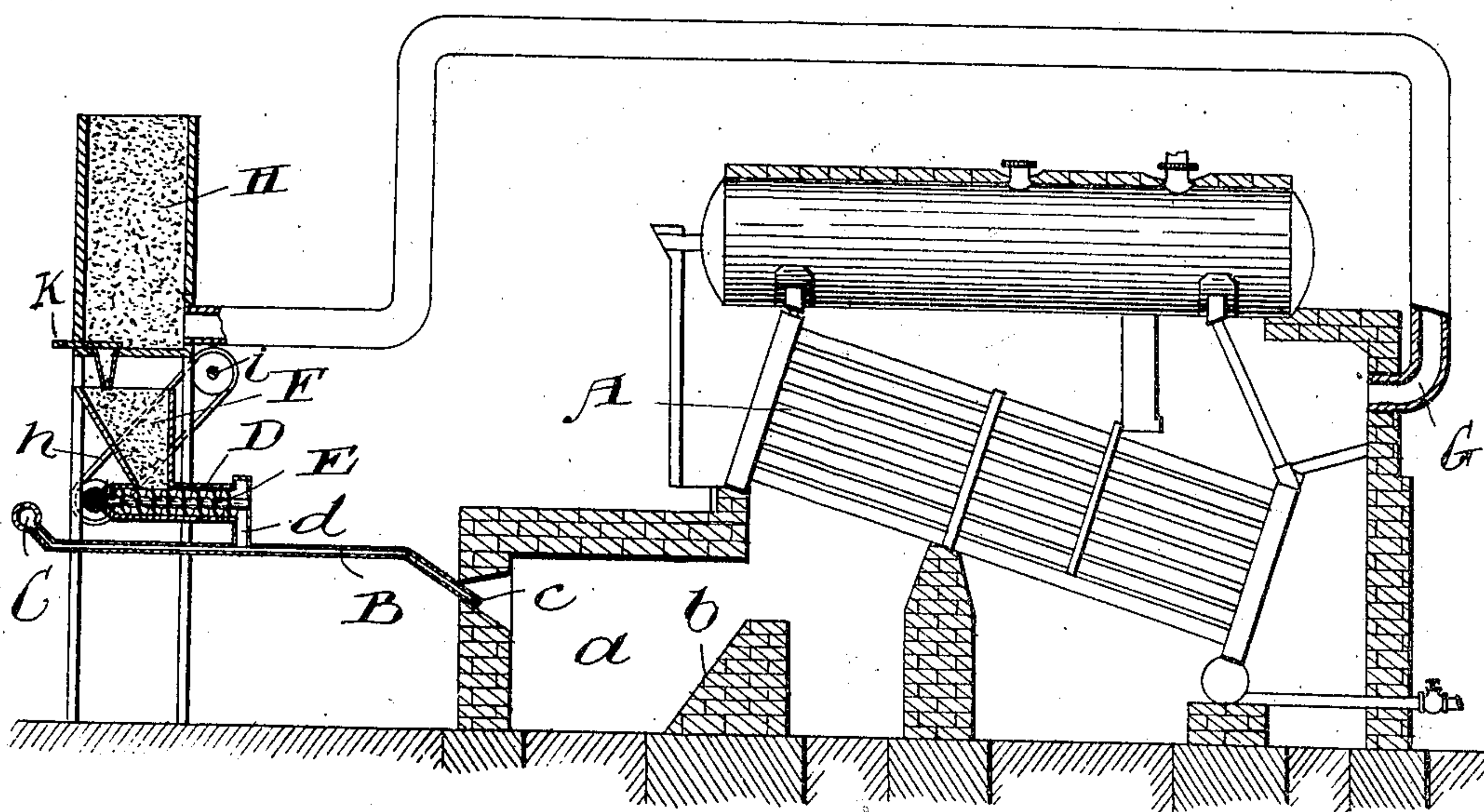


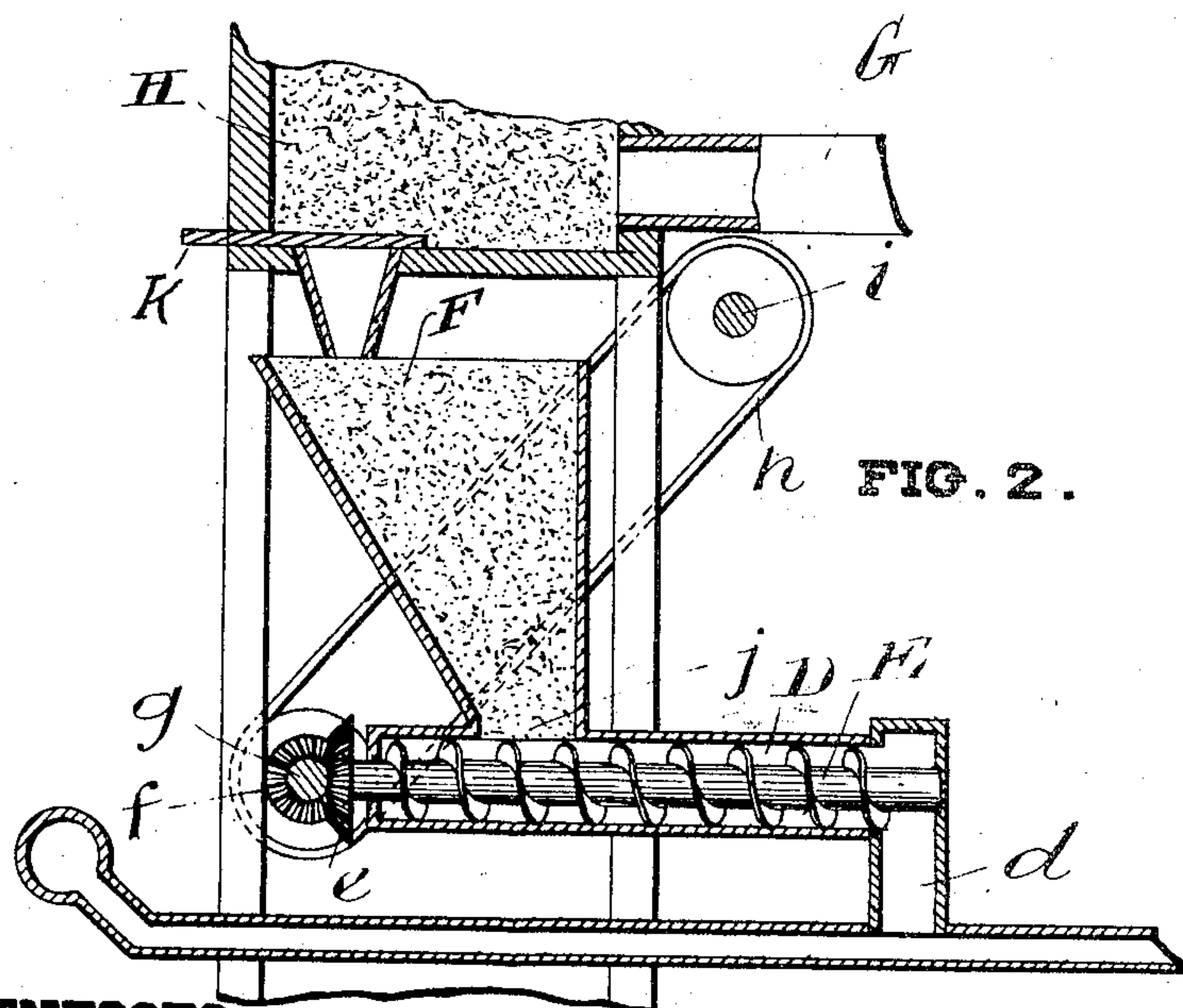
No. 861,514.

PATENTED JULY 30, 1907.

R. D. HASSAN.  
APPARATUS FOR BURNING POWDERED FUEL.  
APPLICATION FILED MAY 12, 1906.



**FIG. I.**



**WITNESSES**

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# UNITED STATES PATENT OFFICE.

ROBERT D. HASSAN, OF OTTAWA, ONTARIO, CANADA.

## APPARATUS FOR BURNING POWDERED FUEL.

No. 861,514.

Specification of Letters Patent.

Patented July 30, 1907.

Application filed May 12, 1906. Serial No. 316,559.

To all whom it may concern:

Be it known that I, ROBERT DONALD HASSAN, of the city of Ottawa, in the county of Carleton, Province of Ontario, Canada, have invented certain new and useful Improvements in Apparatus for Burning Powdered Fuel, of which the following is a specification.

My invention relates to improvements in apparatus for burning fuel in a finely divided state such as powdered coal and the objects of my invention are to provide simple and efficient means under which the rate of burning of the fuel will be absolutely controlled and thus regulate the degree of intensity of the fire; and it consists essentially of a pipe leading into the combustion chamber through which air is blown a conveying pipe for the powdered fuel emptying into the said supply pipe and a worm within said conveying pipe for regulating the amount of fuel passing through the conveying pipe; the various parts of the device being constructed and arranged in detail as herein-  
after more particularly described.

Figure 1 is a vertical longitudinal sectional view of a furnace having my improved apparatus for burning fuel attached thereto. Fig. 2 is an enlarged vertical longitudinal sectional detail of the fuel conveying apparatus.

In the drawings like letters of reference indicate corresponding parts in each figure.

I am aware that it has been proposed to burn finely divided fuel by blowing it into the furnace under considerable air pressure but a difficulty has been experienced in regulating the degree of intensity of the fire and this I accomplish in my invention by employing only a moderate pressure to blow the fuel into the combustion chamber and by controlling absolutely the amount of fuel fed therein.

Referring to the drawings A represents a boiler and furnace of a well known type and *a* is the combustion chamber thereof. The bridge wall *b* at the back of the combustion chamber is preferably inclined as shown and through the front wall the nozzle *c* of an air supply pipe B extends, the nozzle being so directed that the mixture of air and fuel blown through it will impinge substantially normally on the wall *b*.

The supply pipe B is connected to a main supply pipe C through which air is blown at a moderate pressure of about 3/4 ounce per square inch. Entering the supply pipe B intermediate of its length is a joining pipe *d* which leads from the conveying pipe D for the supply of fuel. Within the conveying pipe D a worm E is rotatably supported by means of which the feeding of the fuel is gradually accomplished.

Suitable means are provided for slowly and continuously rotating the worm E that I have shown comprising a beveled gear *e* secured to the end of the shaft supporting the worm which meshes with a pinion *f*

on a shaft *g* which is rotated by means of a belt *h* from a main power shaft *i*.

F is the hopper in which the supply of powdered fuel is contained and is preferably constricted at the bottom as shown. An aperture *j* is provided in the bottom adjacent to a similar opening provided in the top of the conveying pipe through which the fuel will be fed into the conveying pipe D. In the operation of the apparatus the worm E is continuously rotated at a predetermined speed and air is blown through the supply pipe B at a moderate pressure. The fuel falling into the supply pipe B through the joining pipe *d* will be blown into the combustion chamber and there the combustion having once been started it will continue without cessation.

The supply of air and fuel may be so regulated that the combustion taking place in the combustion chamber will be complete whereby there will be no cinders or smoke resulting from the combustion. In fact so complete is the combustion that I have found it practical to use the hot waste gases which result therefrom to dry the powdered coal or other fuel previous to placing it in the hopper. For this purpose I provide a conducting pipe or tunnel G leading from the furnace to the bottom of the bin or other receptacle H within which the fuel is stored. The degree of intensity of the fire will vary with the amount of fuel fed into the furnace and hence by a proper adjustment of the supply of air and fuel any desired temperature may be obtained.

It will be seen that the top of the lower bin or hopper F is open, though by this statement I do not desire to exclude a construction in which there might be a removable cover, the object being to permit ready access from the top of the hopper to the material therein. Further, the top of the hopper is to be located directly beneath the bottom of the bin H, and to be spaced at some little distance therefrom, so that there will be no obstacle to the free access referred to. The bin H may be of very large capacity, so as to hold sufficient material to charge the hopper a number of times;—in any event, it will be considerably larger than the hopper. A slide K or other suitable means controls the outlet of the bin H, so that the hopper may be filled and then allowed to exhaust itself. Thus, it will be seen that, the hopper being filled with a predetermined quantity of fuel and then cut off from the source of supply, and the worm E being rotated at a predetermined rate, the fire may be kept burning in the furnace for a predetermined period. This is one of the reasons for employing two fuel receptacles. Another is that the heated gases delivered by the pipe G should be admitted to the bottom of the receptacle into which they discharge, and thence work their way upward through the mass. Were they thus to be admitted to the recep-



tacle communicating with the worm, the latter would become unduly heated, and the gases and the fumes given off by the drying fuel would also have a tendency to corrode and injure it and its bearings. Hence the provision of a primary receptacle to which the products of combustion are admitted. Moreover, it is of course desirable to extract all the heat from the gases delivered by the pipe G; and, for this reason, the gases should be allowed to permeate upward through a large bulk of the fuel. To this end, the bin H may, if desired, be the main fuel storage receptacle in connection with the furnace; and it will obviously be possible to so proportion the same that the gases issuing from the top will be quite cool. Were the gases permitted to enter into the comparatively small worm-communicating hopper, the gases as given off from the top thereof would be still hot and therefore an undesirable addition to the atmosphere of the furnace room. It will be readily appreciated, too, that a much more efficient drying of the fuel is effected by thus treating the latter in bulk, rather than in small quantity. It being established, therefore, that it is desirable to heat and dry the fuel in bulk, another reason will be perceived why the comparatively large drying bin should be distinct and cut off from the feeding hopper. It is that, were there but one large drying and feeding receptacle with a worm at the bottom, the pressure of the large mass of fuel upon the latter would require an undue amount of power to rotate the worm shaft, to such extent that the latter might be arrested should the worm encounter some fuel which had been rendered lumpy by drying.

There remains a signal advantage to be pointed out in connection with the relative arrangement of the hopper F and the worm E and pipe D, and relates to the communication between the hopper and the pipe being by means of a restricted opening as already set forth. As just indicated, it is extremely undesirable that the worm shall encounter much resistance from the pressure of the fuel, and moreover the worm could scarcely be depended upon to revolve with a constant speed, as is desired, if it were so positioned as to be obliged to agitate any considerable body of fuel. Thus were the bottom of the hopper not restricted and the pipe D to communicate with the entirety of said bottom, or were the worm to be placed directly within the wide bottom of the hopper, there would be too much pressure upon the worm to accomplish my purposes. Mention may also be made of the special advantages attendant upon

the use of a worm in connection with my other arrangements. As already indicated, this structure is admirably adapted to deliver the fuel to the air blast in predetermined quantities; and its special value in conjunction with the arrangements for drying illustrated is that it serves efficiently to reduce again to powder such of the fuel as may have become somewhat agglomerated by the drying action. It will thus be appreciated that a feeding hopper open at its top and communicating by a restricted opening at its bottom with a worm-containing pipe possesses peculiar significance in connection with the provisions for pre-drying the fuel, since the worm may be relied upon to break up any ordinary agglomerations of fuel, while, should the restricted opening at rare intervals become choked, the ready access which is possible to the top of the hopper enables the opening to be easily cleared by the insertion from above of any suitable rammer or other instrument.

It will thus be seen that I have devised an exceedingly cheap and simple apparatus which may be applied to any ordinary type of furnace to burn the powdered fuel in the same and in which the temperature of the furnace will be controlled through the controlling of the supply of fuel.

While I have described with great particularity of detail one specific embodiment of my invention yet it is not to be understood therefrom that the invention is limited thereto as changes might be made therein within the scope of the appended claims without departing from the spirit of the invention.

What I claim as my invention is:—

In an apparatus for burning powdered fuel, the combination with a furnace and an air-delivery pipe therefor, of a fuel bin of large capacity having a valved outlet at its bottom, a pipe arranged to conduct heated products of combustion from said furnace and delivering into said bin, a hopper of greatly smaller capacity than said bin and entirely distinct from the same, the top of said hopper being open and spaced considerably below the bottom of said bin and the hopper being so disposed that said open top is readily accessible from without, a pipe underlying said hopper and communicating with the bottom thereof by a restricted opening, and communicating also with said air-delivery pipe, a worm within the hopper-underlying pipe, and means for revolving the same.

Signed at the city of Ottawa, in the county of Carleton, and Province of Ontario, this 8th day of May, 1906.

R. D. HASSAN.

Witnesses:

RUSSEL S. SMART,  
WM. A. WYMAN.