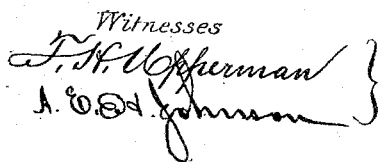


*Distributing (and) Feeding Powdered Fuel
to Furnaces.*

PATENTED FEB 7 1871



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IMPROVEMENT IN APPARATUS FOR DISTRIBUTING AND FEEDING POWDERED FUEL TO FURNACES.

Specification forming part of Letters Patent No. 111,615, dated February 7, 1871.

To all whom it may concern:

Be it known that I, THOMAS RUSSELL CRAMPTON, of Westminster, London, in the county of Middlesex, in the Kingdom of Great Britain, have invented a new and useful Apparatus for Distributing and Feeding Powdered Fuel to Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the same, which will enable those skilled in the art to which my invention appertains to construct and use the same.

In a patent bearing even date herewith I have described and represented an apparatus for feeding, regulating, dividing, conducting, and discharging powdered fuel to furnaces adapted for burning fuel-charged air, in which the feeding is effected by rollers supplied directly from a hopper.

My present improvements relate to supplying the feeding-rollers by screw-conveyers or other means, in such manner as to keep them always supplied with more than the required amount of fuel, and to carry the surplus away, to be again returned to the feeding-rollers.

In this way I continuously circulate the surplus fuel over the feeding-rollers; and, in carrying out this object, I use two hoppers, one of which serves to supply the feeding-rollers, while the other receives surplus fuel passing from the feeders, and vice versa, thus alternately using the hoppers as delivering and collecting hoppers to supply one or more feeding and conducting apparatus for one or more furnaces from a single conveyer which unites the two hoppers.

My present improvements also relate to supplying to each furnace a uniform degree of pressure without regard to any difference of pressure in the main pipe supplying the several furnaces, caused either by disconnecting one or more furnaces, the fluctuations of the blower, or other causes, the minimum pressure in the main pipe being always equal to the pressure required at the furnace. Moreover, when all the furnaces are at work there are still causes which make it impossible to supply a uniform pressure to several branches, as it is found that a number of branch pipes supplied with air from one main at any consider-

able velocity and pressure have a greater or lesser difference of pressure from each other and from the main pipe, according to the position and nature of the connections and bends in the branches.

To counteract the bad effects resulting from the irregularity of pressure, I employ a regulator, interposed between the main supply-pipe and the air-nozzles, so adjusted as to maintain a uniform pressure of any desired degree. By this means I am enabled to work several furnaces with the same or different uniform pressures.

The degree and uniformity of the several pressures are not influenced by any change of pressure in the main supply-pipe so long as the minimum pressure is equal to the pressure required.

It is found that when two or more furnaces are supplied with air from one and the same main, and the supply of air is equal to the requirements of all the furnaces, if such supply of air from one or more furnaces should be stopped off, then there would be a corresponding excess in the remaining furnaces.

As it is essential to perfect combustion to maintain a uniform supply of air to the furnace, and as my invention accomplishes this thing, the regulator is, therefore, an important feature in the new combination in which it is used.

The accompanying drawing represents a vertical longitudinal section of an apparatus adapted for feeding powdered fuel to furnaces embracing my invention, and in which the fuel-hoppers A A' are shown as being arranged near the ends of a conveying-trough, B, with which the hoppers communicate.

The hoppers are constructed, by preference, with vertical sides, and are provided with stirrers C, of any suitable construction, and so arranged at the bottom that the whole area of the fuel contained in each hopper is disturbed by their action. The working of these stirrers forces the fuel from the hopper through an opening, *a*, at its side into the conveying-trough. The openings *a a'* in the hoppers are fitted with slide-doors *b b'*, by which they may be closed and opened, as will be hereinafter more fully described.

The conveying-trough B is provided with a

screw-conveyer or worm, D, so that the folds or vanes thereof shall revolve near the bottom of the trough. Openings *c* are made in the bottom of the trough, and beneath each a suitable distance I arrange a pair of feeding-rollers, E and F, corresponding to the number of furnaces used, communication being had between the feeders and the conveying-trough by means of shallow boxes *d* abutting on the rollers so as to maintain an inclined position, and thus form limited supply-chambers, which are kept constantly filled with powdered fuel, in a position to be drawn regularly therefrom between said rollers. The lower of these rollers, E, is provided with a funnel, G, into which enter the receiving ends of the dividing-pipes H². These feeding-rollers, and their adjustment and relation to the receiving and dividing pipes H², being fully represented and described in my patent aforesaid, need not be more particularly referred to here.

Now, it will be observed that one or the other of the hoppers is always supplying one end of the screw-conveyer, and that as the latter is revolved the powdered fuel is carried along over the openings of the limited supply-chambers *d*, and fills them on a level with the bottom of said trough, while the surplus is continued on to the opposite end of the trough into a receptacle, *e* or *e'*, at the end thereof, from whence it is delivered into the hopper A', to be reconveyed through the trough to supply the feeders, the surplus going into the same hopper from which it came by any suitable means; or it may be lifted by means of an elevator, or otherwise, into the hopper.

This reconveying is effected by reversing the motion of the screw-conveyer D, opening the outlet *a'* of the hopper A', and closing the opening of the hopper A. The surplus fuel will pass back through the trough to the feeding-rollers into the receptacles *e*, and be elevated into the hopper from which it was first fed.

In the example shown, these elevators consist of endless bands of buckets H H¹, passing around pulleys I I¹ arranged within the receptacles *e* and *e'* at each end of the trough, and pulleys I² and I³, supported just above the top of the hoppers, so as to cause said bands of buckets to incline toward the hoppers, so that the buckets will fill as they pass into the receptacles for the surplus fuel, and be discharged as they turn the upper pulley into the hopper. In this way the hoppers containing the powdered fuel can be used alternately as supply or collecting hoppers, as required, the fuel, in either case, being forced out of the hoppers by the stirrers in excess of that required for the feeding-rollers, and thus insuring a constant supply to the mechanism of a number of furnaces at the same time and by the same device.

The screw-conveyer, feeding-rollers, and elevating devices may be actuated by any well-known means, arranged in any desired manner, and according to the position of the whole

apparatus; but as such means for communicating motion from one device to another are clearly within the skill of the artisan, the representation of the connections which each part should have of themselves or with each other is deemed unnecessary.

The screw-conveyer may be driven at the required speed, and its motion reversed when necessary, by any suitable means.

The openings *c* in the trough may be provided with slides *f*, by which they may be closed or regulated, as desired.

The hopper A is supplied direct from the grinding apparatus or from the store of fuel, in any suitable way.

It should be observed that although the drawing shows one line of screw and feed rollers, it is evident that furnaces requiring feeding, which are not in the line, can be supplied from lateral screws supplied from the main screw; and in some cases the fuel may be so conveyed from one supply-hopper passing out of the straight line and carried by diverging screws, and the end terminating at the hopper from which the fuel originally was supplied, the surplus fuel passing into said hopper without reversing the screw, as before alluded to.

In the drawing I have shown a blower, J, a main supply-pipe, K, and branch pipes L, in connection with each other and the air-nozzles *g*; but it is obvious that the construction and arrangement of these parts may be varied to suit the purpose and convenience.

The blower J may be of any desirable character and attached directly to the main supply-pipe K, and from the latter the branch pipes L lead to and connect with the supply-chambers M of the air-nozzles. Upon these branch pipes L the regulators are arranged, so that the air passing through said pipes must pass through said regulators and have its pressure governed thereby. These regulators may be of any suitable construction; but I prefer to use a well-known kind, consisting of a water-cistern, N, in which is placed an inverted cup, O, inclosing the ends of the receiving and discharging pipes. These pipes enter the cistern at the center of its bottom and extend up some distance above the water-line, the receiving-pipe P being placed concentrically within the exit-pipe Q, so as to leave an annular space, *i*, equal to the area of the receiving-pipe.

The top of the receiving-pipe P is partially covered by a fixed rim through the opening *n*, in which is a movable cone, R, suspended from the top of the inverted cup. The base of this cone projects into the receiving-pipe, and is of greater diameter than the opening in the rim of said pipe.

From this construction of regulator it will be observed that, when the pressure is not in excess of that for which the cup is weighted, the passage between the cone R and the rim is equal to the full area of the supply-pipe; but when the pressure exceeds that intended the inverted cup O is thereby forced upward, and with it the cone, until the opening around

the cone is sufficiently reduced to diminish the pressure in the cup until it equals the pressure of the weight upon the cup. At this point an equilibrium will be established, and the force of the air going into the furnace will not be in excess of the pressure intended, whatever may be the pressure in the supply-pipe from the fan or blower.

The pressure of air supplied to the furnace may be varied to any desired degree by changing the weights upon the top of the cup.

The regulator is made tight by the ordinary water-joint.

The branch pipes L may be provided with cut-off valves, if desired.

Having described my invention, I claim—

1. In an apparatus for feeding powdered fuel to furnaces, the combination of the feeding-rollers E and F with the trough B, screw-conveyer D, and the intermediate limited supply-chambers *d*, arranged and operating so that the latter will be kept constantly filled with fuel irrespective of the direction in which the fuel is moving in the trough, as described.

2. The combination of the hoppers A and A' with the trough B, screw-conveyer D, and elevating-buckets H and H', constructed, arranged, and operating so that while one hop-

per is supplying the fuel to the feeding apparatus for one or more furnaces the other will collect the fuel not taken from the conveyer by said feeders, and vice versa, as described.

3. The pressure of a series of furnaces, regulated and controlled automatically, to the same or different uniform degrees for each furnace from one and the same supply of air, as described.

4. In combination with an apparatus for feeding several furnaces from one supply with powdered fuel and air, and a fan or blower, a regulator interposed between the furnace or furnaces and the blower, as described.

5. In apparatus for feeding, regulating, dividing, conducting, and discharging powdered fuel into furnaces, the combination of the supply-hoppers A A', the conveyer D, the feeding-rollers E F, the receiving and conducting pipes H² and S with the branch pipes L, air-regulators, air-main, and blower, substantially as described.

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