

[54] **CONVEYOR INSTALLATION WITH A SCREW CONVEYOR**

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[58] Field of Search..... **110/8 R, 18 R, 101 R, 109; 100/95 R, 98 R**

[56]

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[57]

ABSTRACT

In a furnace, a conveyor arrangement with a screw conveyor for such solid combustible material as wood waste, a means for equalizing or balancing any variations in the weight of the material by volume.

11 Claims, 6 Drawing Figures

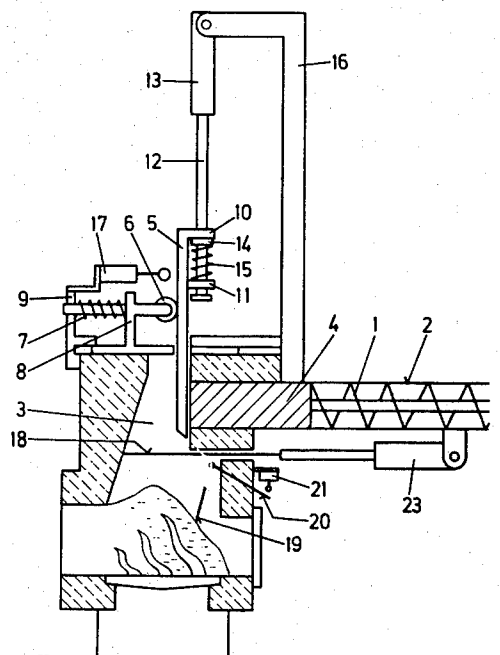


FIG. 1

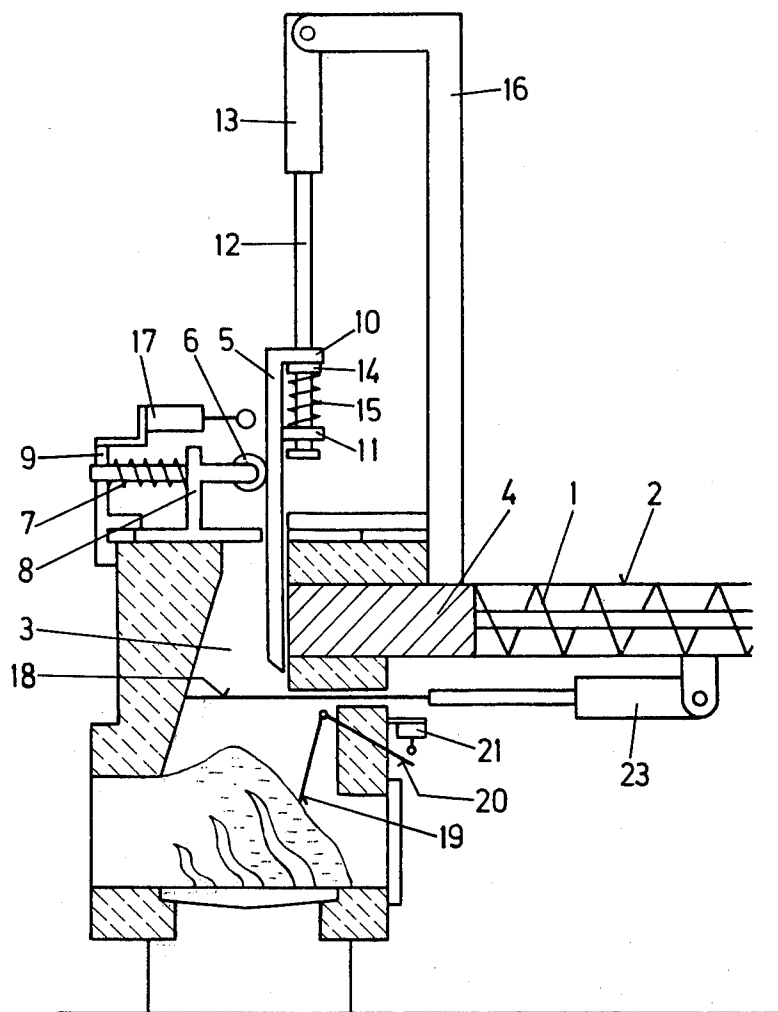
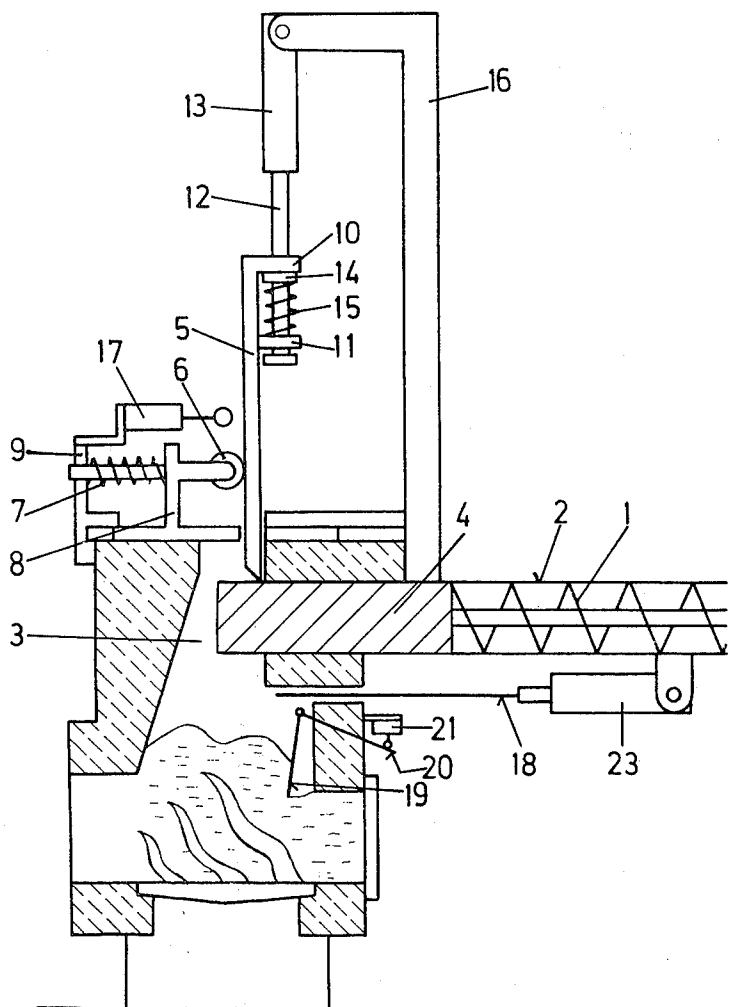


FIG. 2



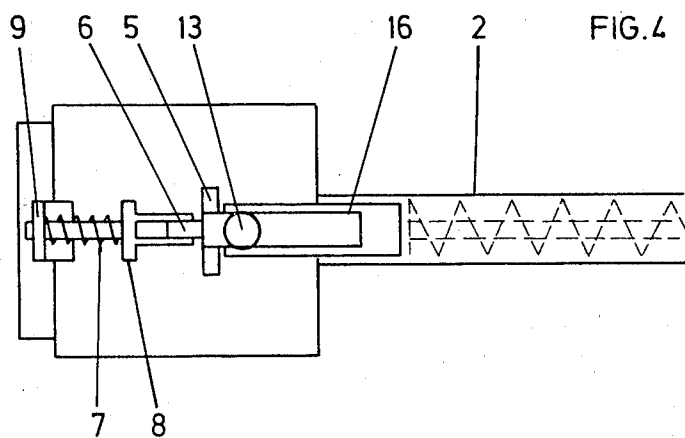
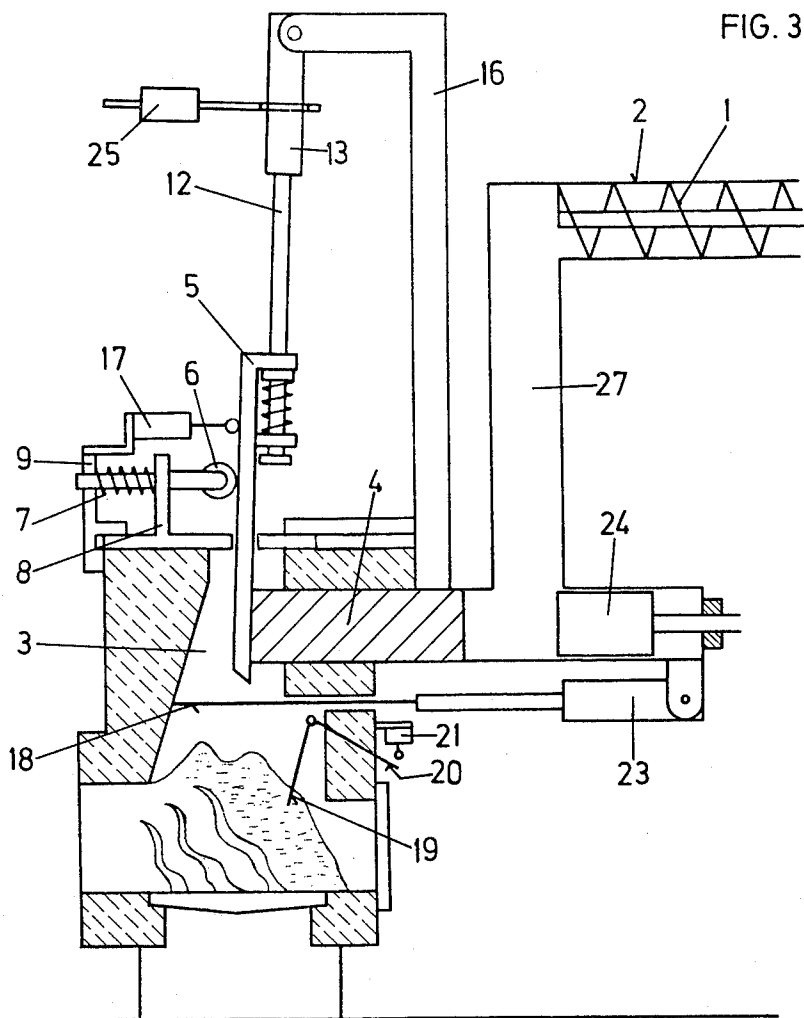


FIG. 5

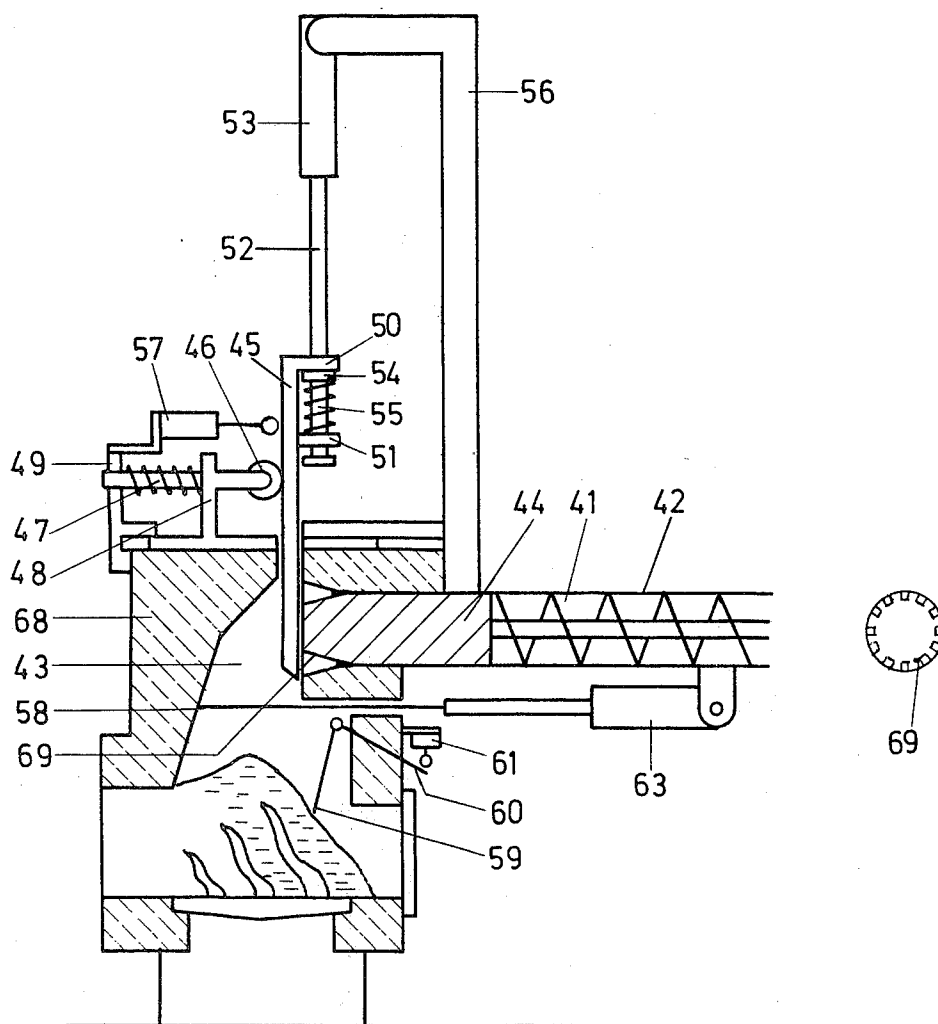
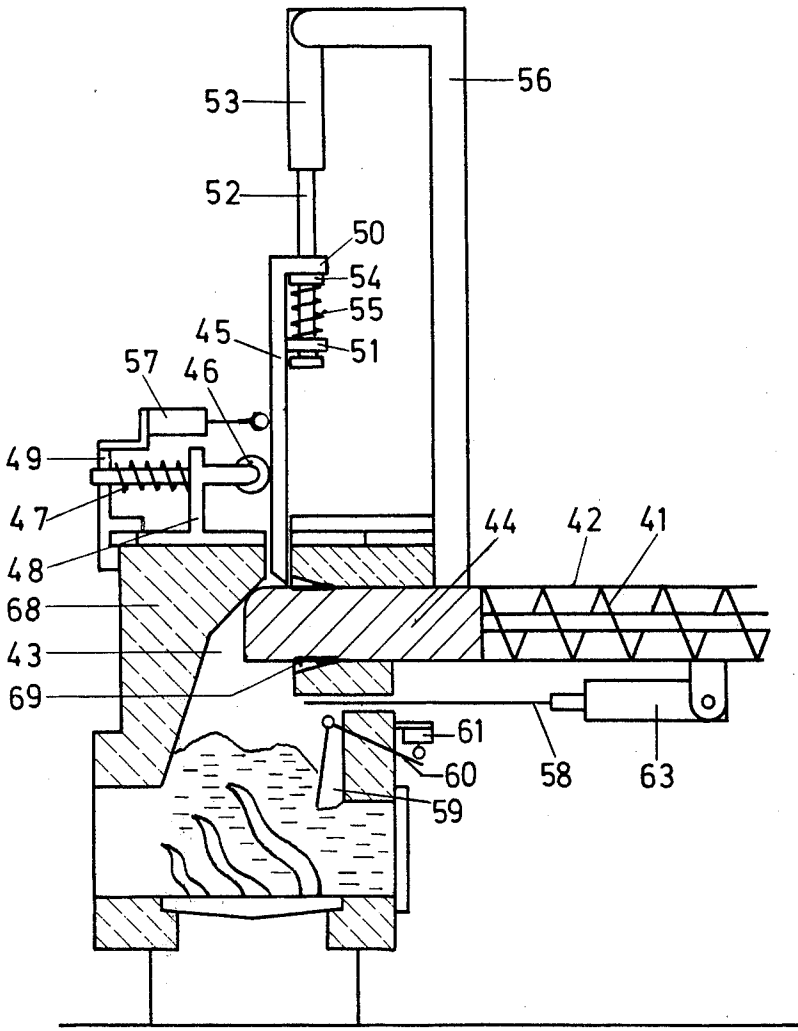


FIG.6



CONVEYOR INSTALLATION WITH A SCREW CONVEYOR

The present invention relates to a furnace arrangement including a conveyor installation with a screw conveyor for solid combustible material, more particularly wood waste or chips, whose weights by volume vary at times.

In order to produce a combustion which is as complete as possible, the fuel introduced into the combustion chamber must be in a predetermined and as far as possible constant ratio with the quantity of air for combustion. The conventional conveyor installations feed a certain weight by volume of fuel to such furnaces by means of screw conveyors. Since different types of such wood wastes usually occur at random in the fuel bunkers from which the screw conveyors extract the fuel consisting of wood waste, i.e., they are badly mixed and often in layers, as for example light shavings and heavy sawdust, these known conveyor installations usually convey at short intervals fuels having greatly varying weights per unit volume into the furnace. Consequently, there is always a strongly varying fuel quantity supplied to the same furnace chamber and in relation to the predetermined combustion air quantity. The furnaces are thus alternately overloaded or underloaded with fuel, the good mixing of the combustion gases with the air for combustion seldom occurs and the firing temperature is accordingly often too low. This leads to the well known inadequate combustion installations which no longer satisfy the conditions for environmental protection. In addition, with such installations, the danger exists of a back firing from the furnace chamber into the bunker or hopper for the wood waste.

German Pat. No. 63,923 describes a machine for pressing plastic masses, which comprises a pressing member disposed inside the pressing chamber. This pressing member inside the pressing chamber can consequently only be used for pressing fluid plastic compositions because the compressed material ejected from a compression chamber with a pressing member mounted in front of it cannot possibly be forced through beneath a rotatable surface of this pressing member firmly anchored in the pressing chamber since this pressed material already compressed to a certain volume is much too solid.

This construction, which shows a machine for dehydrating plastic compositions, is consequently unsuitable for being used for the purpose according to the invention.

In German Pat. No. 591,629, the compression of the fuel is effected by the combustion tube and the screw tapering towards their outlet end. This method of compressing the fuel produces an irregular weight by volume of the fuel because the compression of the fuel is effected according to the tapering of the screw and of the burner tube and not according to the counteracting pressure of a presser member arranged following the chamber. The compression takes place exclusively according to the tapering of the burner tube and it cannot be adjusted or altered. Consequently, there is no balancing of the weight by volume but only a uniform reduction of the volume of the fuel.

The invention has for its object the design of a conveyor installation which largely avoids this disadvantage which is caused by the changing weight by volume of the fuels, the invention improving the safety against back firing of the conveyor installation.

The conveyor installation according to the invention is characterized by a means for equalizing or balancing the changes in the weight by volume of the solid combustible material.

Preferred embodiments of the invention are hereinafter explained merely by way of example and by reference to strictly diagrammatic figures, wherein:

FIG. 1 is a longitudinal section through a conveyor installation with a slide member or damper arranged in front of the fuel chamber outlet and also a furnace chamber which is covered by a second damper.

FIG. 2 is a longitudinal section through the conveyor installation of FIG. 1, with the first damper withdrawn and the furnace chamber opened.

FIG. 3 is a longitudinal section through a conveyor installation similar to FIG. 1, with the first damper applied under pressure and a pressing piston for the initial pressing of the combustible material in the pressing chamber.

FIG. 4 is a plan view of the conveyor installation according to FIGS. 1 to 3.

FIG. 5 is a longitudinal section through another conveyor installation with a damper arranged before the fuel chamber outlet, a spring ring provided with resilient tongues mounted before the damper and for compressing the conveyed wood waste and also with a furnace chamber covered by a second damper.

FIG. 6 is a longitudinal section through the conveyor installation according to FIG. 5 in the position for feeding, immediately before the shutting off thereof upon reaching the upper fuel level in the combustion chamber.

The conveyor installations which are shown in FIGS. 1 to 4 comprise screw conveyor 1 which is mounted in conveyor trough 2. The conveyor trough 2 is continued either directly (according to FIGS. 1, 2 and 4) or by way of a gravity shaft 27 (according to FIG. 3), into pressing chamber 4. The pressing chamber 4 opens into furnace chamber 3. The screw 1 terminates in front of pressing chamber 4. In this chamber 4, the combustible material conveyed by screw 1 is compressed by screw 1 itself or by piston 24 (FIG. 3) so that no immovable plug is able to be formed in chamber 4, the chamber being widened conically towards the outlet thereof. In order to press in chamber 4 the wood waste materials which arrive with a varying weight by volume, damper 5 is disposed before the outlet of the chamber, the damper shutting off chamber 4 from the furnace chamber side. A roller 6, which is loaded by spring 7 (FIGS. 1 and 2), bears against damper 5 and holds it in the closed position against the force of the fuel to be compressed in chamber 4. As well as or instead of loaded roller 6, it is possible to provide counterweight 25 (FIG. 3). By adjustment of spring 7 and of counterweight 25, respectively, the pressing force which acts on damper 5 can be adjusted, as required, so as to make possible the suitable setting of an optimal weight by volume of the fuel. The roller 6 is secured in holder 8 which at the same time partially covers furnace chamber 3 and is displaceably mounted in guide means 9. The damper 5 is displaceably fixed in guides 10 and 11 and on push rod 12 of thrust motor 13. The push rod 12 is provided with holding ring 14. With outward movement of push rod 12 from thrust motor 13, holding ring 14 presses on spring 15 which, in turn, slides the damper against that end of the fuel plug meanwhile ejected from chamber 4. The free end of slide member or damper 5 is formed as a cutting edge so that, when

damper 5 is pushed out downwardly, the plug of fuel emerging from chamber 4 is cut off at the outlet of chamber 4 and the latter is closed by damper 5. If the damper is, for example, unable to cut through the combustible material because of a foreign body in the latter, spring 15 is compressed and neither a blocking of thrust motor 13 nor a permanent deformation or breakage of a component of the conveyor installation is caused. The thrust motor 13 for its part is pivotally fixed on holding means 16.

Arranged above guide means 9 for roller 6 is limit switch 17. If slide member or damper 5, and thus holding device 8, is forced back against the pressure of spring 7 by the fuel leaving chamber 4, damper 5, after a certain outward swinging movement (FIG. 3) actuates limit switch 17 which switches on thrust motor 13. Together with motor 13, another thrust motor 23 is also switched on, this latter motor retracting second damper 18 which is connected to it and which closes the furnace chamber in an upward direction so that the access to furnace chamber 3 becomes free. After the upward movement of damper 5, this is once again forced into its closing position by spring 7 as regards pivotal angle (vertical position according to FIG. 2), but is disposed above the plug of fuel issuing from the chamber. The thrust motor 13 is so adjusted that slide member or damper 5, after swinging back into its normal position, is immediately pushed again into the initial position before the outlet of pressing chamber 4 and cuts off the plug of fuel which has previously been discussed and which falls from above into furnace chamber 3.

This supply of fuel is continued automatically until the fuel loaded in the furnace chamber presses against pivoted flap 19 which operates switch 21 through lever 20. By this means, the supply of fuel is shut off until the fuel is suitably consumed, whereupon flap 19 is relieved and once again swings back into its horizontal initial position. With the embodiment according to FIGS. 1 and 2, both the conveying action and also the pressing of the fuel in pressing chamber 4 are effected by means of screw 1, whereas in the embodiment according to FIG. 3, the compressing of the fuel to a weight by volume which is as far as possible uniform is effected by piston 24.

The installation as described is extremely simple in its construction and is consequently reliable in operation. Despite the occurrence of different weights by volume in the conveyor installation, it permits a feeding of a substantially constant quantity of fuel per unit of time, so that the combustion can take place with the best possible composition.

The fuel compressed in the conveyor installation naturally offers an excellent safeguard against back-firing from the furnace installation into the fuel bunker.

By comparison with the conventional conveyor installations, the following novel features are also especially to be mentioned:

The arrangement of a pressing chamber immediately above the furnace chamber for the uniform compression of fuel which arrives irregularly and in non-homogeneous form, the compression being able to be effected either directly with the screw conveyor or by means of a special piston, pneumatically, hydraulically, electrically or mechanically.

The compression ratio of the arriving fuel can be modified with easy access from outside.

In order to prevent a blocking of the chamber after the pressing of the fuel has taken place, the chamber is widened slightly conically towards its outlet.

When the appropriately adjusted fuel density has been reached or when the adjusted opening force has occurred, the slide member or damper, swung out from its normal position, is drawn upwardly, swung back into its normal position and pushed downwardly, and with the sliding and closing movement, it simultaneously separates the projecting plug of fuel from the remainder of the combustible material in the chamber 5. By synchronizing the opening movement of closure damper 18 of furnace chamber 3 and the ejection of the fuel, and also of the movement of closing and cutting damper 5, furnace chamber 3 is directly connected to the fuel bunker only for a very short time period.

A special sensing member, constructed as a flap, shuts off the conveyor installation as soon as the furnace chamber has been filled to a certain fuel level. When the level falls below a certain low position, the supply of fuel is switched on again, controlled by this flap. A suitable resilient connection between thrust motor and damper makes impossible a deformation of these parts, due to solid foreign bodies in the cutting plane of the damper closing the chamber, so that a blocking of the motor likewise cannot occur. Since in this case no fuel drops into the furnace chamber, the conveying of fuel continues to take place and the damper will cut through the fuel plug as soon as the foreign body is completely ejected from the chamber.

The installation can be so arranged that, when the conveyor installation itself is stationary, the chamber outlet is in every case closed off by the damper.

Differing from the conventional conveyor installations, which convey an adjusted quantity by volume with a variable weight by volume per unit of time, it is possible with the installation which has been described hereinabove to obtain a set quantity by volume with a practically constant weight, i.e., a fuel with a weight by volume which remains constant, and to supply it to the furnace chamber. As a result, an optimal combustion is also guaranteed in practice without any traces of smoke. When using such a conveyor installation, it is no longer necessary to supervise the feeding of the fuel. Since it is necessary with the prior known installations which convey strictly by volume to have a constant adaptation as regards fuel quantity and combustion air quantity in order to achieve best possible combustion conditions, this operation being very difficult, this adaptation was usually not carried out with the necessary care or in fact not at all. It is in this respect that the present invention provides assistance.

The conveyor installation which is shown in FIGS. 5 and 6 comprises screw conveyor 41 which is mounted in conveyor trough 42. The conveyor trough 42 is directly continued into pressing chamber 44. This chamber 44 opens into furnace chamber 43. The screw ends before pressing chamber 44 wherein the combustible material, for example, wood chips, sawdust and the like, mixed with one another and conveyed by screw 41, is compressed by the screw 41 itself. So that no non-displaceable plug can be formed in chamber 44, chamber 44 is widened out conically towards its outlet end. In order that the wood waste forming with a varying weight by volume may be pressed in chamber 44 to a more uniform weight by volume, spring ring 69 having spring blades sloping towards the chamber axis are arranged immediately before the conical widened por-

tion, the blades conically reducing the passage cross-section towards the outlet and thus offering a suitable resistance to the forward movement of the wood waste by screw 41. This causes a compression of the wood waste conveyed by screw 41 to a size which depends on the tension of the leaf springs of spring ring 69. This tension can be adjusted within a certain limit. It is also possible to adapt this pressing force to the material being conveyed by replacing spring ring 69. Arranged at the outlet from conical chamber 44 is slide member or damper 45 which shuts off chamber 44 towards the furnace chamber side. A roller 46, which is loaded by spring 47, bears against damper 45. The force which acts on damper 45 can be adjusted, as required by adjustment of spring 47. The roller 46 is fixed in holding device 48 which at the same time partially covers furnace chamber 43 and is displaceably mounted in guide means 49. The damper 45 is displaceably mounted in guides 50 and 51 and on push rod 52 of thrust motor 53. The push rod 52 is provided with holding ring 54. With the projection of push rod 52 from motor 53, holding ring 54 acts on spring 55 which, in turn, moves the damper 45 towards that end of the fuel plug ejected from chamber 44. The free end of the damper 45 is formed as a cutting edge so that, with the downward movement of damper 45, the continuous length of fuel issuing from chamber 44 is cut off at the outlet of chamber 44 and the chamber is closed by damper 45. This position is shown in FIG. 5. It moves immediately to the position according to FIG. 6, in which the permitted fuel level in the combustion chamber is reached and thrust motor 53 is controlled to move into the closed position, as will hereinafter be explained.

If slide member or damper 45 is unable to cut through the combustible material because of a foreign body being in the latter, spring 55 is compressed and there is neither a blocking of motor 53 nor a permanent deformation nor a breakage of any component in the conveyor installation. The thrust motor 53 in its turn is pivotally fixed on holding means 56.

Arranged above guide means 49 for roller 46 is limit switch 57. When the combustible material is ejected from the chamber and reaches damper 45, the latter and thus also holder 48 is forced back by the fuel leaving chamber 44 and against the pressure of spring 47. The damper 45 then actuates limit switch 57 after a very small pivotal movement and the switch switches on motor 53. Simultaneously with motor 53, another thrust motor 63 is switched on, which retracts second damper 58 which is connected to it and which closes the furnace chamber in a downward direction so that the access to furnace chamber 43 becomes free. After the upward movement of damper 45, the latter is once again forced into its closed position by spring 47. However, damper 45 is disposed above the length of fuel emerging from chamber 44. The length of fuel is now pushed forwards, corresponding to continuously revolving screw 41, where the fuel is compressed in predetermined manner by the leaf springs of spring ring 69 and is conveyed in this condition with the leaf springs open to a greater or lesser extent, corresponding to FIG. 6. The combustible material is consequently compressed to a predetermined weight by volume. The continuous length leaves chamber 44 and the leaf springs of spring ring 69 and moves forward in a horizontal direction until it strikes against a wall of the combustion chamber formed as deflecting wall 68, as indicated in

FIG. 6, and breaks up. It then enters the combustion chamber, as will be seen in FIGS. 5 and 6.

This feeding of the fuel progresses automatically and continuously until the fuel filling the furnace chamber presses against pivoted flap 59 which operates switch 61 through lever 60. As a consequence, the feeding of the fuel is interrupted until the fuel is suitably burnt up, whereupon flap 59 is relieved of pressure and once again swings back into the horizontal initial position.

It is possible in this way for the compressed fuel discharged from pressing chamber 44 to drop continuously and regularly as regards quantity into the furnace or combustion chamber, this not being possible with the intermittent working procedure. However, this plays a part with certain fuels; with the operation of damper 45 at intervals, the fuel drops in the form of balls at short intervals into the combustion chamber. This intermittent supply of fuel leads to sudden fluctuations in the perfect conditions between air for combustion and fuel and this is undesirable.

Such disadvantages, which as occur with certain fuels, are largely reduced by the present embodiment, since the plug of fuel ejected from pressing chamber 44 is no longer cut off at intervals but the continuous length, with the forward feed, presses against deflecting wall 68, is thereby crumbled and drops in small fragments regularly into the furnace chamber. With this method of operation, it is possible to leave the feeding of the fuel in operation and without thrust motor 53 being operated at intervals until this supply is shut off by filling switch 61. The slide member or damper 45 is only opened at the commencement of the conveying of fuel and is immediately closed again when the conveying operation has ended.

In this way, a conveying installation is obtained which in practice ensures a continuous operation and supply of a fuel, more particularly wood waste, which has an approximately constant weight by volume.

I claim:

1. In combination, a furnace having a furnace chamber and a conveyor installation for supplying a solid combustible material to the furnace chamber, the conveyor installation comprising means for delivering the solid combustible material under pressure, a compression chamber having an inlet and an outlet, the delivering means being in communication with the compression chamber inlet to deliver the solid combustible material under pressure into the compression chamber, a closure member arranged to close and open the outlet of the compression chamber selectively, the compression chamber outlet being in communication with the furnace chamber, control means operative to maintain the closure member in the closed position until a predetermined force exerted by the compressed material in the compression chamber on the closure member moves the closure member to open the outlet and again moves the closure member to close the outlet after the pressure of the delivering means has ejected compressed material into the furnace chamber through the open outlet, and a control element in the furnace chamber actuated by the level of the material in the furnace chamber for deactivating the material delivering means.

2. In the combination of claim 1, the material delivering means being a screw conveyor feeding into the inlet of the compression chamber.

3. In the combination of claim 1, the conveyor installation comprising a screw conveyor having a delivery

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end, a gravity material conveying conduit between the delivery end of the screw conveyor and the inlet of the compression chamber, and the delivering means being a piston arranged to deliver the material from the conveying conduit to the inlet of the compression chamber under pressure.

4. In the combination of claim 1, the actuated control element also moving the closure member to close the outlet of the compression chamber.

5. In the combination of claim 1, the closure member being a damper arranged to be pivoted by the predetermined force to open the outlet, and the control means comprising means for loading the closure member with an adjustable force counteracting the pivoting of the damper.

6. In the combination of claim 5, the loading means being an adjustable spring.

7. In the combination of claim 5, the pivotal damper being slidable across the outlet, and the control means comprising a reciprocating means for sliding the damper into the open and closed position.

8. In the combination of claim 7, a yieldable member interposed between the reciprocating means and the damper.

9. In the combination of claim 7, the control means being arranged to operate the reciprocating means to slide the damper into the open position upon pivoting of the damper against the adjustable force, and to slide it into the closed position upon pivoting of the damper under the adjustable force in the open position, sliding of the damper from the open into the closed position

causing severing of the compressed material at the outlet of the compression chamber.

10. In the combination of claim 9, the damper comprising a forward cutting edge for facilitating severing of the compressed material.

11. In combination, a furnace having a furnace chamber and a conveyor installation for supplying a solid combustible material to the furnace chamber, the conveyor installation comprising means for delivering the solid combustible material under pressure, a compression chamber having an inlet and an outlet, the delivering means being in communication with the compression chamber inlet to deliver the solid combustible material under pressure into the compression chamber, a closure member arranged to close and open the outlet of the compression chamber selectively, the compression chamber outlet being in communication with the furnace chamber, and control means operative to maintain the closure member in the closed position until a predetermined force exerted by the compressed material in the compression chamber on the closure member moves the closure member to open the outlet, the pressure of the delivered material against the closed closure member producing an air flow restraining and backfire preventing plug of the material in the compression chamber, and again to close the closure member after the pressure of the delivering means has ejected compressed material into the furnace chamber through the open outlet.

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