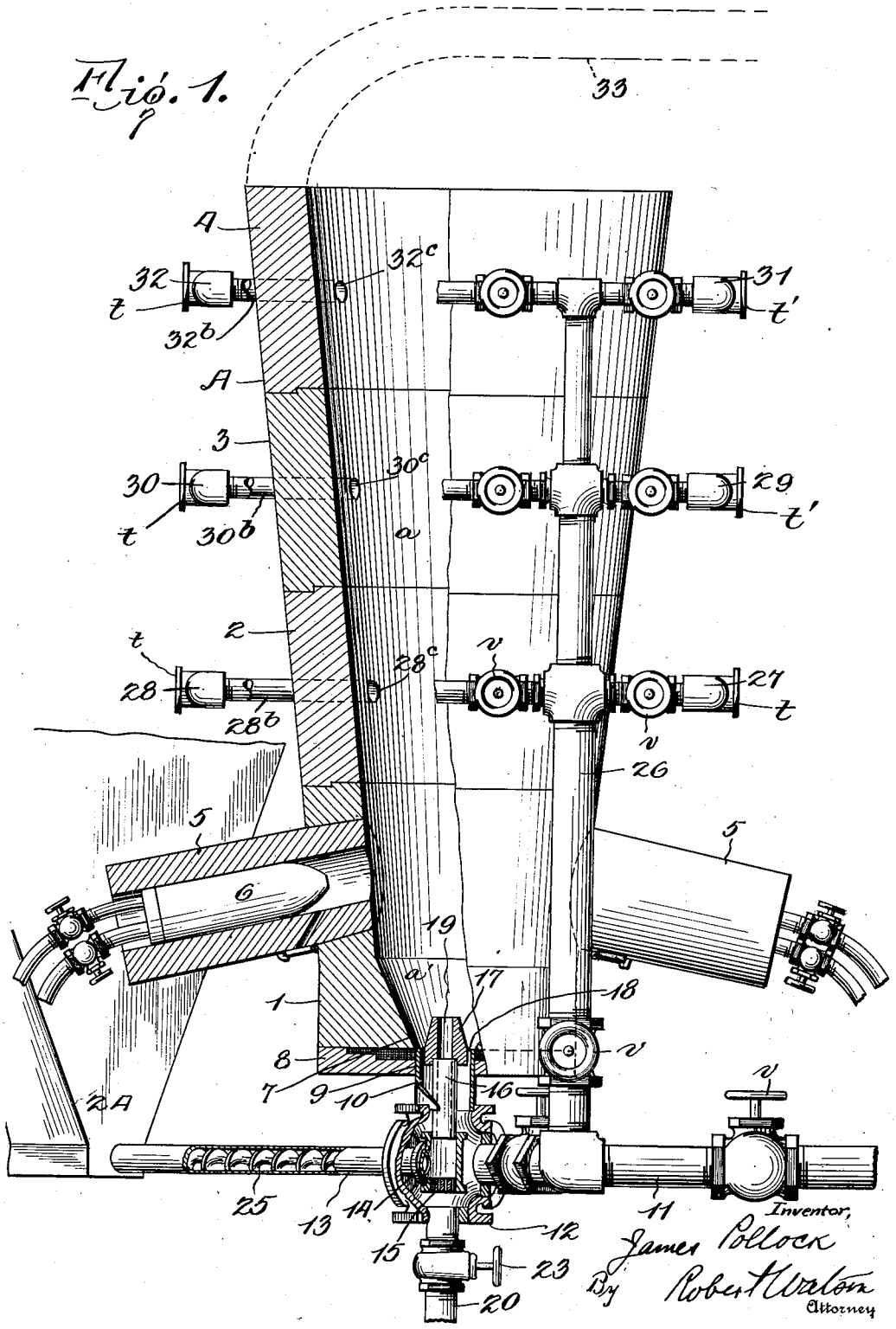
March 17, 1925. 1,530,321

J. POLLOCK

FURNACE FOR BURNING FINE COAL

Filed Aug. 30, 1923 2 Sheets-Sheet 1

Fig. 1.



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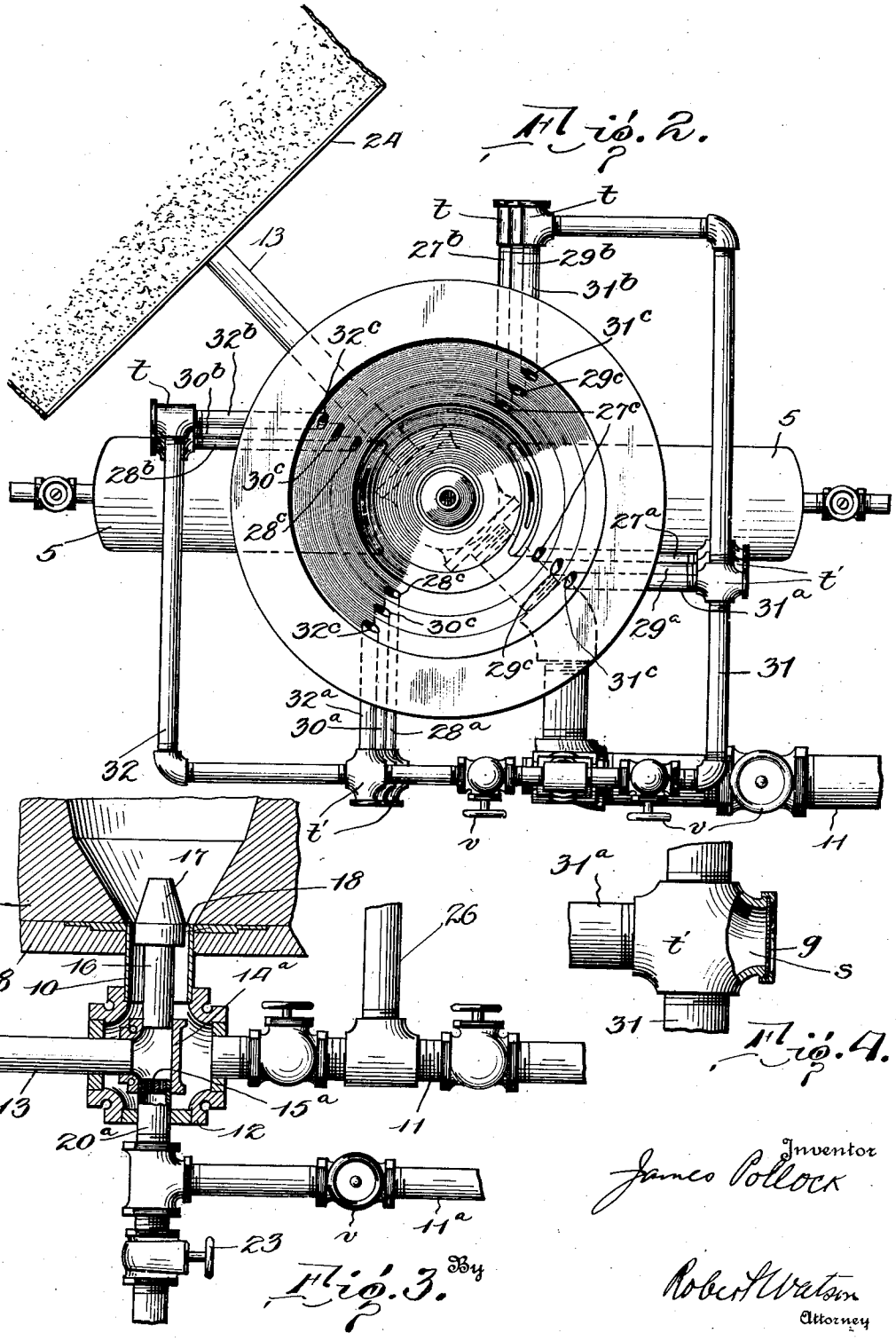

Fig. 2.

Fig. 4.

Fig. 3.

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UNITED STATES PATENT OFFICE.

JAMES POLLOCK, OF NEW YORK, N. Y.

FURNACE FOR BURNING FINE COAL.

Application filed August 30, 1923. Serial No. 660,191.

To all whom it may concern:

Be it known that I, JAMES POLLOCK, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Furnaces for Burning Fine Coal, of which the following is a specification.

This invention relates to a furnace for burning coal dust. In the anthracite coal regions of Pennsylvania large deposits of fine coal, practically dust, have accumulated, by washings from the coal dumps, the fine particles of coal being carried by water to places where obstructions or dams have been built to allow the coal dirt, as it is called, to settle and prevent it from flowing on to adjacent lands. This coal dirt or dust is too fine for burning in a grate and I have therefore devised a furnace for burning the fine fuel, which furnace is so constructed that the fuel will be held in suspension in an air current until it is consumed, when the ash will be carried out of the chamber with the hot gases. The interior of the furnace chamber enlarges from the bottom upwardly, and the fuel and the air for holding the fuel in suspension are admitted into the lower and more contracted part of the chamber, while auxiliary air for promoting combustion and causing a circulation and intimate mixture of the fuel particles and gases is admitted to the chamber in regulated quantities at various points in the upper part of the furnace. The gradual upward enlargement of the furnace chamber provides room for the expansion of the gases and for the auxiliary air supplied to promote combustion and circulation, without causing such an increase in the internal pressure as would force the unburnt fuel out at the top of the furnace chamber. As the fuel is very fine, a low air pressure will keep it in suspension, and by regulating the pressures and the quantities of air admitted, a practically perfect combustion of the fuel may be obtained.

In the accompanying drawing,

Fig. 1 is a side elevation of the furnace, partly in vertical section;

Fig. 2 is a top plan view of the same;

Fig. 3 shows, in central vertical section, a modified arrangement of the air connections for blowing fuel into the furnace chamber; and,

Fig. 4 is a detail view showing one of the sight openings.

Referring to Figs. 1 and 2 of the drawing, A represents the furnace comprising an upright wall, circular in cross section and of approximately increasing diameter from the bottom to the top thereof. As shown, the wall is composed of tapering sections 1, 2, 3, and 4, and these sections are preferably made of fire clay, although they may be of metal lined with firebrick. Tubes 5, also preferably of fire clay, extend through the wall of the furnace near its lower end and at opposite sides thereof, and in these tubes are arranged burners 6, for igniting the fuel. These burners may be of any suitable kind for burning liquid fuel or gas.

The interior face of the furnace chamber *a* converges at the bottom to a central opening 7 in the section 1, forming a funnel *a'*. A plate 8 fits against the bottom section and is provided with an opening 9, registering with the opening 7. A short tube 10 fits closely within the opening 9 and this tube is connected to the main air pipe 11 through a casing 12, which is in the form of an enlarged coupling. The pipe 11 is connected to a suitable blower, not shown, for blowing air into the furnace chamber. A pipe 13 extends into the casing 12, and upon the end of this pipe, within the casing is mounted a T-fitting 14, having in one end a plug 15, which is provided with numerous small perforations, and from the other end of the fitting a tube 16 extends upward centrally in the tube or pipe section 10, and upon the upper end of the tube 16 is arranged a conical nozzle 17. The base of the nozzle 17 is arranged within the tube 10 and spaced from its inner wall, leaving a narrow annular air passageway 18 between the nozzle and the tube. With the arrangement described, air flowing from the pipe 11 into the casing 12 will flow through the perforated plug 15 into the fitting 14 and from thence through the opening 19 in the nozzle into the furnace chamber, and the air will also flow from the casing 12 upwardly through the pipe or tube 10 and through the annular passageway 18 into the furnace chamber. A blow-off pipe 20 leads downwardly from the bottom of the casing 12 and this pipe is provided with a valve 23, which is normally closed.

The pipe 13 is a feed pipe for conveying

coal dust from a suitable hopper 24 to the interior of the fitting 14. A suitably driven worm 25 is provided in the pipe 13, for conveying a continuous supply of coal dust to the fitting 14.

The coal dust, constantly fed into the fitting 14, is carried into the furnace chamber by the air which blows through the perforations 15 into the fitting, and thence through the opening 19 in the nozzle 17. This dust is held in suspension in the furnace chamber by the air blown through the nozzle and also through the annular opening 18, the air pressure being suitably regulated for that purpose. In starting the furnace, the burners 6 are ignited and kept burning until the furnace chamber becomes very hot and the fuel and gas within the chamber are ignited and in an incandescent state, when the burners may be cut off. In order to supply additional air to the burning fuel and to cause an intimate association of the coal dust entering the chamber with that which has become heated or ignited within the chamber, I construct the chamber so that it enlarges from the bottom upwardly and provide a plurality of air inlets at various points from the bottom to the top of the furnace, these inlets being arranged so that the air will enter the furnace chamber at an angle to its radius and cause a constant swirling motion of the dust and gases. Thus, a feed pipe 26 leads upwardly from the main air supply pipe 11 and at the height of the section 2 of the furnace, pipes 27 and 28 lead off from the pipe 26. The pipe 27 has branches 27^a and 27^b which extend into openings 27^c in the wall of the furnace, these openings extending horizontally at an angle to the axis of the chamber and being arranged approximately 90° apart. The pipe 28 has branches 28^a and 28^b which enter openings 28^c in the wall of the furnace, these openings being 90° apart and also being 90° removed from the openings 27^c. Above the pipes 27 and 28 are other pipes, 29 and 30, leading from the feed pipe 26, and above the pipes 29 and 30 are other pipes 31 and 32, which also lead from the feed pipe 26. The pipe 29 has branches 29^a and 29^b which lead into openings 29^c in the furnace wall, and the pipe 30 has branches 30^a and 30^b which lead into similar openings 30^c in the furnace wall. The pipe 31 has branches 31^a and 31^b which lead into openings 31^c in the wall, and the pipe 32 has branches 32^a and 32^b which lead into openings 32^c in the furnace wall. These openings, 27^c and 32^c are all arranged for admitting air laterally into the furnace chamber at an angle to the radius thereof and they are spaced apart circularly and also vertically of the chamber to give an even distribution of the air. The air delivered into the furnace through these openings causes a circulation of the air, gases and fuel in the chamber and an intimate mixture of the incoming fuel with the ignited gases and incandescent particles of unconsumed fuel. The furnace chamber is made of relatively small diameter at the bottom so that the vertical column of air will be confined and will have a proper lifting force to carry the coal dust upwardly into the upper part of the chamber. In the part of the chamber above the bottom section where combustion principally takes place, the chamber widens to give more space for the gases and for the air which is admitted through the branch feed pipes to promote combustion of the gases.

With proper regulation of the fuel feed and the air pressure, the coal dust will be held in suspension in the furnace until consumed, and the ash, which is impalpable dust, will be carried out at the top of the furnace by the draft and will deposit at some point outside of the furnace chamber. The dotted lines 33 in Fig. 1, indicate a deflector or crown sheet for directing the hot gases laterally through or beneath a boiler where the furnace is associated with a boiler.

Any particles of fuel, or incombustible material in the fuel, which may drop to the bottom of the furnace chamber after being injected into said furnace chamber will be carried by the funnel-shaped end a' of the chamber to the annular orifice 18 where it will meet a strong jet of air and be carried upward again into the chamber. If such particles are of coal they will be consumed, and if they are of slate or stone they will eventually be disintegrated by the heat and carried out of the furnace with the gases. If any fuel accumulates in the casing 12 and it is desired to clean this casing, it is only necessary to open the valve 23 when the fuel will be blown out through the pipe 20 by air admitted from the pipe 11.

Valves v are provided in the main pipe, the feed pipe and the various branch pipes for controlling the air pressure and flow, and at the outer end of each of the inlet pipes 27^a, 27^b, 28^a, 28^b, etc. is arranged a sight opening S, closed by glass or other transparent material, g, (Fig. 4) through which the condition of the fuel can be observed. These sight openings are conveniently arranged in the pipe fittings t and t'.

In Fig. 1 of the drawing, the air from the pipe 11 is blown through the annular orifice 18 into the furnace chamber, and air at the same pressure passes into the nozzle for blowing the coal dust into the furnace chamber. It may be desirable to use air at one pressure for blowing the coal dust into the furnace, and at another pressure for assisting in holding the dust in suspension, and

for this purpose the modification shown in Fig. 3 may be used. In this figure, the pipe 20^a leads upwardly through the bottom of the casing 12 and into a fitting 14^a. In the upper end of the pipe 20^a is a perforated plug 15^a, upon which fuel from the pipe 13 may deposit. Air at suitable pressure is delivered into the pipe 20^a through a pipe 11^a, and it will be seen that the air pressure will blow the fuel upwardly through the nozzle into the furnace chamber. Air from the pipe 11 flows directly through the opening 18 into the furnace chamber, and the pressure of the air may be different from that in the pipe 11^a.

It is believed the invention will be clear from the foregoing without further description. By the arrangement described, with proper regulation of the air pressures, fine fuel may be held in suspension until completely consumed. Thus the maximum amount of heat may be obtained from the fuel. The sight-openings at the various air inlets enable the operator to observe the condition of the fuel at various heights in the furnace and enable him to determine whether the air pressure is suitable or whether it should be increased or diminished.

What I claim is:

1. In a furnace for burning fine coal, a vertically arranged combustion chamber, of increasing diameter from the bottom toward the top, means for blowing the coal upwardly into said chamber, means for igniting the coal, and means for injecting air into the chamber above the inlet for the fuel.

2. In a furnace for burning fine coal, a vertically arranged combustion chamber, of increasing diameter from the bottom toward the top, means for blowing the coal upwardly into said chamber, and means for injecting air into the chamber above the inlet for the fuel at various points spaced vertically apart.

3. In a furnace for burning fine coal, a vertically arranged combustion chamber, circular in cross section and of increasing diameter from the bottom toward the top, means for blowing the coal upwardly in said chamber, and means for injecting air laterally into the chamber above the inlet of the fuel.

4. In a furnace for burning fine coal, a vertically arranged combustion chamber, circular in cross section and of increasing diameter from the bottom toward the top, means for blowing the coal upwardly in said chamber, and means for injecting air laterally into the chamber at various points spaced circumferentially and vertically apart.

5. In a furnace for burning fine coal, a vertically arranged combustion chamber of increasing diameter from the bottom toward the top, a nozzle projecting upwardly in the lower part of said chamber, means for feeding fine fuel to said nozzle, means for blowing air through said nozzle to force the fuel into the chamber, and independently controlled means for blowing air upwardly into said chamber adjacent the nozzle.

6. In a furnace for burning fine coal, a vertically arranged combustion chamber of increasing diameter from the bottom toward the top, a nozzle projecting upwardly in the lower part of said chamber, means for feeding fine fuel to said nozzle, means for blowing air through said nozzle to force the fuel into the chamber, and means for forcing air into the chamber at various points above the nozzle.

7. In a furnace for burning fine coal, a vertically arranged combustion chamber of circular cross section and of increasing diameter from the bottom toward the top, the bottom of said chamber having a central opening, and the side wall of the chamber converging to said opening, a fuel nozzle projecting upwardly into the chamber through said opening and spaced from the wall of the opening to provide an annular orifice therebetween, means for feeding fine coal to said nozzle, and means for forcing air through the nozzle and through said orifice to inject the fuel into the chamber and hold it in suspension therein.

8. In a furnace for burning fine coal, a vertically arranged combustion chamber of circular cross-section and of increasing diameter from the bottom toward the top, the bottom of said chamber having a central opening, and the side wall of the chamber converging to said opening, a fuel nozzle projecting upwardly into the chamber through said opening and spaced from the wall of the opening to provide an annular orifice therebetween, means for feeding fine coal to said nozzle, means for forcing air through the nozzle and through said orifice to inject the fuel into the chamber and hold it in suspension therein, and means for forcing air laterally into the upper portions of the chamber.

9. In a furnace for burning fine coal, a vertically arranged combustion chamber, an upwardly directed nozzle in the lower part of said chamber, means for blowing the coal through said nozzle into the chamber, an air pipe surrounding the nozzle and spaced therefrom to form an annular air opening, means for blowing air through said annular opening to hold the coal in suspension, and means for igniting the coal.

In testimony whereof I hereunto affix my signature.

JAMES POLLOCK.