June 23, 1970 J. B. STRIBLING 3,516,370

FURNACES

Filed April 18, 1968 3 Sheets-Sheet 1

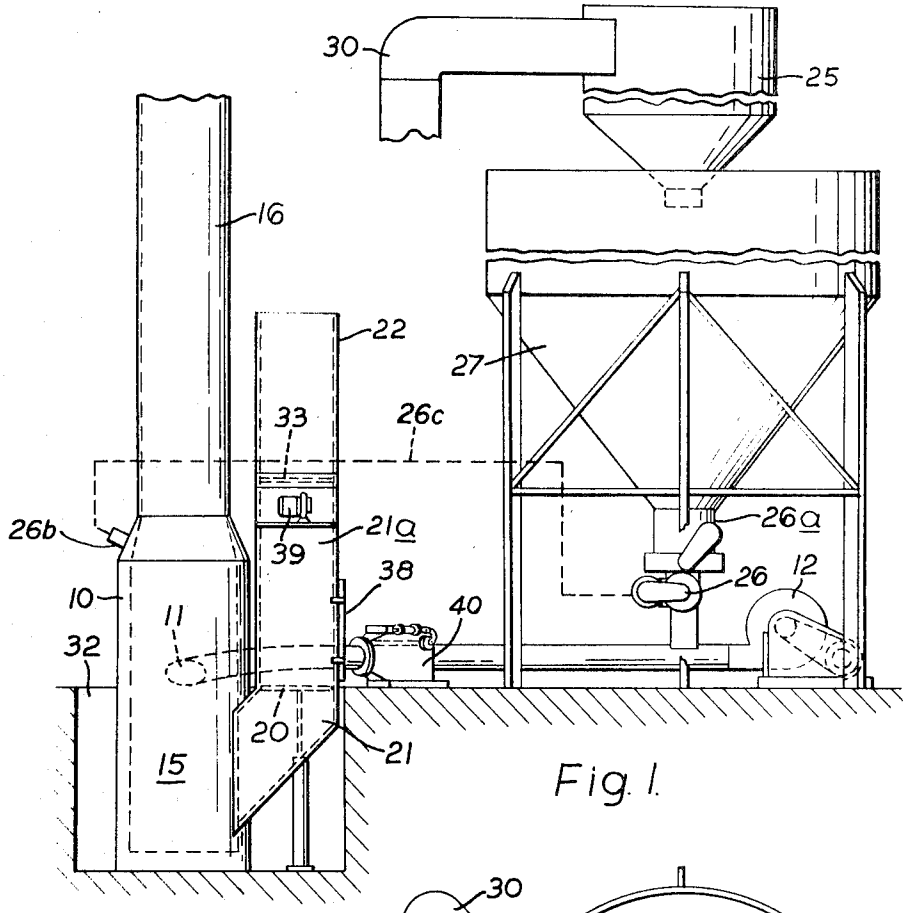


Fig. 1.

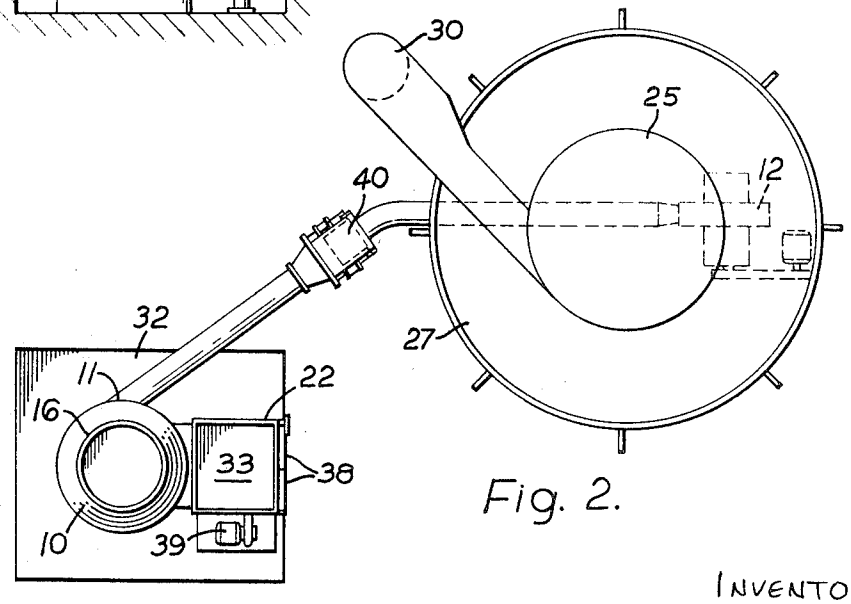


Fig. 2.

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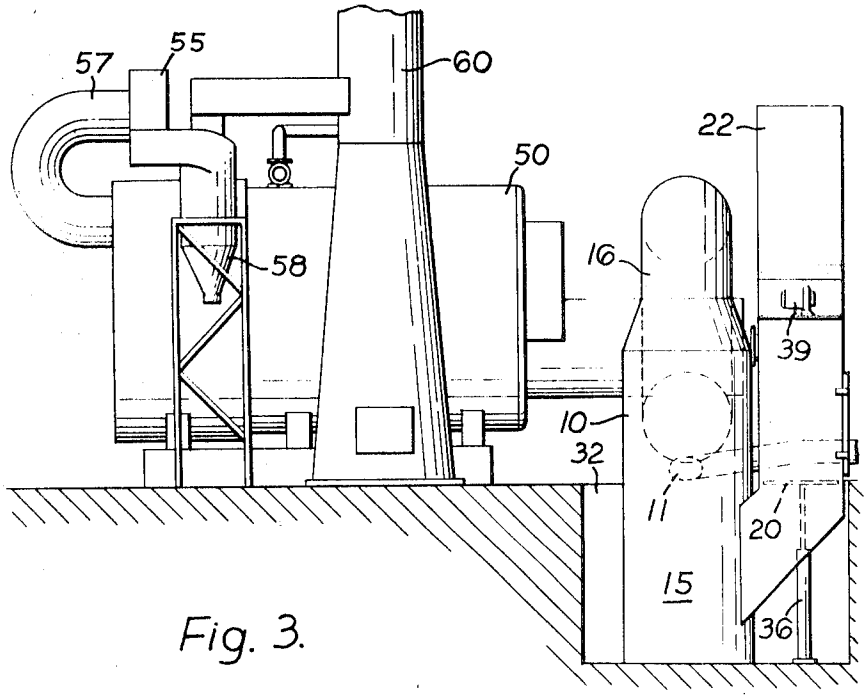


Fig. 3.

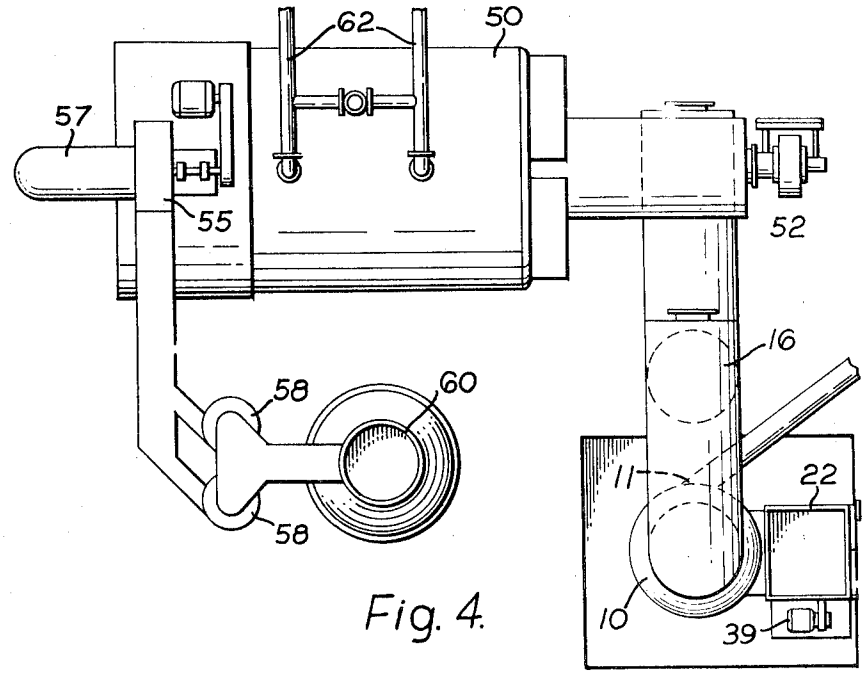


Fig. 4.

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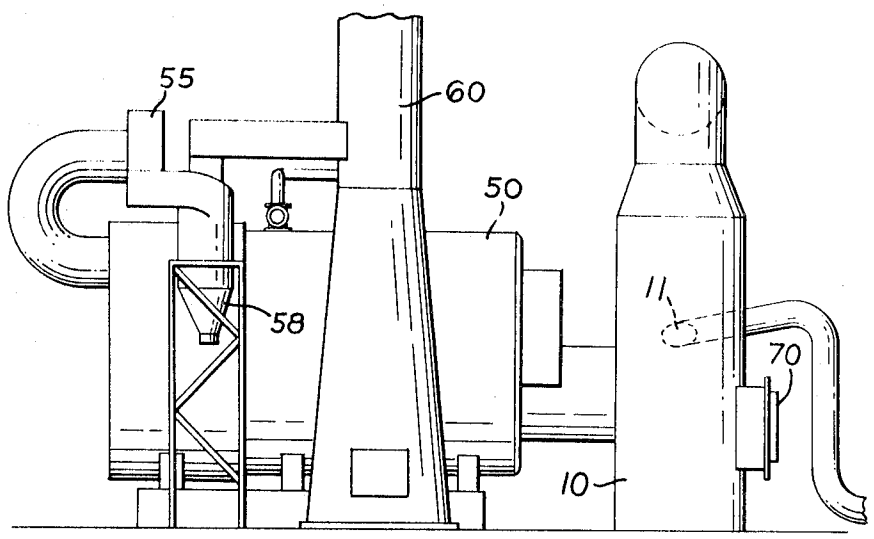


Fig. 5.

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3,516,370

FURNACES

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Int. Cl. F23g 7/00
U.S. Cl. 110—7 1 Claim

ABSTRACT OF THE DISCLOSURE

The invention provides a furnace for burning waste material and arranged to be fed from two separate sources with different kinds of material.

This invention relates to furnaces.

Considerable difficulty is often experienced in the disposal of finely divided particulate of materials, such as wood waste, since such materials cannot readily be disposed of by tipping or otherwise dumping on open ground, and the alternative of burning is unsatisfactory in that the material either will not burn readily in conventional boilers and furnaces, resulting in incomplete combustion and subsequent atmospheric pollution, or alternatively may be explosive when mixed with air in the correct proportions so that combustion is a hazardous operation.

It is an object of the present invention to provide a furnace for burning finely divided particulate materials which gives an efficiency of combustion greater than that of conventional types of boiler or furnace, which minimizes the explosion hazard, and which also enables other types of material to be burnt.

According to the present invention a furnace comprises a first generally cylindrical combustion zone having an inlet for combustible material arranged tangentially at its periphery and a further combustion zone communicating with the said first zone and having a separate inlet, and furnace temperature responsive flow control means whereby the rate of flow of material to said first zone may be controlled in accordance with a predetermined furnace temperature range. The two combustion zones may be more or less coextensive within the furnace.

Preferably the inlet to said second zone is in the form of a refractory lined sloping chute and is normally closed by a furnace door. Advantageously the door is disposed in a compartment which is adapted to be pressurized in those instances where the furnace itself is operated at a positive pressure.

Various embodiments of the invention are now more particularly described with reference to the accompanying drawings wherein:

FIG. 1 is an elevation of one embodiment and FIG. 2 is a plan thereof,

FIG. 3 is an elevation of a second embodiment and FIG. 4 is a plan thereof, and

FIG. 5 is an elevation of a third embodiment.

Referring now to FIGS. 1 and 2, the furnace comprises a vertical generally cylindrical chamber **10** having an inlet **11** for fine combustible material arranged tangentially at its periphery near the top of the chamber.

Combustible material in finely divided form may be fed via the tangential inlet together with combustion air from fan **12** at a high velocity so that a spiral flow pattern within the chamber extends downwardly from the inlet. When the combustible material/air mixture is ignited the flame pattern also conforms with the spiral flow and the products of combustion are therefore generated at a position below the inlet in the zone **15**.

The combustion chamber **10** is located in a pit **32** so as to be partly below ground level, so that the feed pipe

extending between the fan **12** and inlet **11** extends substantially at ground level.

The products of combustion escape from the chamber via the central vortex, defined by the flow pattern, and a stack **16** is disposed above the cylindrical combustion chamber to vent them to atmosphere. By virtue of the fact that the products of combustion are compelled to traverse a region of extremely high temperature the effluent from the stack contains very little, if any, unburnt material.

The lower end of said cylindrical combustion chamber is provided with a sloping side chute **21** whereby solid particles of combustible material too large or too heavy for admission through the tangential inlet **11** may be admitted by periodic manual operation. This chute is closed with a furnace door **20** horizontally located at the top of the chute and contained within a compartment **21***a* which is adapted to be maintained at pressure greater than that in the body of the furnace by means of a high pressure fan and motor **39**. Access to the compartment **21***a* is given through a further door **38**, the closing of which door controls the pressurizing of the compartment. In addition, to prevent undesirable abnormal build up of pressure in the furnace, which by communicating with the compartment **21***a* through the side chute **21** might lift door **20** and burst open door **38** to the subsequent harm of the operator, a further top outlet to the compartment **21***a* is closed by a pressure sensitive bursting panel **33** contained in an extension duct **22** to guide such outbursting gases away from the zone of the operator.

Whilst these features prevent danger from burning material in the area of the furnace operator it is also desirable to provide means of preventing excessive pressures of combustion gas from passing back from the furnace **10** through the inlet **11** and possibly causing damage elsewhere. Such means comprises a pneumatic gate **40** which serves as a control valve, being located between the inlet **11** and the position of entry of fine dust from the storage hopper **27** which is generally in a position adjacent to the fan **12** providing combustion air and conveying air for the material. The gate **40** is operable automatically by a pneumatic or electrical failure in the pneumatic feed system, or by a sudden change in pressure in that system which might be caused by abnormal rise in pressure in the furnace chamber preceding a blowback of hot gas through the inlet **11**. Thus the gate may be controlled by a device which responds to the current being used by the fan, and in addition a device which responds to the velocity of the combustible material/air mixture in the inlet duct, and in addition a device which responds to changes in the pressure of the air mixture in the inlet duct. The pneumatic gate prevents the back ignition of dust into the pneumatic feed due to the flame travel rate exceeding the rate of flow of the combustible material/air mixture. Additionally, a restrictive orifice device at the inlet **11** normally maintains the speed of the combustible material/air mixture at a rate above that of the normally expected speed of back propagation of flame, and additionally again, means are provided by a rotary metering and sealing valve **26** to prevent any such back propagation of flame as may conceivably escape both the restrictive device **11** and the pneumatic gate **40** from communicating with the wood waste stored in the main hopper storage system **27**. Additionally again, a duct extension is fitted to the inlet of fan **12** whereby means are taken to ensure that any flame passing through all the above mentioned points in the system is deflected to atmosphere at a point where no danger either to the operator or to the equipment can occur.

Flow of combustible material to the tangential inlet **11** is effected by means of the fan **12** arranged on the inlet side of the chamber so that the furnace operates

at a positive pressure. The feed of material is effected through a rotary metering valve **26** from a main storage hopper **27** by means of a mechanical arch breaking and rotatory discharging device **26***a*, both this device and the rotary metering valve **26** being capable of adjustment in speed to give variation of rate of feed of combustible material either manually or automatically according to furnace temperature (sensed by probe **26***b* and operatively coupled to said valve **26**) as indicated by the dash-line **26***c*.

The main storage hopper **27** would normally be filled by means extraneous to the system presently described, such as a pneumatic extraction system from the machines forming the waste, having a main cyclone discharge unit mounted immediately above the said hopper. The arrangement is particularly suitable for use to burn waste from joinery work and the like, and wood dust from e.g. sanding machines which may be fed through pipe **30** to the cyclone for separation therein of the entraining air.

In operation, when fine combustible material is to be burnt from the storage hopper **27**, the furnace door **20** is closed and the pressure compartment door **38** is also closed. A fire having previously been lighted in the furnace chamber **10** wood dust from the storage hopper **27** would be fed automatically by means of the discharge equipment **26***a* through the rotary metering valve **26** into the pneumatic line powered by fan **12**. When larger material was to be added manually, the control valve **40** would be closed, which closure would automatically stop feed of material through valve **26**, and would additionally by operation of an electrical lock enable the furnace door **20** to be raised and the pressure compartment door **38** to be opened. The furnace would then no longer be under positive pressure and material could safely be admitted manually. Means are provided by limit switches and electrical interlocks to prevent accidental opening of the furnace door while the furnace is under positive pressure, and alternatively to prevent the pressurising of the furnace by opening valve **40** if the furnace door **20** is already open.

One or more thermocouples (not shown) are mounted within the furnace chamber and arranged so as to operate the rotary metering valve **26** and discharger **26***a* and thereby control the admission of particulate combustible material to the furnace. In particular this control would prevent admission of any particulate material unless the furnace temperature was sufficiently high to prevent delayed ignition of dust with attendant risk of explosion, and alternatively would prevent feed of particulate material if the furnace temperature was already at a maximum, such minimum and maximum temperatures being by way of example 600° C. and 1000° C. Additionally the feed devices **26** and **26***a* which are preferably or possibly manually adjustable can also be arranged with mechanical and electrical control to vary the rate of feed according to the conditions existing in the furnace at that time.

By virtue of this control it is impossible for a build up of combustible material to occur within the combustion chamber and therefore the possibility of an explosion occuring is minimized.

It will be seen that the furnace can be used for combustion of manually fed waste through side chute **21** wherein the temperature is not within the required range for the particulate waste feed to be brought into operation. When the temperature has been brought to the required minimum temperature however the feed of particulate waste will cut in and combustion thereof will take place concurrently with the combustion of the waste admitted manually through the side chute.

In addition to the temperature control it is desirable that the control of waste be effected in response to the presence of a flame in the furnace. This may be effected by the inclusion of a photoelectric device (not shown)

which will control the feed of particulate waste to the furnace.

Depending upon the anticipated amount of waste for any particular installation a faciilty for burning an auxiliary fuel may also be provided as in the case of the embodiment of FIGS. 3 and 4.

Referring now to FIGS. 3–4, this includes furnace **10** with inlet **11**, chute **21** and other parts all identical to those in FIGS. 1–2 except that the chimney or flue **16** is connected to a waste-heat boiler **50** so as to utilise the heat of the exhaust gases for water heating or steam raising. In this event then, an oil burner **52** is mounted to discharge combustion products into the exhaust gas passages on occasions when furnace **10** is not operating. Particularly in such cases, a suction fan **55** at the tail end of the boiler may be operated to induce flow through the boiler, although this also makes it possible to run fan **12** at lower operating speed and air flow rate or even in some cases dispense with fan **12**. The used gas passage **57** communicates with fan **55** which communicates with cyclones **58** for grit and ash separation before discharge of combustion products into the final flue or chimney **60**. If the boiler is used for space-heating purposes, water may be circulated via flow and return pipes **62**.

In the modification shown in the embodiment of FIG. 5, the furnace **10** has the inlet **11** and a simple access door **70** for feeding large pieces, and this essentially uses the suction fan **55** as shown in FIGS. 3–4 so that the furnace is at negative pressure when operating. This may be desirable in cases where the supply of waste is not available continuously so that when the waste feed is exhausted the auxiliary fuel may be burned. This is particularly convenient when the furnace is coupled to heat exchange means as referred to or alternatively as a steam raising boiler where it is desired that the production of steam should not be dependent upon the production of waste material.

In addition to the temperature control it is desirable that further controls be included in order to minimise the possibility of explosion. Electrical interlocks may be provided to prevent the opening of the furnace **10** door whilst the furnace is under a positive pressure or whilst the auxiliary fuel burner is in operation. Similarly the interlock may be arranged such that the pressurising of the furnace or the ignition of the auxiliary fuel burner is prevented whilst the door is open whereby the possibility of blow-backs is minimised.

One further contingency which is guarded against in all embodiments is the possibility that the ratio of combustible material/air in the feed will be excessive whereby the combustion of the material will not be complete. As a result of this, unburned material may escape from the stack or there may be a build up thereof with the resulting danger of explosion. Velocity and pressure switches (not shown) are, therefore, provided to control the admission of combustible material in relation to the quantity of air being fed.

Conversely an excess of combustion air is undesirable in that it reduces the efficiency of the furnace when the heat produced thereby is to be utilised. In order to regulate the air flow a control such as an iris diaphragm may be included (in all embodiments) in the inlet duct. If desired, two inlet ducts may be provided in each embodiment, one duct having an air flow control.

It will be appreciated that the furnaces of this invention provide an extremely convenient way of disposing of finely divided particulate materials such as wood waste. The waste, for example from a sanding machine, can be drawn into the system from a position immediately adjacent the machine and fed to the furnace via a pneumatic conveyor possibly via a fuel storage arrangement. By this means the escape of wood dust into the atmosphere is considerably reduced and, furthermore, the

disposal of the dust is effected in a neat, simple and economic manner.

I claim:

1. A furnace comprising a first generally cylindrical combustion zone having an inlet for combustible material arranged tangentially at its periphery, said tangential inlet being connected to a pneumatic feed pipe for supplying combustible material and said feed pipe being connected to a fan for supplying combustion air so as to set up a spiral flow pattern in said zone and ensure complete combustion in said zone, and a further combustion zone communicating with said first zone but located on the opposite side of said first zone to an outlet therefrom so that material burnt in said further zone must pass through the first said zone before reaching said outlet, said further zone having a separate material

inlet, and flow control means responsive to furnace temperature whereby the rate of flow of material into said first zone may be controlled in accordance with a predetermined furnace temperature range.

References Cited

UNITED STATES PATENTS

1,893,913	1/1933	Saint-Jacques	110—28 X
2,925,055	2/1960	Miller et al.	110—105
3,218,997	11/1965	Berghout et al.	110—18

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U.S. Cl. X.R.

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