United States Patent

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[54] **MATERIAL REDUCING SYSTEM HAVING OXYGEN DEFICIENT ATMOSPHERE**
6 Claims, 1 Drawing Fig.

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[50] **Field of Search** 110/106; 241/47, 65

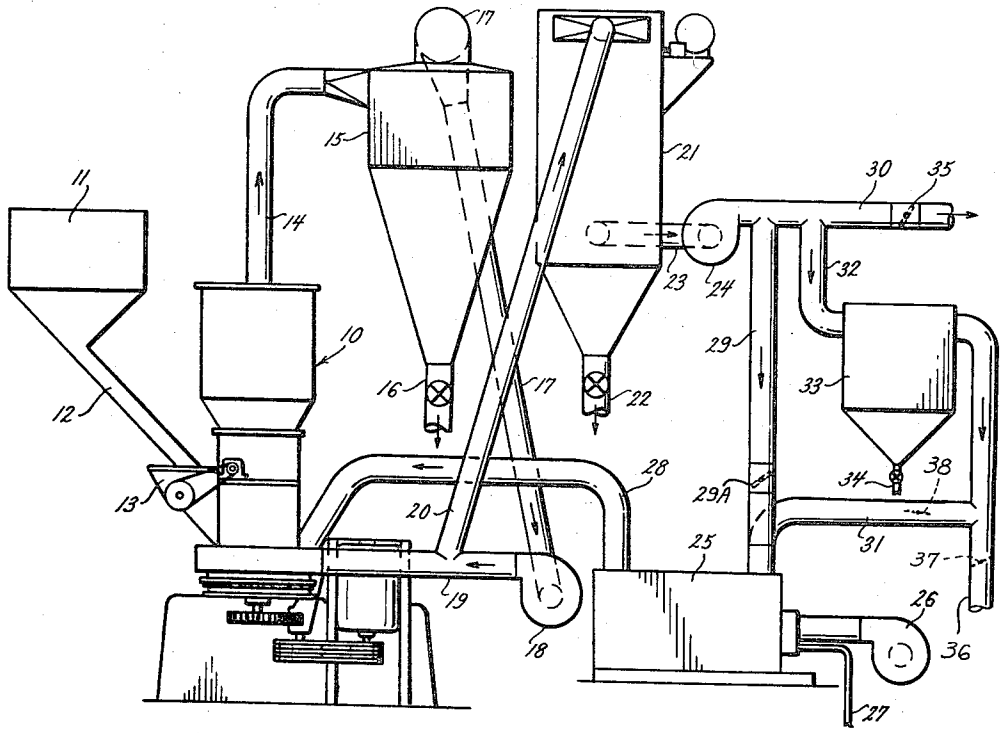
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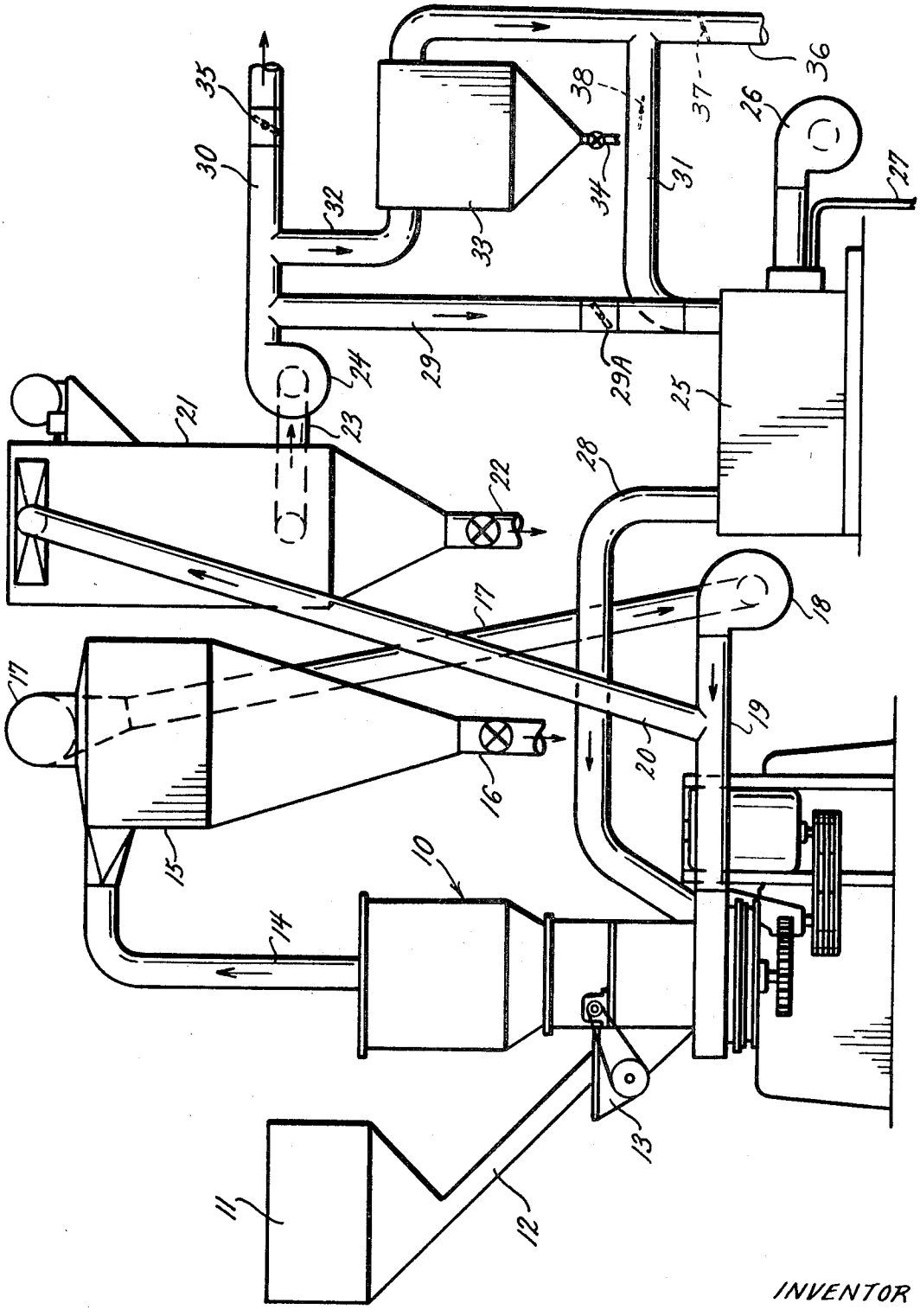
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ABSTRACT: A material reducing mill, crusher, or grinder system having means connected thereto to establish an oxygen deficient atmosphere that approaches a zero condition by extracting moisture from the system to enhance the production of a useful product at a temperature below that at which spontaneous combustion might be initiated.



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MATERIAL REDUCING SYSTEM HAVING OXYGEN DEFICIENT ATMOSPHERE

BRIEF DESCRIPTION OF THE INVENTION

This invention relates to improvements in a system that will allow the operation of grinding or material classifying systems under conditions of low oxygen content in the internal atmosphere and at temperatures where the product to be produced will issue below the spontaneous combustion temperature of such product.

While pollution of the ambient atmosphere in industrial plants and mills is important, it is also extremely important that commercial products should be processed in such a way that explosions, fire hazards, and hazards to operating personnel are adequately protected against. This is especially important in commercial processing apparatus where the product is a combustible such as coal. Coal is a very good example to illustrate the novel and important aspects of the present invention.

A great many industrial operations utilize coal in a finely divided or pulverulent state so that it may be blown into a furnace or other combustion space in a fluent stream. Coal in its fairly large lump size as it is brought from the mines is not suitable for this purpose and consequently must be reduced to a much finer condition so that it will form a fluent stream. One such apparatus for reducing coal to a finely divided state in an atmosphere that will inhibit explosion and fire is disclosed in the U.S. Pat. No. 3,477,650, of Williams granted Nov. 11, 1969. In that patent the system includes a pulverizer mill, and the product is delivered to a suitable cyclone separator where the finely divided product is collected and delivered through a discharge. In order to operate the reducing mill at a sage condition, the system of that patent involves reducing the coal in an oxygen deficient atmosphere and at a suitable elevated temperature to control the moisture level of the system as it is changed by the raw product after it enters the mill.

In accomplishing the foregoing aims the present system incorporates a furnace which produces a hot gas having an oxygen deficient characteristic approaching zero oxygen, which gas is then circulated through the system at such a temperature that it has a great ability to pick up moisture and carry it through the system as a vapor. The temperature is maintained at a level high enough so that the internal atmosphere will not reach complete saturation or the dew point.

The principal object of the present invention is to provide means for rendering the system heretofore described completely operable under oxygen deficient conditions and at temperatures below the spontaneous combustion temperature levels of the product being so processed.

A preferred embodiment of the present invention includes a system for directing the oxygen deficient internal circulating gases in the apparatus through a device which will extract the moisture therefrom and obtain the return of the already oxygen deficient gases to the system by way of the furnace so that only a minimum of ambient primary air needs to be admitted for the purpose of operating the furnace at a level where substantially complete or perfect combustion occurs to use up the oxygen as completely as possible and thereby release oxygen deficient hot combustion gases into the system to maintain the desired inert internal atmosphere.

A preferred embodiment of the present invention is shown in the accompanying schematic diagram of apparatus for extracting moisture from the inert atmosphere in material reducing systems.

DESCRIPTION OF THE APPARATUS

The preferred apparatus, diagrammatically shown in the accompanying drawing, is seen to include a pulverizer mill **10** to which hopper **11** is connected by a suitable chute **12** which feeds the raw product through a suitable air lock **13** so as to restrict the amount of ambient air that is carried into the system with the raw product which may be coal. The pulverized coal is carried through a discharge conduit **14** to the upper end of a cyclone separator **15**. The pulverized solid material is discharged through the outlet **16** from the bottom of the separator, while the inert gases and fines suspended in the gases are discharged through the conduit **17** from the top of the separator. The separation of the gases and fines that float in the gases from the pulverulent material is facilitated by a suitable blower **18** which sucks the gases and fines from the cyclone separator **15** through the conduit **17** and delivers a portion thereof through the conduit **19** back to the mill **10**. A portion of the gas flow established by the blower **18** is diverted through conduit **20** to a second separator **21** where the very fine particles that may have remained in suspension are separated and discharged at the outlet **22**. The inert gas, after being separated from the fines passes through the conduit **23** to a blower **24**.

A furnace **25** is equipped with a primary air blower **26** to supply combustion air and a conduit **27** supplies the gas or the fuel to be consumed in the furnace. It is desirable that combustion be as nearly perfect as possible so that the hot gases discharged from the furnace through the conduit **28** can be as nearly oxygen deficient as is possible, but at least sufficiently oxygen deficient to establish an atmosphere in the system that will be able to pick up moisture to be carried out of the system, and nonresponsive to explosion and combustion conditions. The hot gases in conduit **28** are conducted into the base of the mill **10** and mixed with the recirculated gases supplied through conduit **19**.

What has thus far been described briefly is the system disclosed in said Williams U.S. Pat. No. 3,477,650, wherein a portion of the discharge from the blower **24** is normally recirculated through conduit **29** to the furnace **25** and a portion is conducted to atmosphere through a conduit **30**. To make up air to replace that which is exhausted through conduit **30**, in the system of said patent, fresh air is supplied through a fresh air conduit **31**. However, in the presently preferred embodiment of this invention the exhaust conduit **30** is provided with a bypass conduit **32** which connects into the former fresh air makeup inlet conduit **31**, and a spray dehumidifier or scrubber device **33** of known construction for cooling gases to precipitate the moisture is connected into the bypass conduit **32**. The device **33** is provided with an outlet conduit **34** for draining off the liquid which is extracted from the gaseous medium moving through the bypass conduit **32**.

In order to facilitate the flow of gaseous medium through the bypass conduit **32** the exhaust conduit **30** is provided with a control damper **35** which can be adjusted to force some or all of the flow in conduit **30** to enter the bypass **32** or the conduit **29**, or both, whereby these two flows will combine and enter the furnace **25** to be again returned with the hot gases of the combustion process. The proportion of flow in conduit **29** and in the bypass **32** may be regulated by the damper **29A** in conduit **29**. Closing damper **29A** will cause all of the flow through the device **33**, whereby the system will function as if the conduit **29** were not present.

Instead of allowing the inert atmosphere or gas in the system to exhaust to atmosphere from conduit **30** at valve **35**, it is sometimes useful to pass the flow through the device **33** and then allow the dry inert gas to exit from the system. When operated in this fashion, the valve **35** is closed and the exhausted dry medium is collected for other uses. Accordingly, the conduit **31** downstream of the device **33** may have the exhaust conduit **36** opening therefrom, and control valves **37** and **38** will regulate the flow distribution out of the system or back to the furnace **25**. Valve **35** will, of course, be closed.

By providing the moisture removing device **33** and connecting it to the material reducing system in the manner described, it will be practical to operate the system at a desirable oxygen deficient level and, more importantly, under temperature level conditions at the separator **15** that will not cause the product released at the discharge **16** from the separator to reach the spontaneous combustion temperature level. Furthermore, the device **33** permits the system herein described to accept a

reasonable level of moisture content of the product admitted to the mill **10** and to extract the moisture at the means **33** on a continuous basis so that it will not be necessary to operate the system at such a high temperature to control the moisture that spontaneous combustion in the final product is a problem. Thus, the system is efficiently operated for the purpose described by the proper setting of the dampers **29A**, **35** and **37** to force a sufficient quantity of the moisture laden inert gases through the moisture extracting device **33** at a rate substantially equal to the rate of introduction at the reducing mill **10** of moisture carried in by the freshly introduced raw material. It may be necessary, when exhausting some of the gaseous medium at conduit **36** to close valve **29A** completely so the gaseous medium returned to the furnace **25** after being separated from its moisture can be regulated as desired and still supply any excess at conduit **36**. In either setting, the present system will permit the apparatus to operate while grinding or classifying material that might catch fire due to spontaneous combustion, and it performs this improved function by operating below the product spontaneous combustion temperature level without loosing its operating efficiency due to moisture accumulation in the system.

What is claimed is:

1. In apparatus for reducing moisture containing raw material to a final product having, a raw material reducing mill, a separator, means connecting said mill and separator in a closed circuit in which the gaseous medium carries the mill output of material to the separator for separation from the gaseous medium, a source of oxygen deficient hot gaseous medium connected into said closed circuit, and a recirculation circuit connected between a portion of said closed circuit and said hot gas source; the improvement comprising: means in said recirculation circuit to extract moisture from the gaseous medium flowing therethrough to said source of hot gaseous medium, whereby said source of hot gaseous medium returns the dried medium to said closed circuit.

2. The apparatus improvement of claim **1** including means to regulate the volume of medium subjected to said moisture extracting means.

3. The apparatus improvement of claim **1** including means in said recirculating circuit to exhaust to atmosphere a portion of the medium in said recirculating circuit, and means supplying primary ambient air to said source of hot gaseous medium in a volume to make up the volume exhausted to atmosphere.

4. In apparatus for reducing a raw material to a final product having a raw material reducing means, a first conduit system connected in series with said reducing means, a blower for forcing a flow of medium through said reducing means to carry the final product out of said reducing means, a separator device connected into said conduit system at a station to extract the final product from the flowing medium; a furnace connected into said conduit system system to supply oxygen deficient hot medium into said system, and a second conduit system connected between said first conduit system downstream of said blower and said furnace, the improvement comprising: moisture extracting means connected into said second conduit system to remove moisture from the flowing medium in advance of said furnace, a source of primary combustion air connected to said furnace, and means in said second conduit system to exhaust to atmosphere a portion of the medium flowing in said second conduit system.

5. In apparatus for reducing raw material to a final product having material size reducing means, a first gaseous medium conduit system connected in series with said reducing means, a blower connected into said first conduit system to force flow of the gaseous medium through said reducing means, a furnace connected into said conduit system in advance of said reducing means to supply hot oxygen deficient gaseous medium into said first conduit system, the improvement comprising: a second conduit system connected between said first conduit system in advance of said reducing means and said furnace to recirculate at least a portion of the gaseous medium in said first conduit system through said furnace, and means in said second conduit system to remove moisture from the recirculated gaseous medium in advance of said furnace.

6. The apparatus improvement of claim **5** wherein said second conduit system includes an outlet between said moisture removing means and said furnace to exhaust at least a portion of the dry oxygen deficient medium.