No. 661,700. Patented Nov. 13, 1900.

F. H. LEWIS.

APPARATUS FOR BURNING PULVERIZED FUEL.

(Application filed May 11, 1899.)

(No Model.) 2 Sheets—Sheet 1.

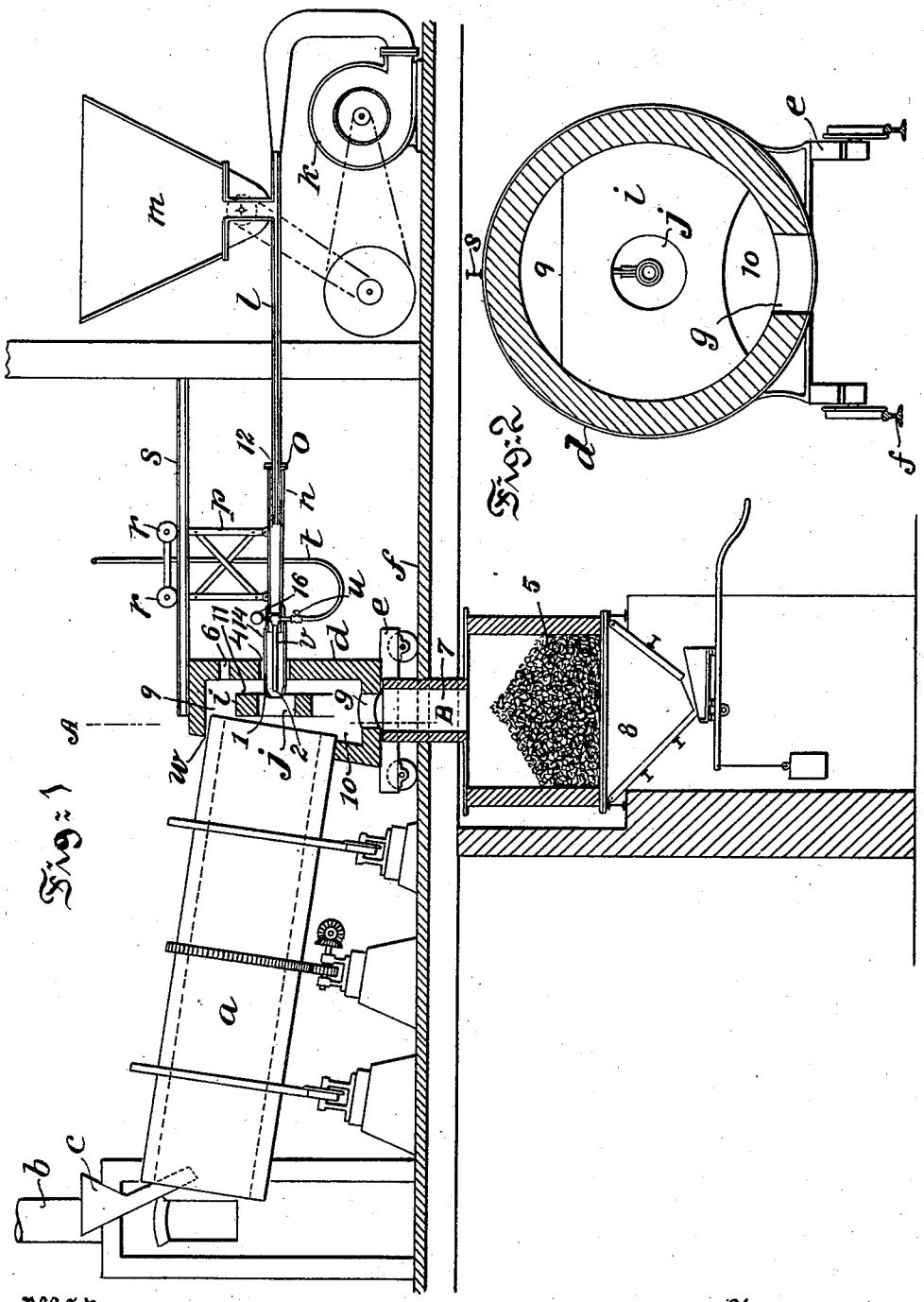


Fig. 1

Fig. 2

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By his Attorney Chas A. Rutter.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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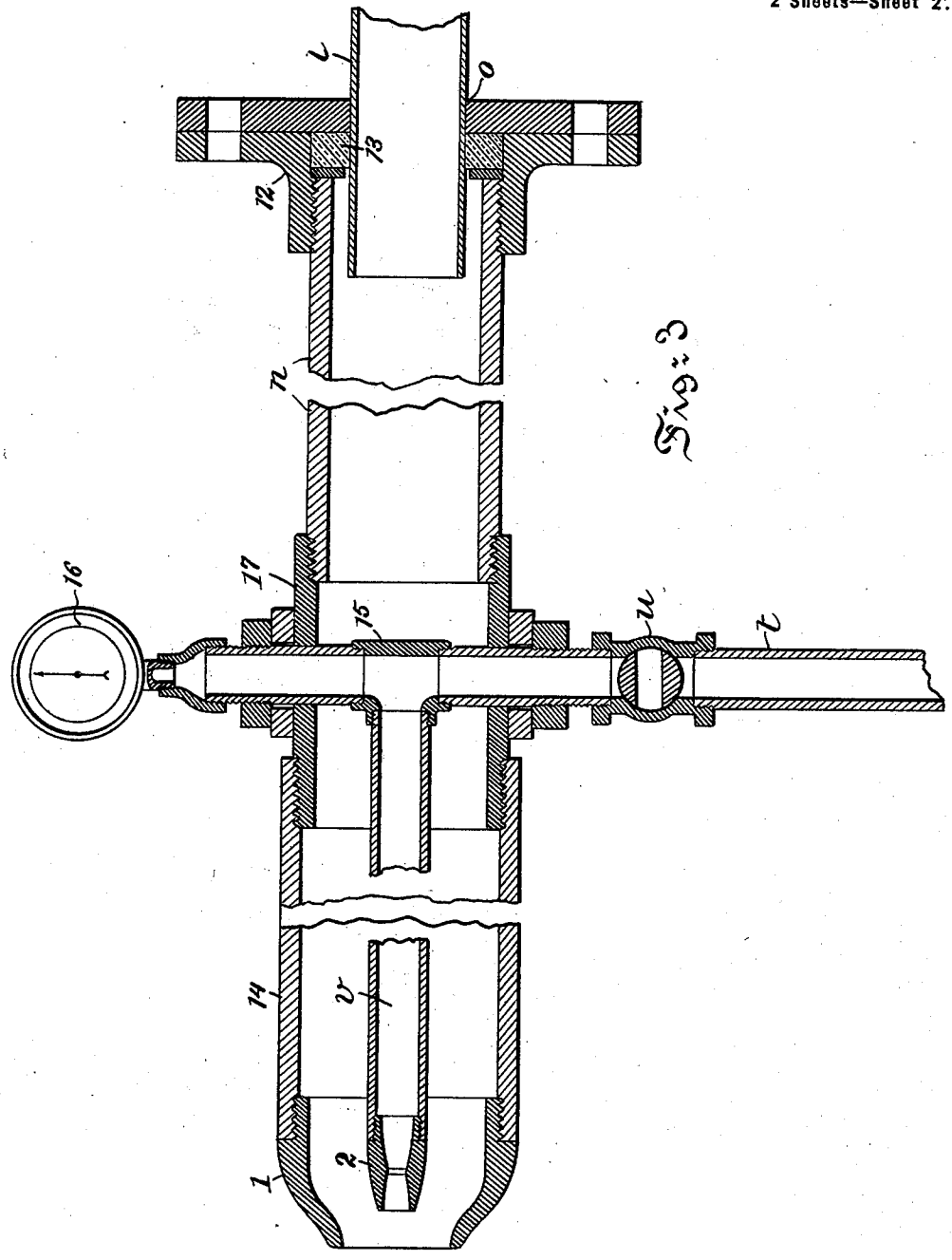


Fig. 3.

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UNITED STATES PATENT OFFICE.

FREDERICK H. LEWIS, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR BURNING PULVERIZED FUEL.

SPECIFICATION forming part of Letters Patent No. 661,700, dated November 13, 1900.

Application filed May 11, 1899. Serial No 716,438. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK H. LEWIS, a citizen of the United States, and a resident of the city and county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Burning Pulverized Fuel, of which the following is a specification.

My invention relates to an improvement in apparatus for the burning of pulverized fuel; and it consists in certain improvements particularly applicable to kilns of the rotary-cylinder type for roasting cement-rock or other materials.

The object of my invention is to secure a more complete combustion and consumption of powdered fuel in apparatus of the class referred to, whereby more economical and superior results are attained as compared with present apparatus.

In the accompanying drawings, forming part of this specification, and in which similar characters of reference indicate similar parts throughout the several views, Figure 1 is a view, partly in side elevation and partly in vertical central section, of my apparatus for burning pulverized fuel. Fig. 2 is a section on the line A B of Fig. 1 on an enlarged scale. Fig. 3 is a view, on a still larger scale, of the discharge end or nozzle of the fuel-duct, the same being shown in longitudinal vertical central section and with the central portion of the same broken away.

The apparatus which I have herein illustrated is constructed as follows: The rotary open-ended cylindrical kiln *a*, supported and operated in the usual manner, is constructed at its upper end with a stack *b* and a feeding-hopper *c* for containing the material to be roasted. The lower or delivery end of the cylinder communicates with and is surrounded by a hood *d*, having an opening *w* in one end, through which the delivery end of the cylinder projects when the hood is in its operating position. The hood is mounted upon a truck *e*, adapted to travel back and forth upon a track *f*. By this construction the hood may be moved into proper operating position, or it may be withdrawn to expose the end of the cylinder, thus giving easy access to the same when desired.

So far as described the apparatus is of the usual and well-known description, and it will be unnecessary to further illustrate or describe the details thereof.

In accordance with my invention a clinker-pit 5 is located beneath the delivery end of the cylinder and below the level of the track *f*, on which the hood-supporting truck *e* is adapted to travel. Projecting from the top of said clinker-pit and communicating therewith is a chute 7, which registers with an opening *g* in the bottom of the hood *e* when the same is in position to close the delivery end of the cylinder. After the hood is in position the joint between it and the chute 7 may be made tight by fire-clay mortar. The hot roasted rock or clinker falling from the revolving cylinder will drop through the opening *g* and chute 7 into the clinker-pit 5, which is simply a shallow chamber with an open grate 8 below.

A partition or arch *i* is located within the hood *d* and extends from side to side thereof. There is a space 9 between the top of said partition and the top of the hood, a space 10 between the bottom of said partition and the bottom of the hood, and a space 11 between the partition and the closed end of the hood. The partition is also provided with a central aperture *j*, which is opposite an opening 4 in the closed end of the hood. The purpose of the partition *i* will be explained farther on.

The powdered fuel is fed to the cylinder through a duct *l*, which communicates with a hopper *m*, located above the duct, near the end thereof farthest from the cylinder. A blower of any suitable form or construction, but in this instance shown as consisting of an ordinary fan-blower *k*, is provided at the outer end of the duct for forcing the powdered fuel into the kiln, as is common in furnaces of this character. This blower will be hereinafter referred to as the "feed-blower."

The discharge end of the duct *l* is provided with an ejector, the details of which are best illustrated in Fig. 3. This ejector consists of a fuel-ejector nozzle 14, having telescopic connection with the duct *l*, the said duct passing through a sleeve 12, secured to the rear end of the nozzle and provided with suitable packing 13. The front end of the nozzle passes through the before-mentioned opening 4 in the closed end of the hood, and consequently

comes opposite to or enters the central aperture *j* of the partition *i*. The nozzle 14 is preferably supported by means of a hanger *p*, Fig. 1, which is suspended from a track *s*, the hanger being capable of being moved along the track by means of rollers *r r*. In this way the nozzle is not only supported in the proper vertical position, but it may be horizontally adjusted relatively to the cylinder or moved entirely away therefrom for the purpose of inspection or repairs or whenever the hood *d* is moved away from the cylinder, as before described.

An air-nozzle *v* is placed concentrically within the fuel-nozzle 14 and has suitable connection with some source of air under high pressure. The air-nozzle *v* is shown as being connected to and communicating with a cross-pipe 15, which passes transversely through the fuel-nozzle some distance in rear of its front end. Connected to one end of this cross-pipe is a supply-pipe *t*, which connects with any suitable supply of compressed air, which is not herein shown. A stop-cock *u* may be located in the pipe *t*, if desired, for turning on and off and regulating the amount of air supplied to the air-blast nozzle. A pressure-gage 16 may be connected to the opposite end of the cross-pipe 15, if desired.

Obviously the air-blast nozzle may be supported within the fuel-ejector nozzle and connected with the air-supply in any desired manner, and the stop-cock *u* and the pressure-gage 16 may be dispensed with.

The ends of the fuel and air nozzles are shown as provided with nosepieces or nipples 1 and 2, respectively, which are connected thereto by screw-threads in order that any desired size, shape, or character of nosepieces may be employed to meet varying conditions and requirements. I prefer to construct the fuel-ejector nozzle in sections, the front section 14 having screw-threaded connection with the rear section *n* through the instrumentality of an intermediate or union section 17, through which the cross-pipe 15 is shown as passing. The chief advantage of this construction is that the nosepiece of the outer nozzle may be adjusted relatively to the nosepiece of the inner nozzle for the purpose of obtaining the best results.

When the parts of the apparatus are in working position, as illustrated in Fig. 1, the fuel-ejector nozzle passes through the opening 4 in the closed end of the hood *d*, and as the central aperture *j* of the partition *i* is in alinement with said opening 4 the said nozzle is in position to deliver the fuel through the aperture and may be adjusted relatively thereto to produce the best and most economical results.

In the operation of an apparatus such as I have described it will be seen that the feed-blast created by the blower *k* is sufficient to carry the pulverized fuel to the cylinder and that the inducing-blast of high pressure issuing from the nozzle *v* causes induced currents of extraneous air to flow into the flame. Owing to the novel location and construction of the clinker-pit 5 the induced air is caused to pass through the hot clinker contained in said pit, and the air is thereby heated before mingling with the fuel issuing from the ejector-nozzle. Of course some of the induced air will be drawn in through the spaces between the cylinder and the hood, and, if desired, a hole or holes 6 may be made in the hood for the entrance of air at a normal temperature. The induction of air is greatly facilitated by the employment of the apertured partition *i*, which serves to confine the blast of fuel-laden air after it leaves the nozzle. As before explained, the position of the nozzle relatively to the aperture in the partition may be adjusted by means of the sliding or telescopic connection between the nozzle and the fuel-duct and the hanger carrying said nozzle. It will further be seen that by my improved apparatus a considerable reduction in the cost of roasting cement-rock, &c., is attained, because not only is there greater economy in the consumption of fuel, but because complete combustion occurs in the lower end of the kiln. Obviously with the present methods the fuel is merely blown in and burns only as it may come in contact with heated air in the kiln-chamber. Hence it is either not fully consumed or else combustion occurs throughout the length of the kiln instead of at the lower end, where practically complete combustion should take place to secure the proper and economical roasting of cement-rock in the manner which is accomplished by my improvements.

I claim as my invention—

1. In an apparatus for burning pulverized fuel, the combination of a combustion-chamber provided with a fuel-inlet, a duct for conveying the powdered fuel to the fuel-inlet, means for producing an air-blast of large volume and small velocity through said duct, and means for injecting a small volume of air or gas at high velocity into the combustion-chamber through the inlet-opening, said injecting means being adapted to entrain the powdered fuel and air for combustion.

2. In an apparatus for burning powdered fuel, the combination of a combustion-chamber provided with an inlet-opening for the fuel elements, a receptacle for containing the powdered fuel, a duct connected with said receptacle and terminating near said inlet-opening for conveying the fuel, means for forcing an air-blast of comparatively large volume and low velocity through said duct, and means disposed near the delivery end of said duct for discharging in the direction of the inlet-opening a blast of air of comparatively small volume and high velocity, whereby the fuel is fed to the combustion-chamber at high velocity and air necessary for combustion is entrained.

3. An apparatus for supplying powdered fuel to furnaces comprising a receptacle for

containing the fuel, a duct leading from said receptacle, means connected with said duct for supplying an air-blast of low pressure for carrying the fuel forward, a fuel-ejector nozzle disposed in the discharge end of said duct and having a telescopic connection therewith, a hanger for supporting said nozzle, an air-nozzle disposed concentrically within said fuel-nozzle, and means for supplying an air-blast of high velocity connected with said air-nozzle whereby the powdered fuel is ejected from said nozzle and air entrained with said fuel.

4. An apparatus for supplying powdered fuel to furnaces, comprising a receptacle for containing the fuel, a duct leading from said receptacle, means connected with said duct for supplying an air-blast of low pressure for carrying the fuel forward, an ejector-nozzle disposed in the discharge end of said duct, movable supporting means for said nozzle, an air-nozzle disposed concentrically within said fuel-nozzle, and means for supplying an air-blast of high velocity to said air-nozzle whereby the powdered fuel is ejected from said nozzle and air entrained with said fuel.

5. An apparatus for supplying powdered fuel to furnaces comprising a receptacle for containing the fuel, a duct leading from said receptacle, means connected with said duct for supplying an air-blast of low pressure for carrying the fuel forward, an adjustable fuel-ejector nozzle disposed in the discharge end of said duct, and having a telescopic connection therewith, a hanger for supporting said nozzle provided with rollers, a track on which said rollers travel, an air-nozzle disposed concentrically within said fuel-nozzle, and means for supplying an air-blast of high velocity to said air-nozzle.

6. In an apparatus for burning pulverized fuel, the combination of a combustion-chamber, a hood surrounding the rear end of said chamber, and provided with an opening at its rear end, a partition or arch in said hood provided with an opening in alinement with the opening in said hood, a storage bin or hopper for containing the fuel, a duct leading from said hopper and provided with a nozzle which projects through the opening in the end of said hood, and means for supplying said duct with an air-blast for forcing the fuel through the central opening in the partition or arch of said hood into said combustion-chamber.

7. In an apparatus for burning pulverized fuel, the combination of a combustion-chamber, a hood surrounding the lower end of said chamber and provided with an opening at its end, an ejector-nozzle adapted to project at its front end through the opening in the end of said hood, a horizontal movable hanger for supporting said ejector, a storage bin or hopper for containing the fuel, a duct leading from said hopper to said ejector-nozzle, the said duct and nozzle being telescopically connected, and means for supplying said duct with an air-blast for forcing the powdered fuel into said combustion-chamber.

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