

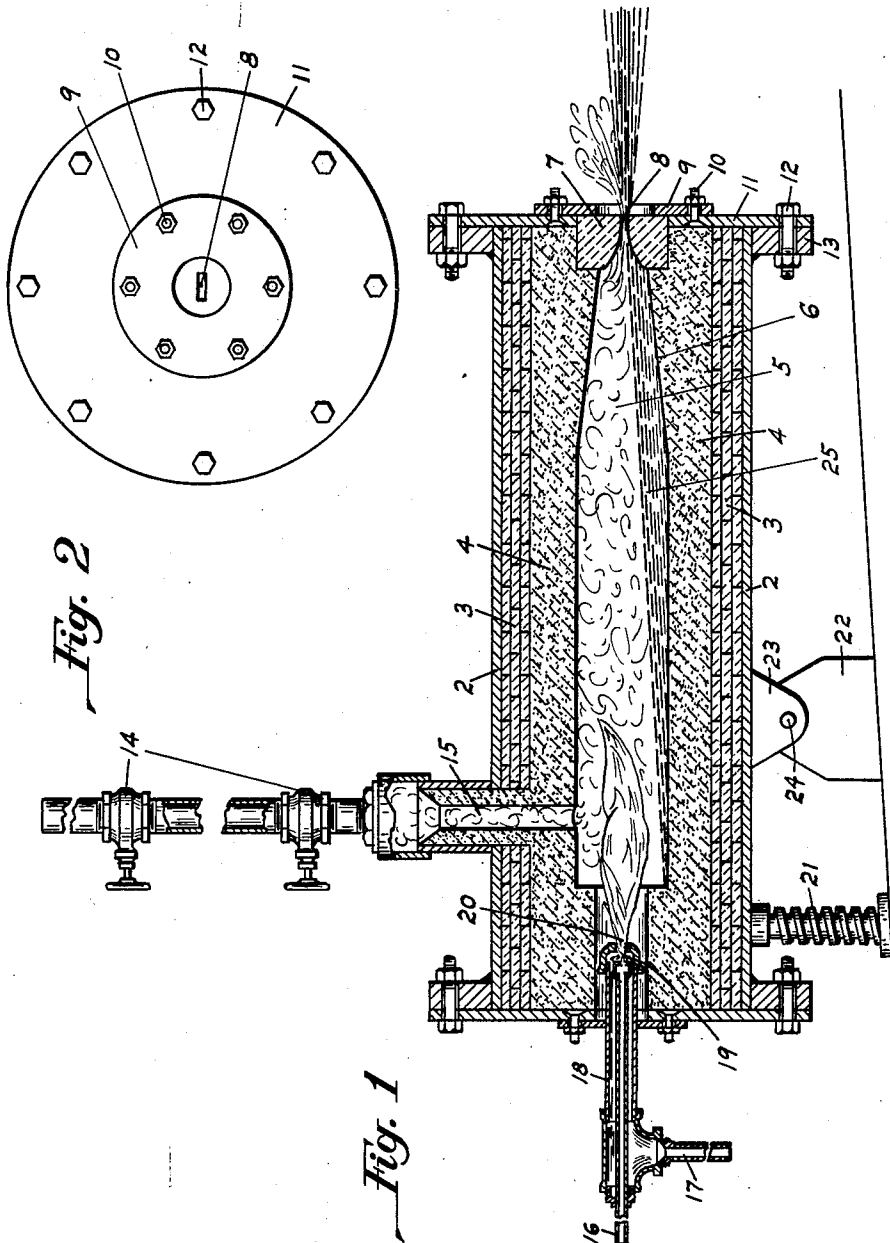
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METHOD FOR PRODUCING FIBROUS MATERIAL

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METHOD FOR PRODUCING FIBROUS MATERIAL

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This invention relates to a method for producing fibrous material and, more particularly, to a method in which hot gasses under pressure are used as the attenuating means for converting the molten material into fibers.

The term "mineral wool" is used generically throughout to include slag wool, rock wool, and glass wool, as well as other inorganic wools. The term "raw material" is used generically to include blast furnace slag, rock, glass, and other inorganic materials used in the manufacture of mineral wool. The term "molten material" is used generically to include molten wool-forming raw materials. The term "shot" as used herein refer to the small globules of material which have not been attenuated by the attenuating blast. The term "short dustlike fibers" refers to the extremely short and extremely fine fibers present in blown mineral wools and which create objectionable dustiness when such wools are handled.

In the manufacture of mineral wool insulation material, one of the main problems is the reduction of the amount of shot and dustlike short fibrous material invariably formed when the wool is blown. It is generally believed that the shot and short fibrous material above referred to are caused by the shattering of the molten stream when the stream is hit by a blast of air or steam directed at an angle to the direction of travel of the molten stream. Furthermore, in the conventional method of blowing mineral wool, the attenuating blast is at a temperature lower than the temperature of the molten stream and, therefore, has a tendency to cool the molten stream at the point of attenuation. This cooling of the stream at the point of attenuation has a definite effect on the amount of shot and short dustlike fibers present in the fibrous wool produced.

In the manufacture of fibrous material from a molten stream it has been found highly desirable to maintain a constant temperature throughout the molten stream so that the temperature at the surface will be substantially the same as the temperature in the center of the stream. This cannot be accomplished where the molten stream is allowed to drop through the atmosphere, because the ambient atmosphere has a much greater cooling effect on the exterior of the stream than it has on the interior, making the molten material at the exterior much more viscous than the interior. Experiments have shown that a wool-forming composition cannot be attenuated properly when the viscosity is above a certain range, and the quality of wool

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blown from molten streams which are allowed to fall through air clearly reveals that much of the mass of resulting product has not been attenuated properly. It is believed that the cooler, more viscous outer surface of the stream of molten material is responsible for a large percentage of shot.

In order to overcome these difficulties, I have devised a method in which the hot gasses resulting from the combustion of fuel used in the melting of the raw material or assisting in keeping the raw material in a molten state are used to attenuate the fibers by blowing the molten stream through an exhaust orifice in a substantially gas-tight furnace. In this type of method, the attenuating blast is at a temperature substantially the same as the temperature of the molten stream and is directed in a path substantially parallel to the direction of flow of the molten stream.

Furthermore, it has been found that when attenuating fibers by a blast which is at a temperature substantially lower than the temperature of the molten material, the blast has a tendency to increase the viscosity of the material very rapidly during attenuation and, of course, when the viscosity is increased to a point above the attenuation range, shot or extremely coarse fibers are formed. By using a blast at substantially the same temperature as the temperature of the material being attenuated, the fiber is maintained at attenuation viscosity for a greater period of time and, consequently, longer fibers and less shot are formed.

An object of this invention is to provide a method of producing mineral wool in which the fibers are exceptionally fine, tough, and have a relatively small amount of shot and of short dustlike fibers.

A further object of this invention is to provide a method of producing fibrous material from molten material in which the hot gases used to convert the raw material to molten material are also utilized to attenuate the fibers; the molten material and hot gases being at substantially the same temperature, thereby keeping the fibers at proper attenuating viscosity over a greater period of time in order to produce longer fibers.

Another object of this invention is to provide a method of producing fibrous material from molten material in which the blast used to attenuate the fibers is directed in a path substantially parallel to the path of travel of the molten stream, rather than at an angle to the path of travel of the stream.

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It is also an object of this invention to provide a method of producing fibrous material from molten material in which the gas used to attenuate the fibrous material is also utilized to assist in keeping the molten material at the proper viscosity for attenuation.

A still further object of this invention is to provide a new method in which the hot gases resulting from the combustion of fuel in the melting furnace are used to attenuate the molten material into fine fibers substantially free from shot and short dustlike fibers.

In order that my invention may be more readily understood, it will be described in connection with the accompanying drawing in which,

Figure 1 is a longitudinal cross-sectional view of a furnace suitable for carrying out my invention, and

Figure 2 is a plan view of the discharge end of the furnace showing the orifice through which the gas escapes and the wool is attenuated.

In the drawing, the numeral 2 designates a cylindrical furnace shell having a lining of insulating brick 3 and an inner layer of rammed high temperature refractory material 4. This refractory material defines a cylindrical chamber 5 having a tapered end 6, said tapered end being partially closed by a refractory element 7 having a rectangular orifice 8 passing therethrough. It will be observed that the orifice 8 is so constructed as to provide an enlarged opening on the inner side of the refractory element 7 and a smaller opening on the outer side thereof.

While the drawing shows a rectangular orifice, it will be understood, of course, that orifices of other geometrical designs can be utilized satisfactorily. This refractory element 7 is held in place by a metal holding ring 9 secured by bolts 10 to the metal plate 11, which forms the front of the furnace housing. By this arrangement, the refractory element 7 is held securely in place between the refractory lining 4 of the furnace and the holding ring 9. This plate 11 is secured by means of bolts 12 to a collar 13 which is secured to the furnace housing 2.

The granular raw material is charged through a double-lock feeding mechanism 14 into the furnace chamber 5 through the passage 15 from any suitable source of supply not shown. With this double-lock mechanism, it is possible to feed additional raw material into the furnace chamber while a constant pressure is maintained within the furnace. The gas or other fuel used in the operation of the furnace is supplied under pressure from a suitable source, not shown, through the pipe 16, and the oxidant is supplied under pressure through the pipe 17 into the tube 18, which surrounds the fuel supply pipe 16. The fuel and oxidant are mixed in the chamber 19, and this mixture is then forced through the opening or nozzle 20 into the rear of the furnace chamber 5 in which it is ignited and burned. Suitable adjusting valves may be positioned in the fuel and oxidant lines to control the ratio of fuel to oxidant which, in turn, controls the temperature in the combustion chamber.

In the operation of the furnace, the granular raw material is fed into the furnace chamber 5 through the double-locking mechanism 14 into the downwardly directed passage 15. A mixture of fuel and oxidant is fed into the nozzle 20 and is burned in the rear of the furnace chamber 5. This mixture of fuel and oxidant is preferably adjusted to produce a furnace temperature of between 2200° F. and 3000° F. At this temperature,

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the raw material is converted to a fluid consistency and forms a pool of molten material 25 in the bottom of the cylindrical furnace chamber 5. Control of the fuel and oxidant supply pressures permits operation of the furnace under any desired pressure. The only means of escape for the gases generated by the combustion of the fuel is through the orifice 8. The characteristics of the desired fiber will determine the pressure to be maintained in the pressure furnace and the viscosity at which the molten material is to be maintained. Other factors being equal, low pressures produce coarse fiber and high pressures produce fine fibers. The preferred range is between 25 to 50 pounds per square inch. However, higher or lower pressures may be used if desired. It has been found through experiment that a viscosity range of 1000 poises to 10 poises is satisfactory for the production of mineral wool by the pressure furnace method, although, for the usual commercial wools, for insulating purposes a viscosity range of from 100 poises to 25 poises is preferred. As the amount of the molten material within the furnace chamber 5 builds up to the level of the orifice 8, it flows through the orifice 8, and the escaping gas passing through the same orifice attenuates the molten material into a fine, tough, fibrous material having a low percentage of shot and short dustlike fibers.

In another embodiment of my invention, the furnace chamber described may be used as a secondary heating or conditioning chamber in the production of fibrous material from molten material. In using my invention in this type process, the raw material is melted in a suitable furnace or crucible; and the molten material is fed down through the passage 15 into the furnace chamber 5. During this feeding, the burner is shut off temporarily to prevent the pressure from impeding the flow of molten material into the furnace chamber. In this embodiment of my invention, the hot gases in the furnace chamber 5 are used to maintain or assist in maintaining the molten material in a fluid condition until attenuated.

In order to overcome the necessity of having the molten pool 25 build up to the level of the orifice 8, I have provided mechanism by which the furnace 2 may be tilted in such manner that a small amount of molten material in the furnace chamber 5 may be made to flow through the orifice 8. To accomplish this, I provide a screw jack or other elevating mechanism illustrated at 21 which is effective for raising the rear of the furnace. Since the furnace is supported on an upright member 22 by means of the cleat 23 and a pivot pin 24, a small amount of molten material in the furnace may be made to flow toward the orifice end of the furnace by operating the screw jack 21. It will be understood, of course, in operations where it is necessary or advantageous to tilt the furnace, it is desirable to have flexible sections such as rubber or other flexible hose in the fuel and oxidant lines.

The following is a specific example of the method of producing mineral wool by my invention: A cylindrical furnace 9½" in diameter and 33" long, provided with a rectangular orifice ⅜" x ½" in its front wall, was charged with a cold charge of granular slag to a depth of 1½". After the furnace had reached a temperature of 2500° F. and a pressure of 30 pounds per square inch, additional slag was charged through the double-locking mechanism. An additional small amount of oxygen was fed into the oxidant line

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to raise the furnace temperature to approximately 2550° F. to maintain the molten material at a viscosity of approximately 28 poises. The slag then started to flow and was blown from the lip of the orifice.

The wool produced during this experimental run was very fine-fibred, soft, and tough, containing substantially less shot and short dustlike fibers than the wool produced by the conventional methods.

It will be clear from the above, that I have developed a new method for producing fibrous material, in which the hot gases resulting from the combustion of fuel in a pressure chamber are used to attenuate the fibers. It will be obvious, too, that in a system of this type, the path of the attenuating blast is parallel to the path of travel of the molten stream, and there is, therefore, less likelihood of the stream being shattered by a blast at a lower temperature directed at an angle to the path of the molten stream. Also, in producing mineral wool from molten material by the above method, the molten stream is at substantially the same temperature throughout, which overcomes the difficulties encountered by the cooling of the exterior of the molten stream when it is allowed to fall through air.

While I have illustrated and described certain preferred embodiments of my invention, it will be understood that the same is not limited thereto, but may be otherwise embodied and practiced within the scope of the following claims.

I claim:

1. The method of producing fibrous material from a molten mass, the steps comprising charging a mass of material capable of attenuation into a pressure-tight combustion chamber, heating the mass in said chamber by the combustion of a fuel-oxidant mixture to a temperature range between 2200° F. and 3000° F., thereby forming a pool of molten material disposed along the horizontal axis of the combustion chamber, tilting the combustion chamber to allow the pool of molten material to overflow through an exhaust orifice for the combustion gases, and attenuating said mass in a substantially horizontal direction solely by the application thereto under pressure of the gases resulting from the combustion of the fuel-oxidant mixture as the mass overflows the pool in the path of the escaping combustion gases.

2. The method of producing fibrous material from a molten mass, the steps comprising charging a mass of material capable of attenuation into a pressure-tight combustion chamber, heating the mass in said chamber by the combustion of a fuel-oxidant mixture, thereby forming a pool of molten material disposed along the horizontal axis of the combustion chamber, tilting the combustion chamber to allow the pool of molten material to overflow through an exhaust orifice for the combustion gases, and attenuating

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said mass in a substantially horizontal direction solely by the application thereto under a pressure ranging between 25 pounds per square inch and 50 pounds per square inch of the gases resulting from the combustion of the fuel-oxidant mixture as the mass overflows the pool in the path of the escaping combustion gases.

3. The method of producing fibrous material from a molten mass, the steps comprising charging a mass of material capable of attenuation into a pressure-tight combustion chamber, heating the mass in said chamber by the combustion of a fuel-oxidant mixture to produce a molten mass having a viscosity ranging between 1000 poises and 10 poises, thereby forming a pool of molten material disposed along the horizontal axis of the combustion chamber, tilting the combustion chamber to allow the pool of molten material to overflow through the exhaust orifice for the combustion gases, and attenuating said mass in a substantially horizontal direction solely by the application thereto under pressure of the combustion gases resulting from the combustion of the fuel-oxidant mixture as the mass overflows the pool in the path of the escaping combustion gases.

4. The method of producing fibrous material from a molten mass, the steps comprising charging a mass of material capable of attenuation into a pressure-tight combustion chamber, heating the mass in said chamber by the combustion of a fuel-oxidant mixture to produce a molten mass having a viscosity ranging between 100 poises and 25 poises, thereby forming a pool of molten material disposed along the horizontal axis of the combustion chamber, tilting the combustion chamber to allow the pool of molten material to overflow through the exhaust orifice for the combustion gases, and attenuating said mass in a substantially horizontal direction solely by the application thereto under pressure of the combustion gases resulting from the combustion of the fuel-oxidant mixture as the mass overflows the pool in the path of the escaping combustion gases.

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