No. 710,033. Patented Sept. 30, 1902.

J. W. BAILEY.

APPARATUS FOR THE COMBUSTION OF FINELY DIVIDED SOLID FUEL.

(Application filed Jan. 18, 1901.)

(No Model.)

FIG. 1.

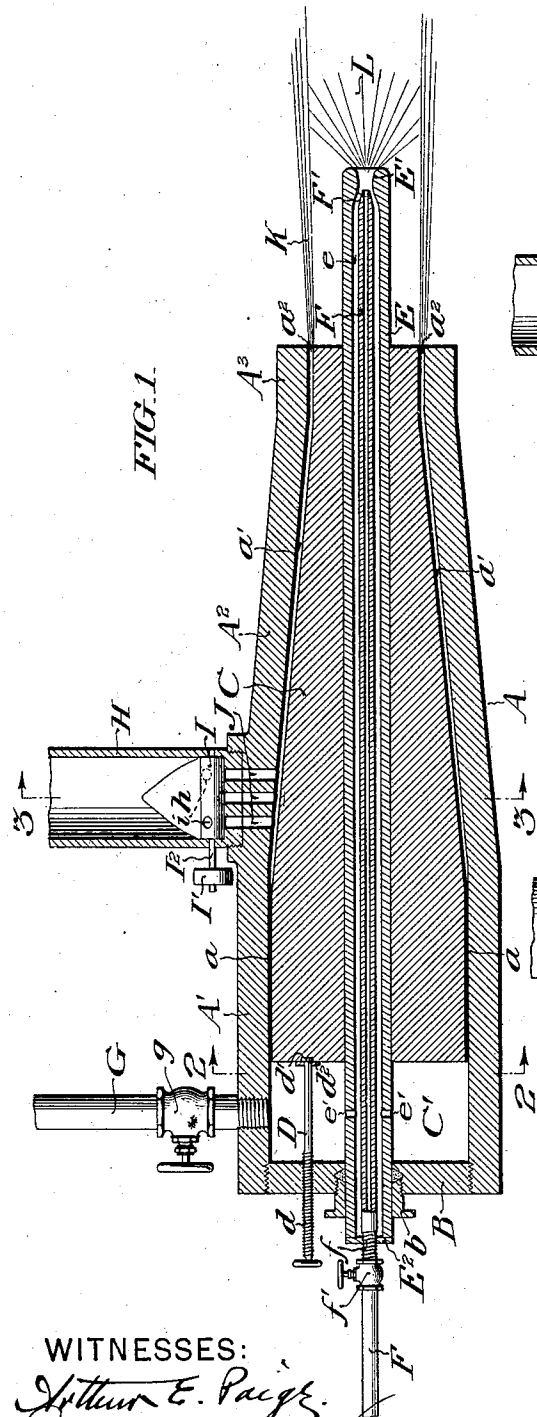


FIG. 3.

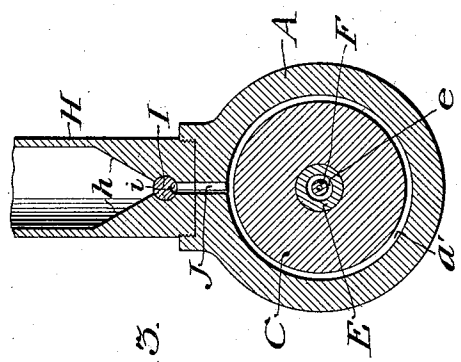
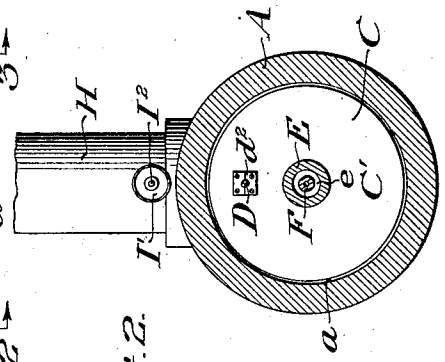


FIG. 2.



WITNESSES:

Witness E. Paige.

James H. Bell

INVENTOR:

J. W. Bailey.

By Raley & Paul

attorneys.

UNITED STATES PATENT OFFICE.

JOHN W. BAILEY, OF JERSEY CITY, NEW JERSEY.

APPARATUS FOR THE COMBUSTION OF FINELY-DIVIDED SOLID FUEL.

SPECIFICATION forming part of Letters Patent No. 710,033, dated September 30, 1902.

Application filed January 18, 1901. Serial No. 43,680. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. BAILEY, a citizen of the United States, residing at No. 62 Danforth avenue, Jersey City, in the county of Hudson and State of New Jersey, have invented a certain new and useful Apparatus for the Combustion of Finely-Divided Solid Fuel, whereof the following is a specification, reference being had to the accompanying drawings.

In said drawings, Figure 1 represents a vertical longitudinal section through an apparatus embodying my invention. Fig. 2 is a transverse vertical section of the same on the line 2 2, Fig. 1. Fig. 3 is a similar section on the line 3 3, Fig. 1.

My invention is addressed to the efficient and economical combustion of solid fuel in a finely-divided form, whereof pulverized coal, coke, or charcoal are typical instances. One method heretofore suggested for burning fuel of this character has consisted in injecting it into a furnace by means of an air-blast, which serves not only to mechanically convey the fuel to the region of combustion, but to supply the oxygen necessary for the support of the same. These conditions, however, while permitting the combustion of the fuel result in the production of a very intense flame within a restricted area with essential disadvantages—such as, for instance, the lack of diffusion of heat throughout a proper region of efficiency and the destructive effect of such a concentrated flame upon the furnace or other inclosure.

The object of my present invention is to afford a means whereby fuel of this character may be burned by means of an air-blast under such conditions as to abate the intensity of the combustion while increasing the efficient volume thereof, thus not only avoiding the destructive effect of a concentrated flame, but affording the most economical and best calorific results for practical purposes.

Broadly speaking, the general principle of operation characteristic of the apparatus depends upon the fact that when water either mechanically divided into spray or previously vaporized into steam is brought into contact with highly-heated carbon a reaction takes place resulting, primarily, in the formation of carbon monoxid and hydrogen. I have discovered that by properly combining with the finely-divided carbonaceous fuel which is undergoing combustion a jet of water in the form of spray or steam this reaction will occur and will result in the continuous formation and practically immediate combustion of a relatively large volume of gaseous fuel. By this means the intense local flame which would otherwise be due to the combustion of the solid fuel is avoided and the area of combustion is greatly increased, so that the total calorific effect undergoes no substantial diminution, while, on the other hand, the practical efficiency and economy are greatly increased, for the reasons above explained.

I will now proceed to describe, by reference to the accompanying drawings, a typical apparatus or burner embodying my invention.

The external body of the apparatus, which may conveniently be termed the "burner-tube" A, is formed of metal or other sufficiently refractory material and preferably has a cylindrical rear portion A′, a converging central portion A^2, and a cylindrical front portion or discharge end A^3 of diminished diameter. The rear end of the burner-tube is closed by a disk B, screwed therein. Within the burner-tube A is a correspondingly-shaped plug C, which is somewhat shorter than said tube, so as to leave an open chamber C′ at the rear portion thereof. The rear portion of the plug C is of sufficiently less diameter than the internal diameter of the cylindrical rear portion A′ of the burner-tube to leave a free annular interspace a. The central portion of the plug C is tapered in conformity with the tapering inner surface of the part A^2, thus forming an annular interspace, as shown at a', whose area can be varied or entirely closed by shifting the plug lengthwise with relation to the burner-tube. The diameter of the front end of the plug C is such as to leave a free annular opening a^2 at the orifice. The plug C is adjustably mounted within the burner-tube by means of a screw-stem D, whose threaded portion d engages with a correspondingly-threaded opening in the disk B, the stem being connected with the plug by means of the head d', which lies in a recess in the end thereof and engages rotatably beneath a plate d^2, secured to the rear face of the plug.

The disk B is provided at its central portion with a stuffing-box *b*, through which passes a tube E, running axially through the plug C and terminating some distance beyond the end thereof in a nozzle E′, whose internal periphery tapers slightly toward the orifice thereof, as shown in the sectional view of Fig. 1. Said tube E fits snugly within the plug, but is capable of longitudinal adjustment with relation thereto.

Within the tube E a tube F is concentrically arranged, the internal diameter of which is such as to leave an annular interspace *e* throughout the whole length of the combined tubes, the front or discharge end of the tube F being externally tapered, as indicated at F′, in substantial correspondence with the tapering inner surface of the tube E. The tube F has a threaded portion *f*, which engages with a correspondingly-threaded opening in a disk E^2, secured across the rear end of the tube E. The tube F is connected with a source of water or steam supply, (not shown in the drawings,) the admission of water or steam being controlled by the valve *f*′. Near the rear end of the tube E radial holes *e*′ are formed, which communicate with the open space or chamber C′ at the rear end of the burner-tube A behind the plug C.

An air-pipe G, controlled by a valve *g*, leads from any convenient source of air-supply under pressure to the said chamber at the rear portion of the burner-tube. A supply-pipe H for the finely-divided solid fuel leads to the burner-tube A at a point nearly opposite to the rear part of its converging portion. Said pipe has preferably a hopper-shaped lower end, as shown at *h*, and is provided with a fuel-feeding device, which may conveniently be constructed in the form of a cylinder I, having pockets *i* formed in spiral lines at radial intervals, the pockets of any given line registering with holes J, formed through the wall of the burner-tube A. Said cylinder I fits snugly, but so as to rotate freely, in a seat formed at the bottom of the tube H and may be actuated by means of a pulley I′, mounted upon the protruding end of the shaft I^2. Thus as the cylinder I is rotated a practically continuous series of discharges of fuel will take place through the holes J as the pockets, filled with their charges of pulverized material, are successively turned downward into juxtaposition with said holes. As the cylinder I fits snugly in its seat, any escape of air past the same is prevented by the peripheral portions which intervene between the respective lines of pockets.

It will be observed that the essential operative elements of the apparatus above described admit of adjustment and regulation with reference to one another. Thus the plug C can be shifted longitudinally, so as to enlarge or diminish the annular space *a*′ in the converging portion of the burner-tube, and also by shifting said plug into its extreme forward position the opening can be entirely closed. The tubes F and E may be shifted longitudinally with relation to the plug C and to the burner-tube, this latter adjustment being permitted by the stuffing-box *b*. The tube F may also be adjusted with relation to the tube E by means of the threaded portion *f*. The feed of solid fuel can be regulated by varying the speed of rotation of the pulley I′. The air-supply and supply of water or steam can be independently regulated by means of the respective valves *g* and *f*′.

The operation of the device is as follows: Air under pressure is admitted through the pipe G into the chamber C′ in rear of the plug C. A portion of the air passes through the openings *e*′ into the pipe E and is discharged at the nozzle E′. The greater portion of the air-blast passes out through the annular space between the plug C and the burner-tube A, issuing at a^2 in the form of an annular jet. The finely-divided solid fuel is fed in through the holes J and as it falls upon the surface of the plug is dispersed and forced outward from the nozzle a^2, where, being ignited, it forms an annular flame, as indicated at K. Water or steam is admitted through the pipe F and issues at the nozzle F′, where it is commingled either in the form of spray or as steam with the surrounding air-blast issuing from the nozzle E′. In thus issuing forth the mixed stream of air and watery vapor is diffused, as indicated at L, and comes into contact with the highly-heated carbon in the inner stratum of the annular flame K. Here the reaction occurs whereby the vapor is decomposed to form carbonic oxid and hydrogen, and the gases thus obtained in relatively large volume are at once ignited and consumed in an elongated blast. The resultant diffused flame is well adapted for use under all those conditions where it is desirable to have heating-contact throughout a large area and without excessive local intensity, one application for which it is especially advantageous being in connection with steam-boilers. The adjustability of the apparatus in the respects heretofore indicated enables the operator to regulate the several coöperating elements, so as to give the best results with any particular solid fuel which is used at the time.

Having thus described a typical and preferred form of apparatus embodying my invention, I deem it proper to state that I do not limit myself to the exact mechanical construction shown nor to the precise details of operation above specified.

For convenience of phraseology in my claims I refer to the solid fuel as "pulverized" without, however, meaning to limit myself to any particular degree of fineness in the subdivision of the fuel, nor do I mean to exclude the use of other fuel, such as some form of hydrocarbon, in conjunction with the solid fuel.

I claim—

1. The combination, of a burner-tube; a

plug arranged within the same, to afford a free interspace between the proximate surfaces of the plug and the burner-tube; an air-blast pipe communicating with the interior of the burner-tube; means for supplying pulverized solid fuel to said interspace; a water-pipe running longitudinally through said plug and having a discharge-orifice within the discharge-orifice of the burner-tube; and an air-pipe, surrounding said water-pipe and having a discharge-orifice adjacent to the discharge-orifice of the water-pipe, the interior of said air-pipe communicating with the interior of the burner-tube, substantially as set forth.

2. The combination, of a burner-tube having an internally-tapering portion; a tapering plug arranged within the same to afford a free interspace between the proximate surfaces of the plug and burner-tube; means for adjusting said plug longitudinally with relation to the burner-tube; means for supplying pulverized solid fuel to the interspace between said plug and burner-tube; an air-blast device communicating with the interior of the burner-tube; and means for diffusing watery vapor within the region of discharge of the burner, substantially as set forth.

3. The combination, of a burner-tube; a plug arranged within the same, to afford a free interspace between the proximate surface of the plug and the burner-tube; an air-blast pipe communicating with the interior of the burner-tube; means for supplying pulverized solid fuel to said interspace; a water-pipe running longitudinally through said plug and having a discharge-orifice within the discharge-orifice of the burner-tube; an air-pipe surrounding said water-pipe and having a discharge-orifice adjacent to the discharge-orifice of the water-pipe, the interior of said air-pipe communicating with the interior of the burner-tube; and means for adjusting said air-pipe longitudinally with relation to the water-pipe, substantially as described.

4. The combination of a burner having a definite annular discharge-orifice and an interior chamber communicating with said orifice; means for supplying pulverized solid fuel to said chamber; means for supplying to said chamber an air-blast adapted to project said solid fuel through said orifice; means for regulating said air-blast; means for supplying and discharging watery vapor within the area surrounded by said annular orifice; means for regulating said watery-vapor discharge; means for supplying and discharging a distinct air-blast within the area surrounded by said annular orifice; and means for regulating said last-mentioned air-blast, substantially as and for the purposes set forth.

5. The combination of a burner-tube; a plug of less diameter arranged therein to afford an annular interspace and discharge-orifice; means for supplying pulverized solid fuel to said interspace; means for regulating said supply of solid fuel; means for supplying an air-blast to said interspace; means for supplying and discharging watery vapor within the area surrounded by said annular orifice; means for regulating said discharge of watery vapor; means for supplying and discharging a distinct air-blast within the area surrounded by said annular orifice; and means for regulating the said air-blasts, substantially as and for the purposes set forth.

JOHN W. BAILEY.

Witnesses:
E. J. BUNKER,
CHAS. EDGAR MILLS.