(No Model.) 2 Sheets—Sheet 1.

# H. KLUEPFEL.

## FINE FUEL FURNACE.

No. 516,652. Patented Mar. 20, 1894.

Fig. 1.

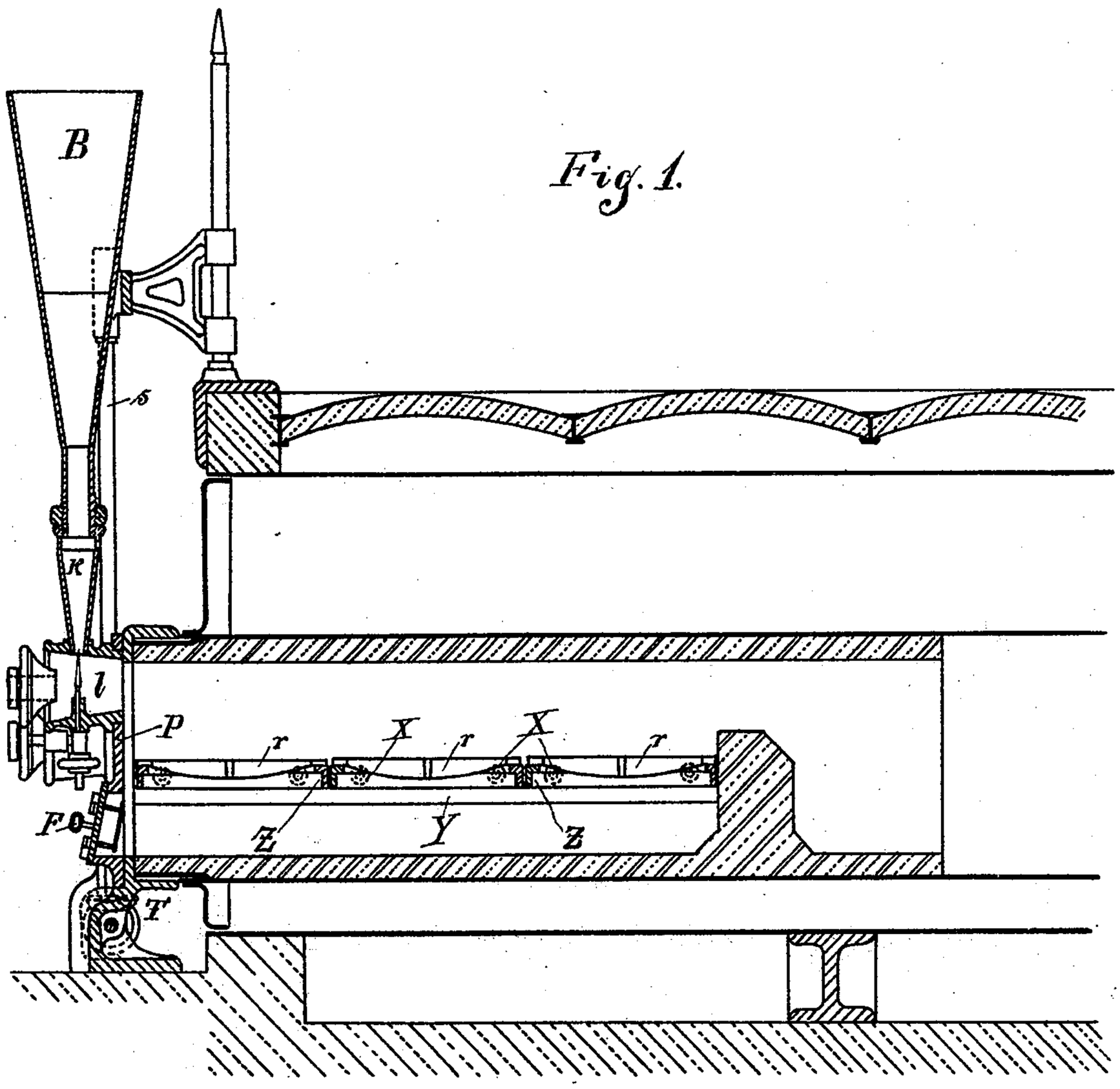



Fig. 3.

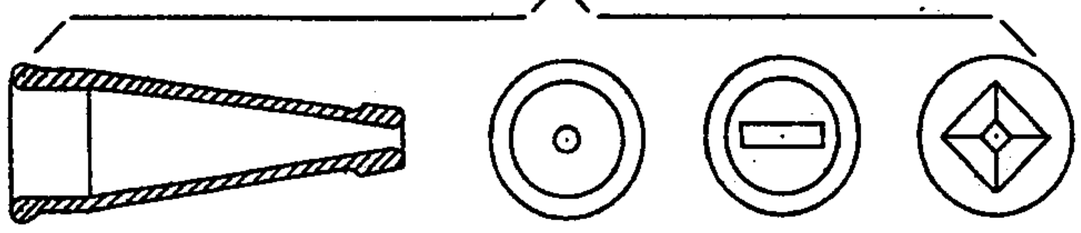
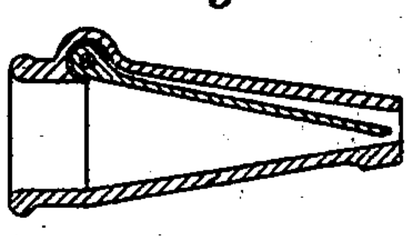


Fig. 4.



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(No Model.) 2 Sheets—Sheet 2.

# H. KLUEPFEL.

## FINE FUEL FURNACE.

No. 516,652. Patented Mar. 20, 1894.

*Fig. 2.*

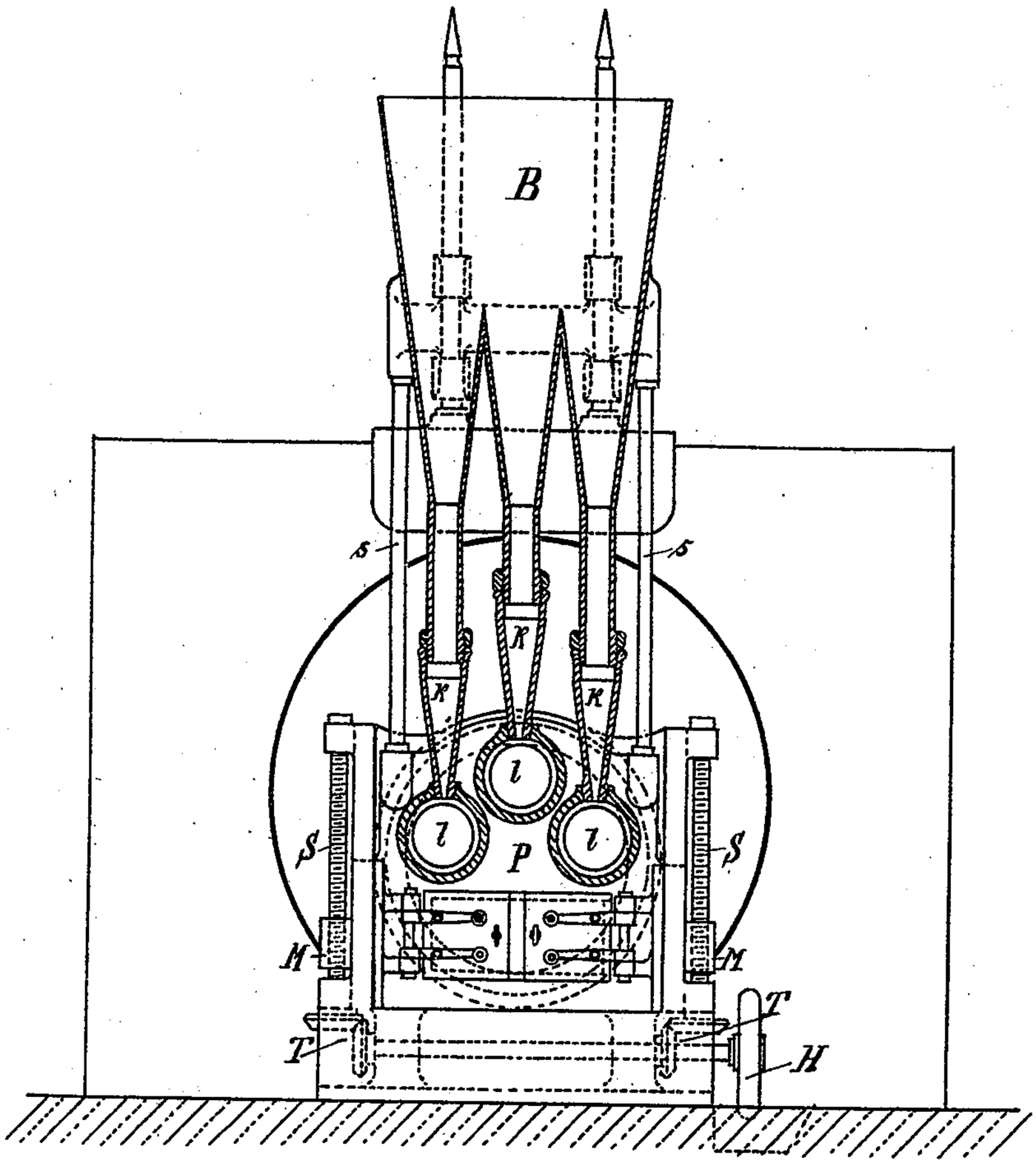
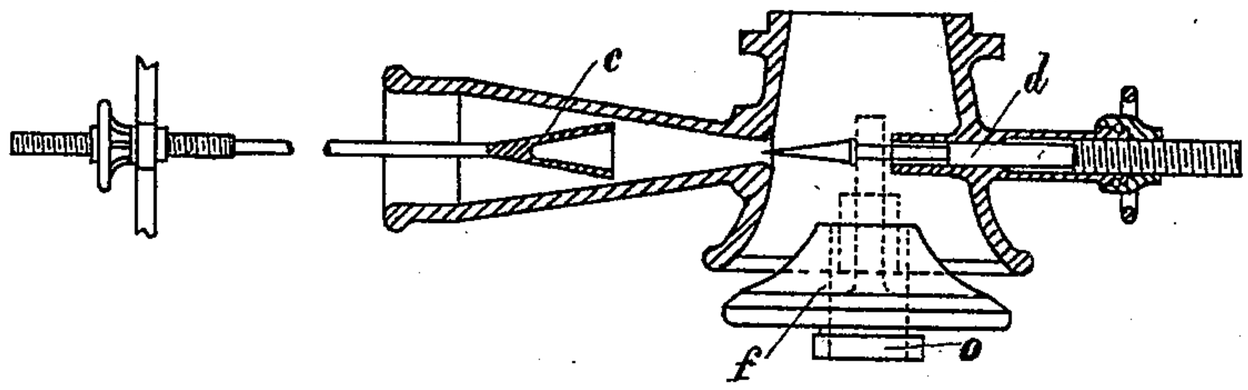



*Fig. 5.*

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# UNITED STATES PATENT OFFICE.

HERMANN KLUEPFEL, OF BARMEN, GERMANY.

## FINE-FUEL FURNACE.

SPECIFICATION forming part of Letters Patent No. 516,652, dated March 20, 1894.

Application filed October 31, 1893. Serial No. 489,619. (No model.)

*To all whom it may concern:*

Be it known that I, HERMANN KLUEPFEL, a subject of the King of Prussia, residing at Barmen, in the Kingdom of Prussia, Germany, have invented new and useful Improvements in Furnaces for Pulverulent and Fine-Grained Fuel, of which the following is a specification.

This invention relates to furnaces for burning pulverulent or finely divided fuel, as coal dust, and aims to provide certain improvements in devices of this character.

To this end, in carrying out the invention in its preferred form, I provide a receiver for the fuel, a conveyer, communicating with said receiver for carrying the fuel to the point of delivery, an air blast for conveying the fuel to the point of combustion, means for controlling said blast, a valve for controlling the supply of fuel, and preferably a movable frame or plate carrying said parts and serving as the front plate of the furnace and movable upwardly above the furnace to give access to the interior thereof, and a movable grate within the furnace for use previously to the ignition of the powdered fuel and removable therefrom beneath said plate when the latter has been raised.

In the accompanying drawings, Figure 1 is a vertical axial section of a flame tube boiler to which the preferred form of my improvement is applied. Fig. 2 is a front elevation thereof, the fuel feeding apparatus being in vertical section. Fig. 3 shows in axial section, and in three end views, three different shapes of removable mouth pieces for fuel conveyers. Fig. 4 is a section of such a mouth piece having a swinging throttle valve. Fig. 5 is a vertical axial section of a mouth piece of the construction shown in Fig. 1 but having an axial longitudinally adjustable cone throttle valve within the fuel conveying pipe.

Referring to the drawings let B represent the receiver for the fuel, *s* bars carrying the receiver, P a plate engaging said bars, closing the flame tube at front of the boiler, *l* the air supplying tubes which are carried by said plate, F the fire doors provided with the usual dampers and carried by said plate, *k* conveying pipes connected to and communicating with the receiver at top and opening into the tubes *l* at bottom, M nuts fixed to the plate P, S screw spindles engaging these nuts, H a hand wheel for operating the screws S, T bevel gears between the screws and hand wheel, Z the grate frames, and *r* the grate bars. *d* is a valve for controlling the flow of fuel, *c* a similar valve for a like purpose, *f* a valve for controlling the air supply, and *o* a peep aperture in the latter valve.

The receiver B may be of any suitable construction, and may have one or more fuel conveying pipes *k* communicating with its under side and leading to the air current pipes *l*. A suitable valve is provided for controlling the flow of fuel from the receiver. Preferably a valve *d* arranged axially of the discharge mouth of each pipe *k*, and disposed within the air pipe *l* is provided, which valve can be moved toward or from the pipe *k* to control the area of the annular discharge space between the mouth of this pipe and the valve, and thereby determine the feed of the fuel. If desired, however, a valve *c* within the pipe *k* may be used, either alone or in conjunction with the valve *d*, for controlling the speed of supply of the fuel.

According to one feature of my invention I construct the internal walls of the receiver, the fuel conveying pipes, and the external walls of the valve or valves *d* and *c*, at an angle of inclination relatively to the horizontal which is steeper than the natural angle of slope of the fuel. This is an important feature, for the reason that pulverulent or finely divided material will not move under the action of gravitation over an inclined plane the inclination of which is less than the natural angle of slope of the fuel, but will in such a case adhere to or rest upon the wall or plane and eventually prevent the passage of subsequent fuel thereover. With my invention I construct the walls with such steep inclinations that none of the powdered fuel will adhere thereto, it all passing freely thereover under the action of gravitation. I also construct the walls of the valves *d* and *c* with like inclinations preferably the reverse of the inclination of the walls of the pipes *k*.

The receiver B, bars *s*, and plate P, constitute essentially a movable frame carrying the fuel feeding and draft controlling apparatus. This frame is manipulated to open or close

the flame tube of the boiler by means of the screws S, or in any other suitable manner.

According to another feature of my invention the powdered fuel is discharged into a gaseous current or blast, preferably an air current induced by the usual draft of the furnace, and this current serves to convey the fuel into the flame tube of the boiler, suitably subdividing the fuel and intermixing the air or gas with it, and I provide means for controlling this current. Preferably this is accomplished by providing an air pipe *l* carried by the plate P, and opening into the flame tube, and an air valve *f* at the outer open end of this pipe movable to open or close the same for controlling the flow of current therethrough.

Another feature of the invention consists in providing a removable grate frame Z carrying the grate bars *r*, which frame rides into the flame tube on rollers X engaging tracks V therein, and is inclosed therein by the plate P when the latter is down. This frame can be withdrawn from the furnace, when combustion of the powdered fuel is well under way, or preferably when the furnace is sufficiently heated to ignite the powdered fuel when the latter is fed thereto, by raising the plate P and drawing out the grate frame. The grate frame is usually loaded with ordinary fuel, which is ignited and burned in the flame tube until the requisite heat has been generated therein to ignite the powdered fuel, whereupon the frame may be withdrawn and the powdered fuel fed to the furnace.

In operation the powdered fuel is placed in the receiver B, the valve for controlling the discharge through the pipes *k* is closed, the temperature of the flame tube is raised by ordinary fuel on the grate frame Z, the plate P and feeding apparatus are then raised and the grate frame withdrawn, the plate and feeding apparatus are then restored, the valve controlling the feed properly adjusted, and the operation of burning the powdered fuel then commences. In this operation the conveying pipes *k* discharge preferably an annular stream of powdered fuel into the air pipe *l*, and the current through the latter takes up the powdered fuel, subdivides it, mixes with it, and carries it into the combustion chamber or flame tube, where it is ignited either by the heat already generated therein as before described, or in any suitable manner. A continuous and regular flow of powdered fuel follows, which may be controlled by adjusting either the fuel valve *d* or *c*, or both. The air current may be controlled by the air valve *f*. The operation may be observed through the aperture *o*. The draft may be controlled by the doors F.

Preferably the apparatus is constructed with one receiver B having three conveying pipes *k*, each having a separate air pipe *l*, and the flame tube is partly lined internally with fire brick, or other refractory material, up to beyond the fire bridge, in order to protect the walls of the boiler against projecting jets of flame.

It will be seen that my invention provides an improved furnace in which powdered fuel can be readily and conveniently utilized, and it will be understood that the invention is not limited to the precise details of construction and arrangement set forth in its preferred form, as it may be availed of according to such modifications as circumstances or the judgment of those skilled in the art may dictate, without departing from the essential features of the invention.

Preferably the mouth pieces or conveying pipes *k* are removable so that different sizes and forms can be employed. Several forms are shown in Fig. 3. To facilitate the removal of the mouth pieces they are constructed at their lower ends to fit corresponding sockets in the tops of the air pipes *l*, and the discharge outlets from the receiver are adapted to pass into the upper ends of the pipes *k*, and are screw threaded above these ends, and carry a nut screwing down on the pipes to hold them in position, as shown in Fig. 1. Preferably a threaded hand wheel engages the screw threaded stem of the valve *d*, and is carried at the under side of the air tube *l* for adjusting this valve. A similar adjusting device is provided above the valve *c* and carried by a frame thereover. With each of these adjusting devices a suitably arranged mark or graduation may be provided to indicate the quantity of fuel fed through the valve in a given unit of time.

The air current will be regulated according to the quantity of fuel used and the purpose for which the combustion is required. Ordinarily cold air may be employed, but for some purposes, especially for melting processes, it will be desirable to first heat the air.

What I claim is—

1. In a furnace for burning finely divided fuel, the combination with the combustion chamber, of a receiver for the fuel, a discharge outlet for said receiver, a plurality of mouth pieces for said outlet, and air tube *l* opening into said chamber and having a socket at top, said mouth pieces each fitting said socket in said tube at their lower ends, and each fitting said discharge outlet from said receiver at their upper ends, and constituting removable pipes communicating between said receiver and said air tube, whereby one can be substituted for another, substantially as and for the purpose set forth.

2. In a furnace for burning finely divided fuel, the combination with a combustion chamber of a front plate P therefor, an air tube *l* carried by said plate, a receiver B for the fuel above said plate, a conveying pipe leading from said receiver into said tube for discharging the fuel therein, and a frame *s* carrying said plate and receiver and movable vertically to raise and lower said parts to give access to said chamber, substantially as and for the purpose set forth.

3. In a furnace for burning finely divided fuel, a combustion chamber and a fuel feeding apparatus, in combination with a movable front plate for said chamber carrying said apparatus, and a removable grate frame in said chamber opposite said plate, whereby ordinary fuel can be ignited on said grate frame to heat said chamber to a temperature necessary to ignite the finely divided fuel, and thereafter said grate frame can be removed and the finely divided fuel fed to said chamber, where it will be ignited by the heat thereof.

4. In a furnace for burning finely divided fuel, a combustion chamber, in combination with apparatus for feeding the finely divided fuel thereto, a front plate for said chamber carrying said apparatus and movable vertically relatively to said chamber to open and close it, and a removable grate in said chamber for retaining the ordinary fuel requisite to initially heat it, whereby when said front plate is moved from said chamber said grate can be withdrawn therefrom, substantially as and for the purpose set forth.

5. In a furnace for burning finely divided fuel, the combination with the combustion chamber of a receiver for the finely divided fuel, a conveying pipe *k* for discharging the fuel therefrom, and an air supplying tube *l* receiving the discharged fuel and opening into said chamber, the inner walls of said conveying pipe constructed with an inclination steeper than the natural angle of slope of said fuel, and a valve for controlling the discharge through said conveying pipe and constructed with walls of like but reversed inclination to those of said conveying pipe.

6. In a furnace for burning finely divided fuel, a combustion chamber, in combination with a conveying pipe *k* for feeding the finely divided fuel to said chamber, said pipe having inclined inner walls, and a valve within said pipe, arranged axially thereof, movable in vertical direction for controlling the flow therethrough, and constructed in the form of a cone the outer walls of which are of the same but reversed inclination to those of said pipe.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HERMANN KLUEPFEL.

Witnesses:

FRIEDR. SCHADDE,

FR. SCHADDE, Jr.