally rectangular chamber having a  
20 sliding cover and connected to and constructed integrally with checker brick regenerators whereby the air, used in combustion, as well as the fuel if producer gas is burned, may be pre-heated.  
25 These soaking pits are expensive to build, require an excessive amount of floor space, and the nature of their design makes it extremely difficult to obtain satisfactory heating.

There are three conditions that exist with  
30 these pits which contribute to the difficulties encountered in obtaining the best results: First, in the old style pit the air and gas are manually controlled so that there is no way to insure against oxidizing the steel with excess air, nor  
35 is there any way to insure against the use of excess gas and consequently the loss of fuel; second, in the old type of pit the covers are supported on tracks and are designed so that the brick work of the cover comes almost but not  
40 quite into contact with the brick work of the pit when the covers are closed. There is, therefore, always an opening and through this opening either the gas is being wasted or air is being  
45 drawn into the pit thus oxidizing the steel; third, in the orthodox pit there are rather large openings in the opposite walls of the pit near the top and the flame comes in from one side  
50 for 15 or 20 minutes while the products of combustion go out the opposite side and then the direction is reversed for the next period. It is easy to see that the ingots will not all be subjected to the same heat conditions from top to  
55 bottom and from side to side of the pit.

With the rapid developments in special alloy steel and the more rigid requirements in the

handling of steel it has become exceedingly important that a soaking pit should be designed so that it can be completely automatically controlled, and that all parts of all ingots should have the same treatment. Pits have been designed with sealed covers but it has been necessary in these pits to remove the whole cover to charge or draw the steel, necessitating excessive exposure of the steel, requiring elaborate mechanism for moving the cover, and requiring an  
5 excessive amount of floor space.

In my improved pit, I use a fuel with a known heat content and I may conveniently employ standard equipment of well known type to regulate the heat of the furnace and also to regulate  
15 the air and the amount of gas being used. I admit the air and fuel in a generally tangential direction below the hearth of the pit so that the outer walls of the pit are heated and the flame and products of combustion circulate around the  
20 pit as they ascend, and finally pass out the openings in the bottom of the pit near the center. As my furnace is encased in steel and insulated and as there is no opening or leakage in the top except a small sealed hatch which is opened  
25 only while steel is being actually charged or drawn, it will be seen that my improved structure is a very efficient heating furnace. If any pre-heating of air and fuel is desired it is preferably done in a separate disconnected regenerator or  
30 recuperator.

Among the objects of my invention is the provision of a soaking pit wherein ingots may be charged and drawn with a minimum of heat loss and of exposure of the steel in the pit to the air.  
35 Other objects of my invention are: the provision of an improved heating furnace or soaking pit for steel ingots in which the necessity for regenerators is eliminated and in which each ingot is subjected to substantially exactly the same heating conditions regardless of the position of the  
40 ingot in the heating chamber; the provision of an improved circular soaking pit having a rotatable cover whereby any ingot may be selectively removed from the heating chamber; the provision of a circular soaking pit in which the ingots are not subjected to the direct flame of the heating burners and are protected from oxidization; the provision of a circular soaking pit which is  
45 extremely simple in its arrangement and construction and which may be provided with a plurality of slag outlets; and the provision of a soaking pit for ingots having a high heat efficiency and large ingot capacity for a given floor  
55

space and which may easily and accurately be controlled in a definite and accurate manner.

The above and other objects of my invention will appear from the following description of one embodiment thereof, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical sectional view through one of my improved soaking pits with the cover and cover operating mechanism removed. A number of ingots are shown in position.

Figure 2 is a plan view of the apparatus shown in Figure 1.

Figure 3 is a fragmentary horizontal section taken on line 3—3 of Figure 1 and illustrating the arrangement of the burners in the wall of the pit.

Figure 4 is a plan view of my improved soaking pit with the cover and cover operating mechanism in place.

Figure 5 is an enlarged fragmentary plan view of the hatch cover lifting and swinging mechanism.

Figure 6 is an enlarged fragmentary vertical cross-section through my soaking pit taken on line 6—6 of Figure 4.

Figure 7 is an enlarged detached view of the hatch cover operating mechanism illustrating the parts in the positions they assume when the hatch cover is closed.

Figure 8 is a view similar to Figure 7 but illustrating the parts in the positions they assume when the cover has just been lifted.

Figure 9 is a view similar to Figures 7 and 8 but illustrating the parts in the positions they assume when the cover has been lifted and swung out of registry with the opening in the main pit cover.

Figure 10 is an end elevation of the apparatus shown in Figure 7.

Referring to the drawings, the main shell of the soaking pit structure comprises a cylindrical metal drum 1 having a metal base or bottom 2. A centrally disposed hollow tubular pintle 3 is rigidly supported on the base 2 and the entire structure may be supported by suitable columns 4. The bottom of the pit is located sufficiently above a floor level that cars may be moved beneath slag outlets 5 and 6 and, if desired, a plurality of my improved soaking pit structures may be arranged in a row with their slag outlets in alignment whereby a battery of soaking pits may conveniently be served by the same slag cars.

Immediately adjacent the outer shell 1 is a lining 7 of heat insulating material. This lining extends across the bottom of the pit as seen at 8 and also surrounds the hollow circular pintle 3 as seen at 9. The rest of the interior structure of the soaking pit may be built up of fire brick or other suitable material and comprises a sloping hearth or bottom portion 10, which is also preferably faced with a suitable bottom material such as coke breeze or such other material as may be suitable. The pit bottom slopes downwardly from the central column 11 of the brick work which surrounds the pintle 3 and an annular trough 12 extends around the pit bottom at the outer periphery thereof. This trough is provided with oppositely disposed slag outlet openings 5 and 6 and the trough preferably slopes so that any slag which drains into it will flow out of the openings 5 and 6. Any suitable kind of closure members, such as the swinging gates 13 and 14, may be provided for the slag outlets 5 and 6 and it will be understood that these are normally kept closed except when it is desired to

discharge slag which has accumulated in the pit or when making bottom.

Above the level of the pit bottom 10 and extending inwardly from the outer wall of the pit I have provided an annular projection 15 having a sloping face portion 16 against which the sides of the ingot 17 rest and by which they are supported. The gas outlet pipes 18, 19, 20 and 21 are equally spaced around the central column 11 and extend downwardly into an annular header conduit 22 which in turn connects to the main flue 23 which is adapted to carry the products of combustion to a suitable stack.

A trough 24 extends around the top of the outer wall of the pit and may be filled with water or sand to provide a seal for the rotating cover as will be more fully described later. Another trough 25 extends around the central metal pintle member 3 and it is also filled with sand or water to seal the inner edge of the cover. By providing these annular trough seals the rotatable top or cover, generally indicated at C and best seen in Figure 4, is completely sealed at all times. By this means leakage between pit and cover is entirely eliminated and loss of heat greatly restricted.

The cover C consists essentially of a suitable frame work built up of the main beams 26, the transverse beams 27, a circular outer rim member 28 and the inner ring member 29 (see Fig. 6). A body 30, of suitable refractory and heat insulating material, is supported by the frame structure just described. As seen in Figure 6 a flange 31 extends downwardly from the central ring member 29 into the trough 25 thus completing the seal at the center of the cover. In like manner an annular flange 32 extends downwardly into the outer trough 24 and effectively seals the outer joint between the cover and the pit. The entire cover structure is supported by the pintle 3 which has a bearing support 33 mounted at its upper end. Thrust bearing 34 carries the weight of the cover and a vertical bushing portion 35, secured in the main transverse beam section 26 of the cover, guides the cover during its rotation. In order to further insure against undesirable canting or tilting of the cover a plurality of wheels or rollers 36 are mounted at the outer periphery thereof and may, if the cover should tilt or cant slightly, roll upon the surface 37 formed by an angle member secured to the outer wall of the trough 24.

The ingots 17 are deposited in the pit in a vertical position with their bases resting on the bottom 10 and their outer sides leaning against the inclined face 16 of the projecting portion 15 of the outer wall. A plurality of tangentially arranged burners extend through the outer wall 1. Gas or other suitable fuel is supplied through the burner pipes 37 and the air necessary for combustion is supplied through the pipes 38. The nozzle of the fuel pipe 37 is so positioned that the air from the nozzle 38 must come in contact with the fuel before it can contact the steel thus avoiding the possibility of oxidizing the steel. In other words a screen of gas is maintained between the air and the steel. Gas, or other suitable fuel, and air are supplied in proper proportions through the burner nozzles 37 and 38 which are designed and arranged intimately to mix the fuel and air to insure uniform combustion and the elimination of free oxygen. The gas and air traveling circumferentially around the pit with the fuel on the inside of the air insures against the flame coming in contact with the ingots and

eliminates the possibility of any free oxygen coming in contact with the steel. As a further precaution, as is clearly seen in Figures 1 and 3, these burners are disposed below the level of the outer edge of the pit bottom 10 and are adapted to direct their flames in a generally tangential direction into the trough 12 and the flames are not directed against the surfaces of the ingots. The tangential arrangement of the burners furnishes an exceedingly even and uniform distribution of heat throughout the entire pit and, by providing the outlets for the products of combustion at the center of the pit structure on the opposite side of the ingot from the burners 37, the most efficient utilization of the heat is insured. It will be understood that cooling water pipes, such as the pipe 39 in the projection 15, may be provided wherever necessary or desirable in the structure.

In order to permit any ingot to be removed from the pit and another ingot to be inserted in its place without uncovering the entire pit and without disturbing any of the other ingots or permitting any substantial loss of heat from the pit, and in order to overcome the necessity for providing extra floor space to accommodate the pit cover when opened, I provide a relatively small hatchway 40 extending through the top C. This hatchway may be lined with a metal liner 41, water cooled if desired, having a sand trough 42 in its top for the downwardly depending flange 43 of the hatch cover 44. As illustrated the cover 44 comprises a metal frame 45 filled in with refractory material and provided with a pair of upwardly extending ears 46 having a pin 47 extending therebetween.

In the preferred operation of my apparatus the entire top C, including the hatchway 40 and the hatch cover 44, is rotated until the hatchway 40 is directly above the ingot which is to be removed or above the place where an ingot is to be deposited. The hatch cover 44 is then lifted from its seat and swung about the center of the pit top C until the hatchway is open whereupon the crane ingot gripping jaws can operate in the usual manner to deposit or remove an ingot. If desired the top C can be rotated and the hatch opened simultaneously.

In order to rotate the entire top structure C I provide a relatively large stationary gear 48 which is keyed to the central pintle structure 3. A co-acting gear 49 (see Fig. 4) is mounted on and carried by the cover C and may be driven through a suitable gear box 50 by the motor 51 which is also carried by the frame work of the top C. Thus, by driving the motor 51, the gear 49 will be turned and, as the gear 48 is fixed, the entire cover structure will be rotated about its central support on the pintle 3. The cover 44 can, of course, be rotated in either direction as desired.

The hatch cover 44 is lifted and swung in the manner described above by the mechanism shown in Figures 4 to 8 inclusive. The arm 52 has a hooked end portion 53 which is disposed between the ears 46 of the hatch cover 44 and engages the pin 47. This arm 52 is split, dividing into two portions 54 and 55, which are pivotally mounted on a transverse shaft 56, and which come together again on the other side of the shaft 61. An upwardly extending member 57 provides a support for the cam follower roller 58.

The shaft 56 is supported in the bearing portions 59 and 60 of the bracket member B which in turn is rotatably supported on a vertical shaft 61 (see Fig. 6) which extends upwardly from a

base member 62 secured to the frame of the cover C immediately above and in line with the center of the pintle 3. A thrust flange 63 on the shaft 61 supports the bracket B and thus also supports the weight of the hatch cover 44 when it is lifted and swung into open position. By supporting the hatch cover 44 in the manner described it will be seen that it may be lifted and lowered by moving it with the arm 52 about the shaft 56, and may be moved out of and into position over the hatch opening 40 by swinging the bracket B around on the shaft 61.

The mechanism which accomplishes the lifting and swinging movements of the hatch cover 44 includes a segmental gear 64 which is keyed to the upper end of the shaft 61 and may be held in place thereon by a suitable nut 65 (see Fig. 6). The bracket B includes a platform portion 66 upon which is mounted a reversible motor 67. This motor is connected to a cam 68 through a suitable reduction gear which may be housed integrally with the motor. A crank arm 69 is carried by the cam 68 and has an enlarged head portion 70. The bracket B is also provided with a pair of supporting guides 71 and 72 which guide the rack 73 and maintain it in engagement with the gear segment 64. A connecting rod 75 is pivotally connected at one end to a pin 76 which is secured to the rack 73 and at its opposite end is shaped to form a socket or receptacle 77 for the head 70 of the crank arm 69.

Referring particularly to Figures 7, 8, 9 and 10, the operation of the hatch cover lifting and swinging mechanism will be described.

Assuming that the main soaking pit top or cover C has been rotated until the hatch opening 40 is over the desired portion of the pit and that the parts of the hatch cover mechanism are in their hatch-closed positions as seen in Figure 7, the motor 67 is started and will rotate the cam 68 in clockwise direction as indicated by the arrow in Figure 7. The follower roller 58 on the short end of the arm 52 will always be in engagement with the cam 68 because of the load imposed on the arm 52 by the weight of the cover 44 and, when the cam 68 rotates through 90° into the position shown in Figure 8, the short end of the arm 52 will be depressed causing the opposite end to be lifted carrying with it the hatch cover 44. As this 90° rotation of the cam 68 takes place the crank arm 69 with its head 70 has moved until the head 70 engages the socket 77 in the connecting rod 75. Further rotation of the cam 68 in clockwise direction to the right will not change the elevation of the hatch cover 44 as the adjacent portion of the cam is of constant radius. However, such movement through an additional 90° will cause the connecting rod 75 and the rack 73 to be moved into the positions shown in Figure 9. This movement of the rack 73, which is maintained in engagement with the fixed gear segment 64 by the guides 71 and 72, will result in the arm 52 together with the hatch cover 44 being swung from the position shown in full lines in Figure 4 to that shown in dotted lines in Figure 4.

When it is desired to re-cover the hatch opening it is necessary to reverse the direction of rotation of the motor 67 whereupon the cam 68 will move in a counterclockwise direction causing the head 70 of the crank arm 69 to push against the connecting rod 75, returning the rack 73 to the position shown in Figure 7 and returning the arm 52 and the hatch cover 44 to the position directly above the hatch opening. Fur-

ther movement of the cam 68 will then permit the arm 52 to return to the position of Figure 7 and the hatch cover to be firmly seated in the sand seal thus effectively closing the opening in the top of the soaking pit. A stop pin 78 retains the connecting rod 75 in position to be picked up by the crank head 70 when the hatch is next opened.

It will be seen from the above description that the hatch cover operating mechanism is entirely automatic and is supported entirely upon the top of the soaking pit.

The hatch cover operating mechanism, and particularly the contour of cam 68, may be so designed that the raising and lowering, as well as the rotating motions, are carried out with gradual acceleration and retardation. Again, the vertical and rotating motions of the hatch cover are never simultaneous, one being completed before the other starts. The motor 67 may be controlled from a remote point in any suitable manner. Overruns of the motor 67 can do no harm due to the arrangement of the operating mechanism.

The operation of this improved hatch cover mechanism whereby the soaking pit is opened only through a small opening and for a minimum time while charging or drawing an ingot, results in relatively high heat efficiency. My insulated circular arrangement of the soaking pit with the burners so disposed that the flame and products of combustion evenly and uniformly heat all of the ingots in the pit provides a very simple and trouble-free heating furnace which has low upkeep costs and by which the checker brick regenerator chambers, blowers, etc. necessary with the usual rectangular soaking pits are eliminated.

By providing the hollow central pintle 3, which supports the entire soaking pit top structure, a natural draft cooling is obtained which effectively protects not only the pintle itself but also the operating mechanism disposed on the top of the cover C. Furthermore, this hollow pintle provides readily accessible means for conducting cooling water pipes, wiring, etc. necessary for the control and operation of the cover operating mechanism. A minimum of power is required for operating the pit cover because of its roller bearing support upon the pintle and the fact that is may be substantially balanced so that the entire load is supported on the central pivot. An effective seal is had at all times between the walls of the pit and the rotating cover and the entire operation of the cover may conveniently be effected by remote control.

Although I have described the illustrated embodiment of my invention in considerable detail it will be understood by those skilled in the art that numerous variations and modifications may be made in the apparatus and arrangement of parts without departing from the spirit of my invention. I do not, therefore, wish to be limited to the specific embodiment herein shown and described but claim as my invention all forms thereof coming within the scope of the appended claims.

**I claim:**

1. In a soaking pit or the like having a substantially circular heating chamber, a central pilaster, a top for said heating chamber having a bearing on said pilaster and rotatable thereabout, said top having a hatchway opening into the heating chamber, a cover for said hatchway, means for rotating said top about said pilaster, and means for moving said cover to open and close said hatchway.

2. In a heating furnace of the type described having a substantially circular heating chamber, said heating chamber having a downwardly and outwardly sloping bottom, a trough extending around said heating chamber at the outer edge of said sloping bottom, means for discharging slag from said trough, a plurality of burners directed into said trough and positioned below the top thereof, a tubular central pilaster having a cooling passage extending therethrough, a gas outlet extending downwardly adjacent said pilaster, a rotatable top for said heating chamber having a bearing on said pilaster and rotatable thereabout, a hatchway in said top and a removable hatch cover for said hatchway.

3. In a soaking pit of the type described, walls defining a heating chamber, a central pintle extending up through said chamber, a top for said chamber rotatably mounted on said pintle, said top having a hatchway extending therethrough, a removable cover for said hatchway, means mounted on said top for rotating said top about said pintle and means carried by said top for removing and replacing said cover from said hatchway.

4. In a soaking pit of the type described, walls defining a heating chamber, a central pintle extending up through said chamber, a top for said chamber rotatably mounted on said pintle, said top having a hatchway extending therethrough, a removable cover for said hatchway, means mounted on said top for rotating said top about said pintle and means carried by said top for removing and replacing said cover from said hatchway, said last named means including a bracket rotatably supported on said soaking pit top, an arm pivotally mounted on said bracket and arranged to lift said cover, a motor mounted on said bracket, a cam driven by said motor and actuating said arm to lift and lower said cover, a gear fixed to said soaking pit top, a coacting gear carried by said bracket, and means actuated by said motor for moving said gears to cause said bracket to turn about its support on the soaking pit top.

5. In a circular furnace having a hearth or bottom portion, a rotatable top for said furnace, means for maintaining a seal between said furnace and top, means for rotating said top while maintaining said seal, a hatchway in said top, a sealed cover for said hatchway and means for opening and closing said cover.

6. In a circulating heating furnace, a hollow central pilaster having inlet and outlet openings and through which a cooling medium may flow, a top supported by said pilaster and means for rotating said top about said pilaster.

7. In a soaking pit or the like, walls defining a circular heating chamber, a bottom for said chamber, a trough extending circumferentially of the heating chamber at the outer edge of said bottom, a fuel burner positioned below the bottom level and adapted to direct products of combustion around said trough, an outlet for the products of combustion spaced toward the center of said bottom from said trough, and a rotatable top for said heating chamber.

8. In a soaking pit or the like, walls defining a circular heating chamber, a bottom for said chamber, a trough extending circumferentially of the heating chamber at the outer edge of said bottom, a fuel burner positioned below the bottom level and adapted to direct the flame around said trough, an outlet for the products of combustion spaced toward the center of said bottom

from said trough, a rotatable top for said heating chamber, said top having a hatchway and a hatch cover, and means carried by said top for operating said hatch cover.

- 5 9. In a soaking pit or the like, walls defining a circular heating chamber, a bottom for said chamber, a trough extending circumferentially of the heating chamber at the outer edge of said bottom, a fuel burner positioned below the bottom level and adapted to direct the flame around said trough, an outlet for the products of combustion spaced toward the center of said bottom from said trough, a rotatable top for said heating chamber, said top having a hatchway  
10 and a hatch cover, means carried by said top for operating said hatch cover, and independent means for rotating said top.

10. In a soaking pit or the like, walls defining a circular heating chamber, a bottom for said chamber, a trough extending circumferentially of the heating chamber at the outer edge of said bottom, a fuel burner positioned below the bottom level and adapted to direct the flame around said trough, an outlet for the products of combustion spaced toward the center of said bottom from said trough, a rotatable top for said heating chamber, said top having a hatchway and a hatch cover, means carried by said top for operating said hatch cover, and independent means for rotating said top, said hatch cover operating means and said top rotating means being adapted to be simultaneously operated.  
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