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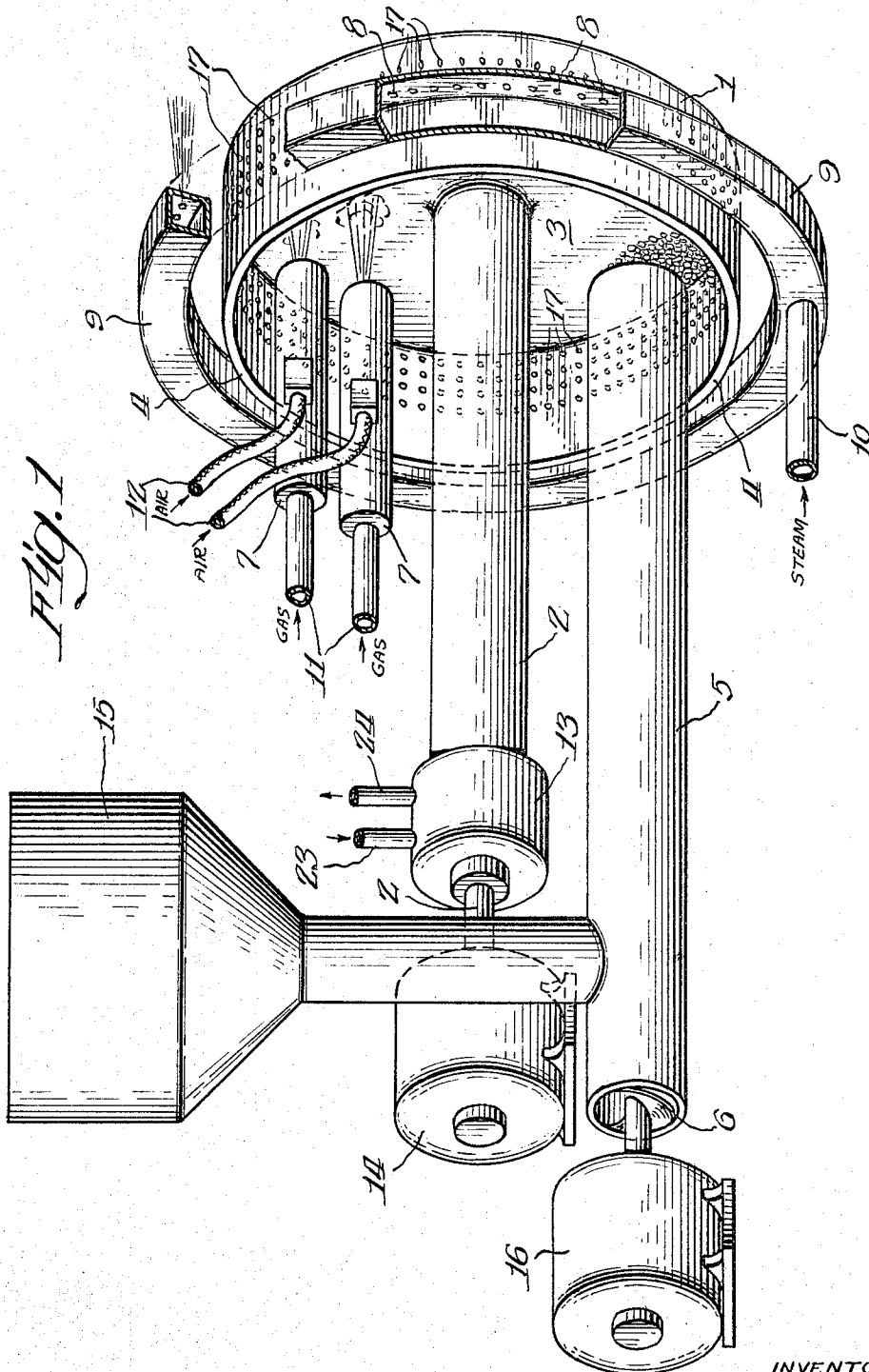
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FIBER FORMING APPARATUS

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2 Sheets-Sheet 1



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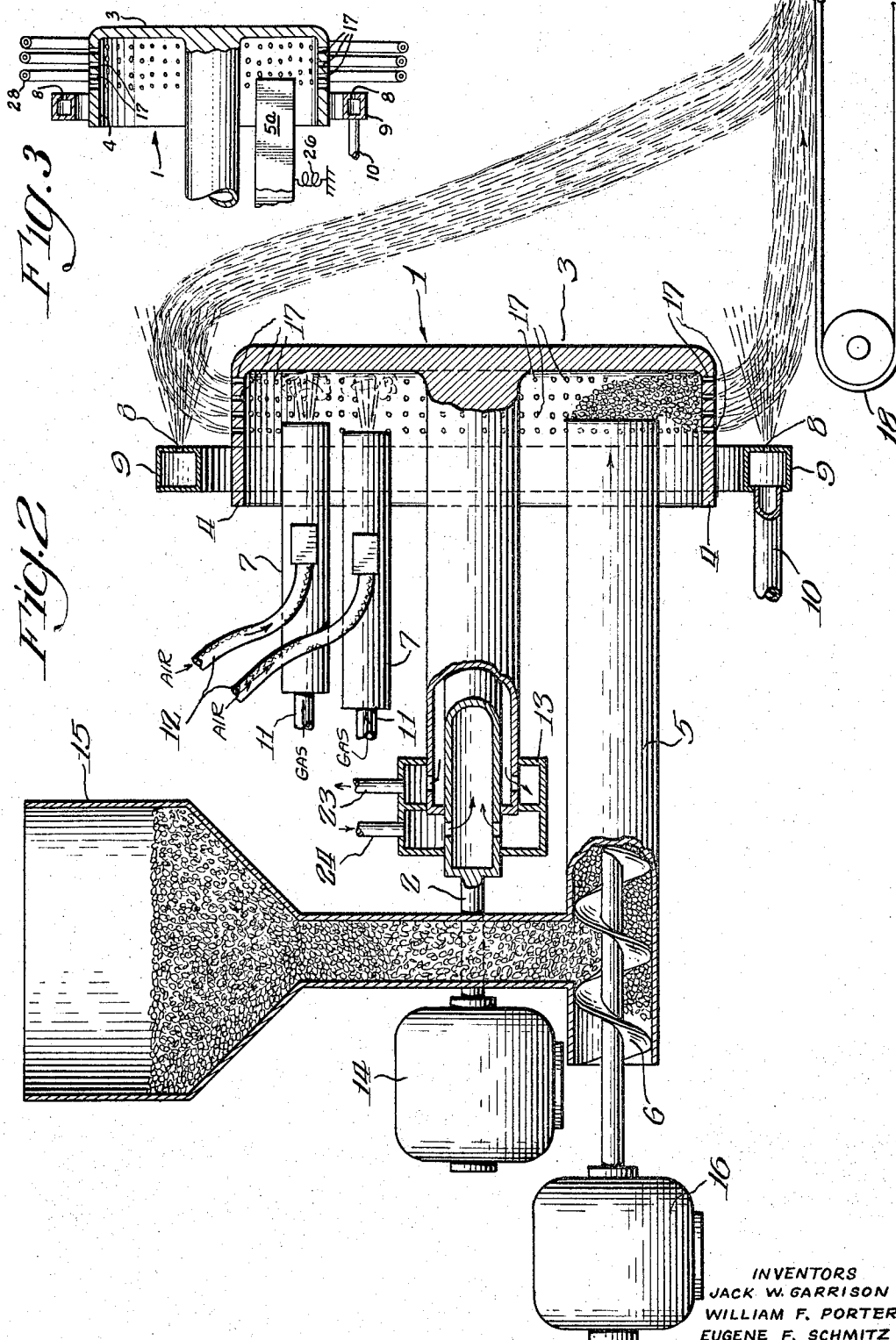
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FIBER FORMING APPARATUS

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9 Claims. (Cl. 65-14)

This invention relates to an apparatus and method for forming fibers and is particularly concerned with the forming of fibers from comminuted materials such as glass by a simple apparatus and method.

The use of non-woven fabrics and blankets of fibers such as glass for insulation and plastics reinforcement has increased sharply and their production has become a matter of considerable economic importance. These fibrous products, even when compressed to practical limits are extremely bulky and, therefore, relatively expensive to transport for long distances. However, the means for production are customarily associated with glass melting furnaces which are such large installations that they often must be established at locations not dictated by the consumers of the fibrous products. It would be highly desirable, therefore, to have a process available which could produce fibrous mats and blankets at an economical price and at a location near the consumer.

It is an object of this invention, therefore, to provide a process and apparatus to enable the spinning of fibers without the need for erecting melting apparatus and all the attendant accessory equipment. It is a further object of this invention to provide a process for the manufacture of glass fibers. It is a still further object of this invention to provide a novel process and apparatus for the conversion of comminuted glass particles into glass fibers. Other objects of the invention will become apparent from the following description and drawings wherein:

FIGURE 1 is a cut-away sketch illustrating the essential features of the apparatus;

FIGURE 2 shows this apparatus as it relates to certain accessory equipment; and

FIGURE 3 is a cut-away section similar to FIGURE 2, on a reduced scale, illustrating certain modifications of the apparatus of FIGURES 1 and 2.

Referring to the drawings, FIGURE 1 illustrates a spinner type fiber forming apparatus having a perforated rotor 1 driven by a substantially horizontal rotor shaft 2. By having the shaft horizontal, or within about 20 degrees of horizontal, the overall height of the installation is reduced. It also enables the secondary attenuation gases to carry the fibers directly into the blow room which seems to reduce the shot content of the product and aids the felting of the fibers into blankets.

For clarity, the supporting bearings and drive means are not shown but they are conventional and do not form a part of the invention. However, the rotor 1 operates at a high temperature and for extended bearing life it has been found desirable to cool the shaft by providing appropriate water passage as shown at 23 and 24. The rotor 1 has a web or disc 3 at substantially right angles to the shaft which supports a perforate rim portion 4. The size and number of the holes 17 are details well known in the art and are determined to a certain extent by the type of glass or other material to be formed into fibers. Preferably, the rim may contain several thousand holes of about 0.75 millimeter diameter. It will be understood that the material and construction of this rotor are quite important because its operating temperature is in the neighborhood of about 2,000 degrees F., and the centrifugal forces exerted by the speed of rotation, upwards of 2,000 r.p.m., stress the material to nearly its operating limits.

2

The fiber forming material is fed to the wheel at a spot near its center by the conveyor 5. This may comprise a helical member 6 driven by conventional means. Other feed devices which tolerate high temperatures may be used such as belt and bucket conveyors and vibrating troughs (see trough 5a in FIG. 3) and screw transfer devices.

The fiber forming materials should preferably be rather finely divided but may contain larger pieces if they are thin so that the action of the conveyor will break them up before they are deposited on the rotor. The rate of feed is preferably adjustable so that optimum fiber forming conditions can be employed.

A preferred type of a fiber forming material suitable for use in this apparatus is a soda-lime borosilicate glass having the following approximate composition:

	Percent
SiO ₂ -----	50.2
B ₂ O ₃ -----	13.0
CaO -----	14.3
Na ₂ O -----	15.4
F ₂ -----	3.0
Al ₂ O ₃ -----	1.8
MgO -----	2.3

Useful departures from this formula will be apparent to those skilled in the art.

To supply the required heat to melt this glass a plurality of gas burners is located so that their flames will play on the interior of the rotor. For simplicity's sake, only two such burners 7 are shown in the drawing. The number of burners, of course, will depend upon their capacity, the operating temperature and rate of feed of the fiber forming material being processed and other variables. Electric resistance or induction heaters (see induction heating coil 26 in FIG. 3), or other alternative heaters may be employed instead of or in addition to the gas burners shown.

Should it be desired to employ secondary attenuation, air, steam, combustion products or other gas may be discharged against the fibers through orifices 8 located in the movable ring 9 (shown cut-away) and supplied through the pipe 10. This ring may be adjustable axially to obtain optimum engagement of the attenuating gas with the fibers being spun.

Referring now to FIGURE 2, the apparatus of FIGURE 1 is shown with some of the accessory equipment to further illustrate the practice of the invention. Two burners 7 are shown with suitable gas connections 11 and air connections 12 to supply heat to the rotor 1. Cooling water conduits 23 and 24 are shown connected to a gland 13 on the water-cooled shaft 2 driven by drive means 14. The conveyor 5 is fed finely divided fiber forming material from the hopper 15 which is propelled to the rotor by the action of drive means 16.

The apparatus illustrated in FIGURE 3 includes a rotor and steam ring as in the apparatus of FIGURES 1 and 2, as indicated by the use of the same identifying numerals. A vibrating trough feed device 5a feeds the fiber forming material to the rotor rim. The trough 5a is resiliently mounted, as on a spring 26, and is vibrated by suitable means (not shown), as is known in the conveyor art. An induction heating coil 28 supplies heat to the rotor for melting the materials fed thereto.

When the apparatus is in operation, the finely divided fiber forming material is delivered to the interior of the rotor where it is held by centrifugal force until melted by the heat from the burners 7 and discharged through the perforations 17. A blast of super-heated steam issuing from the orifices 8 in the steam ring 9 attenuates the fiber which is then accumulated as a blanket on the conveyor 18. The invention will be further explained by

the following example which is intended to be illustrative only and not limiting.

EXAMPLE 1

An apparatus as illustrated in FIGURES 1 and 2 was assembled employing a 11½ inch diameter perforate rotor made of high temperature strength alloy, such as Stainless 310 or Udimet 500 made by Special Metals, Inc. of New Hartford, N.Y. A published composition for this alloy is shown in Table I. The steam for secondary attenuation was turned on and a temperature of 450 degrees F. attained before the rotor drive 14 was actuated. When the cooling water in the shaft had been adjusted to an operating level, the burner 7 was lit to raise the temperature of the rotor to its operating level, about 1900 degrees Fahrenheit. When this level was reached as measured by an optical pyrometer, the glass feed drive motor 16 was turned on and the feed rate regulated to maintain the operating temperature at about 1900 degrees F. This had to be done carefully as the output of the burners was necessarily high. With the soda-lime borosilicate glass of the composition indicated above, the production rate was 150 pounds per hour. The glass fiber from this operation had an average diameter of about 10 microns and contained about 15% shot. On subsequent runs fibers with a diameter of 5 to 7 microns and less than 10% shot were obtained.

Table I

UDIMET 500 COMPOSITION

	Percent
Carbon	0.15
Chromium	15-20
Cobalt	13-20
Molybdenum	3-5
Titanium	2.5-3.25
Aluminum	2.5-3.25
Boron	0.1 Max.
Sulfur	0.015 Max.
Iron	4 Max.
Silicon	0.75 Max.
Manganese	0.75 Max.
Copper	0.15 Max.
Nickel	Balance

It is apparent that this is a novel and highly useful system for the manufacture of glass fibers offering great flexibility at the point of installation. It can operate on a variety of raw materials which need not be as carefully prepared with regard to uniformity of size and weight as required by the processes of the prior art.

The fibers formed by this process may be treated according to the processes well known in the art, e.g., they may be coated with a phenolic resin or lignin binder and formed into mats or blankets by conventional methods.

While the foregoing description and illustration point out one method of our invention, other modifications and embodiments will occur to those skilled in the art which are intended to be covered within the scope of the appended claims.

We claim:

1. Apparatus for forming fibers comprising a sub-

stantially horizontal shaft, driving means for rotating said shaft, a spinner mounted on said shaft for rotation thereby and having a perforate peripheral rim, means for depositing solid particulate fiber-forming material directly upon the inner surface of the perforate area of said rim, and means for heating said spinner to melt said material on the perforate area of said rim and maintain said rim at fiber-forming temperature whereby such molten material is projected through the perforations in said rim to form fibers.

2. Apparatus for forming fibers comprising a spinner having a peripheral rim including an annular perforate area, means for rotating said spinner, supply means having a discharge end for feeding solid particulate fiber-forming material to said spinner, said spinner being positioned with the inner surface of a portion of said perforate area substantially directly beneath the discharge end of said supply means and disposed to receive solid particulate material therefrom directly upon the inner surface of the annular perforate area of said rim as said spinner is rotated, and means for supplying heat to melt said material on said perforate area and maintain said area at fiber-forming temperature whereby the resulting molten material is projected through the perforations in said rim by centrifugal force.

3. Apparatus as in claim 2 including means for supplying heat to a portion of said spinner in close proximity to the inner surface of said rim.

4. Apparatus for forming fibers comprising a spinner having a peripheral rim including an annular perforate area, means for rotating said spinner, means for supplying solid particulate fiber-forming material directly to the inner surface of the perforate area of said rim, and means for heating said spinner to melt said material on the perforate area of said rim and maintain said rim at fiber-forming temperature whereby such molten material is projected through the perforations in said rim to form fibers.

5. Apparatus as in claim 2 including secondary attenuation means associated with the spinner to reduce the diameter of the fiber as it is formed.

6. Apparatus as in claim 2 in which the heating means is a gas burner.

7. Apparatus as in claim 2 in which the heating means is an electric induction heater.

8. Apparatus as in claim 2 in which the supply means is a helical conveyor.

9. Apparatus as in claim 2 in which the supply means is a vibratory trough feeder.

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