April 24, 1956 M. J. AUER 2,743,136

FIBERIZING NOZZLE

Filed Jan. 27, 1955 2 Sheets-Sheet 1

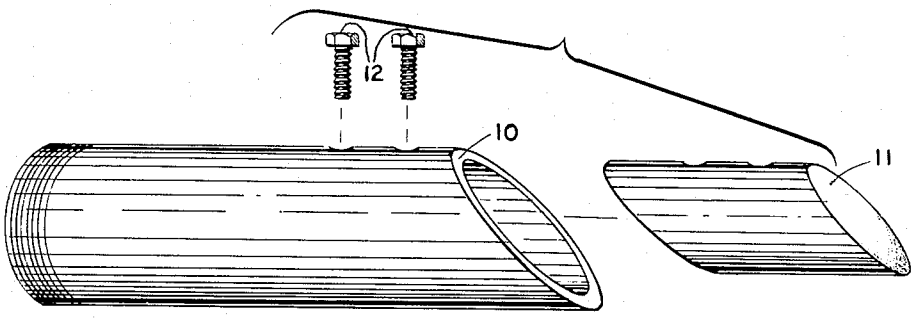

Fig. 1

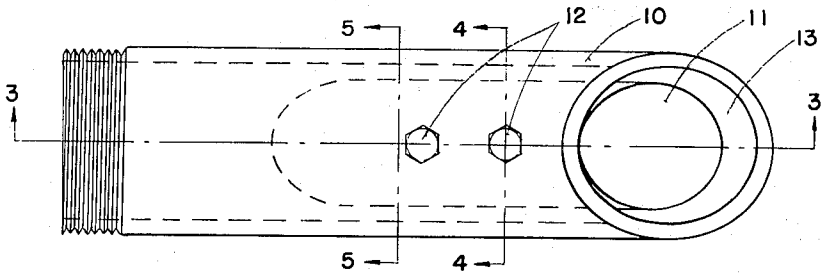

Fig. 2

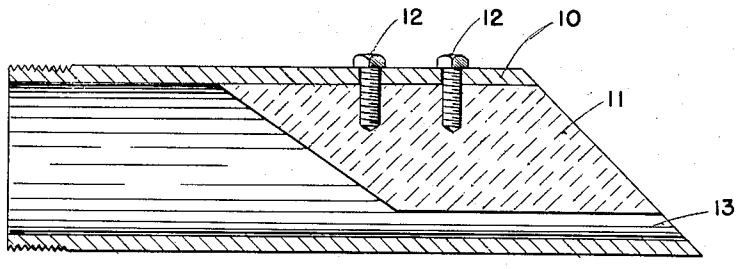

Fig. 3

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FIBERIZING NOZZLE

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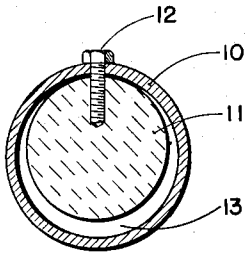

Fig. 4

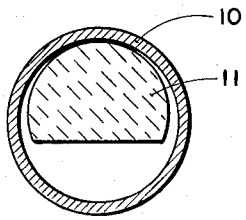

Fig. 5

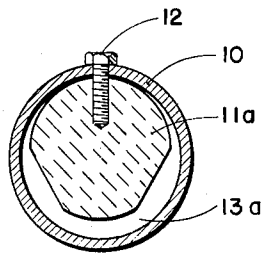

Fig. 6

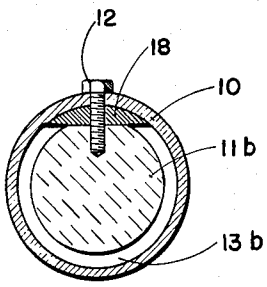

Fig. 7

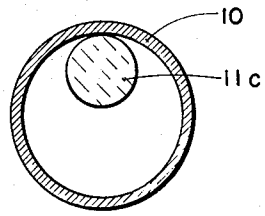

Fig. 8

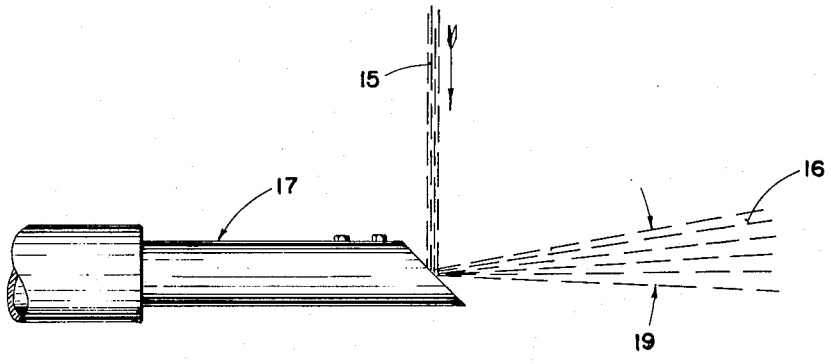

Fig. 9

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FIBERIZING NOZZLE

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Application January 27, 1955, Serial No. 484,380

5 Claims. (Cl. 299—107)

This invention relates to apparatus for the manufacture of inorganic fibrous material. More particularly this invention pertains to a new nozzle for use in the manufacture of blown inorganic fibrous material.

The manufacture of inorganic fibrous material ordinarily comprises releasing a stream of molten inorganic material and subjecting the released stream to fiberizing means. The fiberizing means may be rotating discs, with the released molten stream impinging upon the rotating discs and being fiberized thereby. Fiber made in this way is known as spun fiber. Alternatively, the fiberizing means may be a high velocity blast of a gas such as steam or air, directed against the falling molten stream, thereby fiberizing it, in which case the thusly produced fiber is known as blown fiber. The present invention pertains to the use of the latter means for fiberizing the molten stream, and in particular relates to a novel nozzle for releasing the high velocity blast of gas.

Heretofore, in the manufacture of blown inorganic fiber, the released stream of molten inorganic material was released so as to fall in front of and out of contact with the nozzle that is releasing the high velocity blast of gas. The gas blast impinged upon the vertically falling stream of molten inorganic material changing the direction of movement of the molten material to horizontal, breaking up the stream into numerous molten globules and attenuating the individual globules to form fibers. The blast of gas was therefore required to perform three functions, namely, change the direction of motion of the molten inorganic material from vertical to horizontal, break up the stream of molten inorganic material into individual globules, and attenuate the globules into fibers.

It is an object of the present invention to provide a blast nozzle for use in the manufacture of blown fiber, which nozzle permits the utilization of a substantially greater percentage of the energy of the gas blast in attenuating molten inorganic material to form fibers.

For a better understanding of the present invention reference is made to the drawings, in which:

Figure 1 is an expanded perspective view showing the various parts of the nozzle of Figure 2 dissembled;

Figure 2 is a plan view of the preferred blast nozzle of the present invention;

Figure 3 is a sectional longitudinal elevation taken along line 3—3 of Figure 2;

Figure 4 is a sectional transverse elevation taken along line 4—4 of Figure 2;

Figure 5 is a sectional transverse elevation taken along line 5—5 of Figure 2;

Figure 6 is a view similar to Figure 4, but of a modified form of the blast nozzle of the present invention;

Figure 7 is a view similar to Figure 4, but of another modified form of the blast nozzle of the present invention;

Figure 8 is a view similar to Figure 5, but of still another modified form of the blast nozzle of the present invention; and

Figure 9 is a schematic view showing the use of the

blast nozzle of the present invention in the forming of inorganic fibrous material.

In accordance with the preferred form of the present invention, the blast nozzle comprises a hollow open-ended cylindrical conduit **10**, one end of which may be threaded for connection to the desired high pressure gas line. The other end of the conduit **10**, the blast end, is sloped forwardly in a downward direction so that it lies in a plane that is at an angle of 20° to 70°, preferably 45°, with the axis of the cylinder.

Within the conduit **10** there is a core **11** positioned adjacent the top of the conduit and held in position against the top inside wall of the conduit **10** by means of bolts **12**. The outer face (or front face, considering the blast end of the conduit as the front) of the core **11** is also sloped forwardly in a downward direction so as to lie substantially in the plane of the blast end of the conduit **10**. The vertical cross-sectional area of the core **11** is less than the vertical cross-sectional area of the inside of the conduit, thereby providing an exhaust port or nozzle **13** of crescent shaped cross-section.

The inner or back end or face of the core, that is, the end of the core within the conduit and removed from the blast end of the conduit, preferably is tapered from a point adjacent the top of the conduit forwardly in a downward direction toward the blast end of the conduit at an angle of 15° to 45° with the axis of the cylinder, the angle of taper of the inner face of the core being in the same quadrant as the plane of the outer face of the core. However, if desired, the inner face of the core can be tapered or sloped in other directions, such as perpendicular to the axis of the cylinder. The inner face of the core can be a plane surface, as in Figures 3 and 5, or, if desired, as is shown in Figure 8, the inner end of the core can be conical, tapering to a point adjacent the top of the conduit so that the full length of the conical end section **11***c* is touching the top of the conduit.

Between the two end faces the core preferably is of uniform cross-section of more or less the same shape as the cross-section of the conduit. For example, as shown in Figures 1–4, both the conduit and the core may be round in cross-section, with the diameter of the core being somewhat less than the inner diameter of the conduit. Alternatively, as shown in Figure 6, the conduit may be round in cross-section and the core **11***a* be a modified circle. The nozzle shown in Figure 6 has the advantage of having an exhaust port or nozzle **13***a* of increased cross-sectional area. As shown in Figure 7, the core can be made in two sections, elements **11***b* and **18**. This particular construction gives an exhaust gap **13***b* of uniform radial width around the crescent. If desired, the conduit and core may be of other shapes such as elliptical, square, or even triangular shape so long as the exhaust port is more or less of crescent shaped cross-section and with no opening for exhaust of gas at the top of the conduit. The term "crescent shaped," as used in the present specification and claims to define the cross-sectional shape of the exhaust nozzle, is intended to include not only a true crescent shape, such as the cross-section of the exhaust nozzle of Figure 4, but also modified crescent, U or V shapes such as those described above and those shown in Figures 6 and 7. Furthermore, it is not essential that the exhaust end of the conduit and core be a plane surface. In some instances it is desirable to have the front of the conduit and core curved either concavely or convexly, or even have a core of stepped front surface, so long as it slopes forwardly in a downward direction.

Referring now to Figure 9, in operation the nozzle of the present invention usually is positioned so that its axis is more or less in a horizontal direction. Stream **15** of molten inorganic material is released so as to fall vertical-

ly and impinge upon the tapered front face of the core **11**. Upon striking the core **11**, the stream of molten inorganic material is dispersed into globules which leave the point of contact with the core **11** in a more or less horizontal direction within the crescent shaped blast of high velocity gas coming out of the blast nozzle **17**. Upon coming in contact with the gaseous blast, the molten globules are attenuated, each forming an individual fiber, the overall result being the production of a mass of inorganic fibrous material **16**.

Since, upon striking the front face of the nozzle core, the stream of molten inorganic material is dispersed into many small globules that are moving in a substantially horizontal direction, no substantial percentage of the energy of the high velocity blast of gas is used to break up the stream and change its direction of movement. Consequently more of this energy is available for attenuating the globules into fibers. Because the use of the apparatus of the present invention permits the utilization of higher percentages of the energy of the gas blast for forming fibers, usually substantially higher fiber yields are obtained when using this apparatus than are obtained when using the prior art vertically faced nozzle that does not come in actual contact with the falling stream of molten inorganic material.

Use of the nozzle of the present invention has still a further advantage in that the angle of divergence of the fiberized material, as indicated by the numeral **19** and arrows in Figure 9, is much smaller when using this nozzle than when using a prior art straight-faced nozzle. Consequently, collection of the fiberized material is greatly facilitated.

In summary, the essential characteristics of the nozzle of the present invention are that the core and the conduit form a generally U-shaped exhaust port and that the front face of the core be tapered downwardly in a forward direction (forward being the direction of movement of the gas blast) thereby providing a sloped surface on which the falling stream of inorganic material can impinge so as to be broken up and have its direction of motion changed from vertical to substantially horizontal.

The conduit **10** may be made of any gas-impervious material that can withstand the temperature of the gas passing therethrough. Preferably the conduit is ordinary cast iron pipe. The core **11** usually is made of a somewhat more refractory material, in view of the fact that temperatures up to 2000° C. may be encountered in the manufacture of inorganic fibrous material. In the preferred form of the present invention the core is machined from ordinary electrode graphite.

The size of the conduit and core of the nozzle are determined primarily by the volume of the released stream of molten inorganic material. For example, the inner diameter of the conduit **10** can range from a fraction of an inch for fiberizing small streams of molten inorganic material up to several inches for fiberizing relatively large volume streams. By way of example, a nozzle comprising a 1½ inch I. D. iron pipe conduit with a 45° slope to the exhaust end and having a 1⅜ inch graphite core therein shaped in accordance with Figures 1–5, operating on 100 p. s. i. steam was found to fiberize about 900 pounds per hour of molten inorganic material having a composition of substantially 50% alumina and 50% silica. In contrast, a straight faced crescent shaped nozzle of the same cross-section using 100 p. s. i. steam was found to fiberize only about 800 pounds per hour of the same composition.

While the blast nozzle of the present invention is described primarily in connection with its use in the manufacture of inorganic fibrous material it is to be pointed

out that such a nozzle is suitable for use in the manufacture of other blown inorganic materials. For example, it may be used as the blast nozzle for converting a falling stream of molten mullite into mullite bubbles. Therefore the present invention is not intended to be limited to the use of this blast nozzle in the manufacture of inorganic fibrous material.

Having described the invention it is intended to claim:

1. A blast nozzle comprising an open-ended conduit through which the blast gas passes, the blast end of which conduit slopes forwardly in a downward direction at an angle of 20° to 70° with the axis of the conduit, and a core positioned within and adjacent the top of said conduit, the outer face of said core lying substantially in the plane of the blast end of said conduit, the cross-sectional area of the core being less than the cross-sectional area of the inside of said conduit thereby providing an exhaust port of generally crescent cross-section.

2. A blast nozzle comprising an open-ended conduit through which the blast gas passes, the blast end of which conduit slopes forwardly in a downward direction at an angle of 45° with the axis of the conduit, and a core positioned within and adjacent the top of said conduit, the outer face of said core lying substantially in the plane of the blast end of said conduit, the cross-sectional area of the core being less than the cross-sectional area of the inside of said conduit thereby providing an exhaust port of generally crescent cross-section.

3. A blast nozzle comprising an open-ended conduit through which the blast gas passes, the blast end of which conduit slopes forwardly in a downward direction at an angle of 20° to 70° with the axis of the conduit, and a core positioned within and adjacent the top of said conduit, the outer end of said core lying substantially in the plane of the blast end of said conduit, and the inner face of said core being tapered from a point adjacent the top of said conduit forwardly in a downward direction at an angle of 15° to 45° with the axis of the conduit, the cross-sectional area of the core being less than the cross-sectional area of the inside of the conduit thereby providing an exhaust port of generally crescent cross-section.

4. A blast nozzle comprising an open-ended cylindrical conduit through which the blast gas passes, the blast end of which conduit slopes forwardly in a downward direction at an angle of 20° to 70° with the axis of the conduit, and a core positioned within and adjacent the top of said conduit, the outer face of said core lying substantially in the plane of the blast end of said conduit, the cross-sectional area of the core being less than the cross-sectional area of the inside of said conduit thereby providing an exhaust port of generally crescent cross-section.

5. A blast nozzle comprising an open-ended cylindrical conduit through which the blast gas passes, the blast end of which conduit slopes forwardly in a downward direction at an angle of 20° to 70° with the axis of the conduit, and a core positioned within and adjacent the top of said conduit, the outer face of said core lying subsantially in the plane of the blast end of said conduit, and the inner end of said core being tapered from a point adjacent the top of said conduit forwardly in a downward direction at an angle of 15° to 45° with the axis of the conduit, the cross-sectional area of the core being less than the cross-sectional area of the inside of the conduit thereby providing an exhaust port of generally crescent cross-section.

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