Nov. 4, 1969 P. M. DOWNIE 3,476,323

NOZZLE

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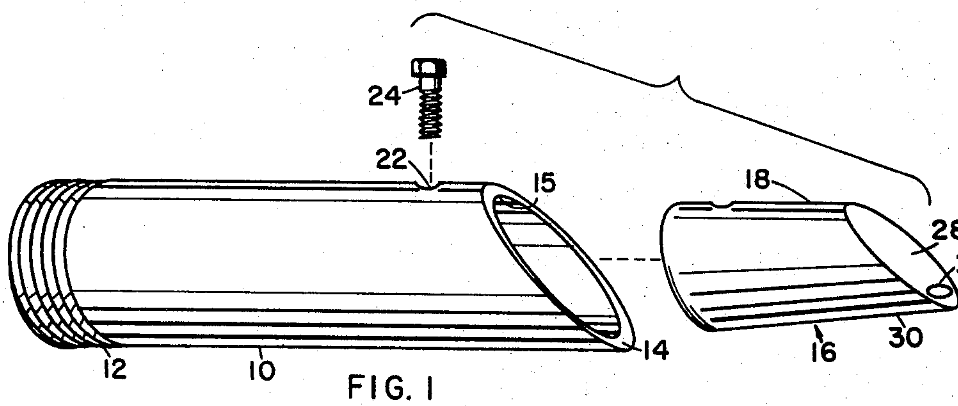

FIG. 1

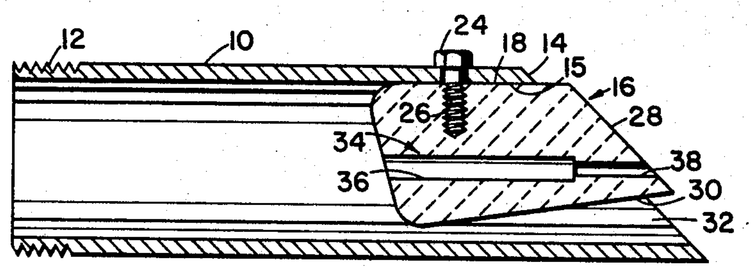

FIG. 2

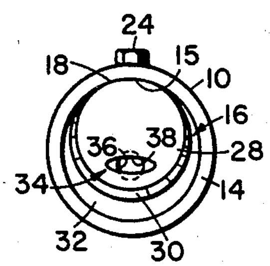

FIG. 3

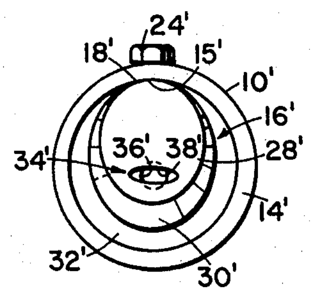

FIG. 4

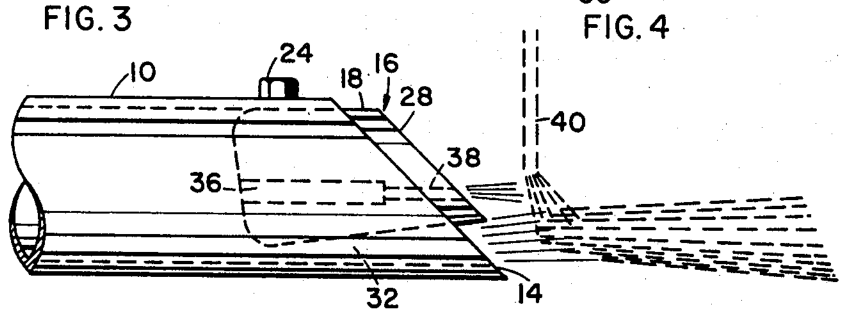

FIG. 5

INVENTOR.
PETER M. DOWNIE
BY K. W. Brownell

United States Patent Office

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NOZZLE

Peter M. Downie, Niagara Falls, N.Y., assignor to The Carborundum Company, Niagara Falls, N.Y., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

A nozzle for passing a gas stream therethrough having a conduit and an insert plug disposed within and attached to said conduit. The plug is of a lesser cross-sectional area than the inside diameter of the conduit to define an exhaust port. A passageway is drilled through the insert plug to provide a second exhaust port.

This invention relates to apparatus used in the manufacture of inorganic fibrous material and, more particularly, to a new and improved nozzle employed in the production of blown inorganic fibrous material.

Normally, in the manufacture of inorganic fibrous material, a stream of molten inorganic material is released and subjected to a fiberizing means. One such fiberizing means may be a high temperature, high velocity blast of gas, such as steam or air, directed at approximately right angles against the molten stream thereby forming many small globules and attenuating them into discrete bodies or fibers.

The production of inorganic fibrous material, particularly ceramic fibers, by the above process has resulted in a product having a relatively low fiber content or percentage of pure fiber obtained from the blown mass of material collected, the remainder of the material being "shot" or unfiberized material. Attempts have been made to solve this problem by inserting cores within the blast end of a nozzle and, although these improved nozzle designs have served the purposes for which they were designed, they have not been entirely satisfactory due to their inability to materially improve the quality of the fiber.

The apparatus of the present invention, as hereinafter described, substantially increases the fiber content or quality of the blown finished product by providing a nozzle having a new and improved core or insert plug incorporated therein, said plug being provided with a passageway to provide a second jet of gas. Utilization of the nozzle of the present invention has improved the fiber quality 25% over that produced by other prior known nozzles.

Accordingly, it is an object of the present invention to provide a new and improved blast nozzle for use in the manufacture of blown fibers.

It is another object of the present invention to provide a new and improved blast nozzle having novel means incorporated therein for improving the quality of the blown fiber.

It is still another object of the present invention to produce an improved finished product having a smaller percentage of "shot" or unfiberized material therein.

It is a specific object of the present invention to provide a new and improved blast nozzle having a new and improved core or insert plug provided with a gas passageway therethrough.

These and other objects of the present invention will become more apparent upon consideration of the following detailed description thereof when taken in conjunction with the following drawings, in which:

FIG. 1 is an exploded perspective view illustrating the various parts of the blast nozzle constructed in accordance with the principles of this invention;

FIG. 2 is a longitudinal sectional view of the assembled blast nozzle shown in FIG. 1;

FIG. 3 is an end elevational view looking into the outlet end of the blast nozzle shown in FIG. 2;

FIG. 4 is an end elevational view illustrating another embodiment of the blast nozzle of the present invention; and

FIG. 5 is a schematic view showing the use of the blast nozzle of the present invention in the forming of inorganic fibrous material.

Referring to the drawings it will be seen that a blast nozzle constructed in accordance with the principles of this invention comprises a hollow cylindrical conduit **10** provided with external threads **12** at one end thereof cooperable with an internally threaded high pressure gas line (not shown). The other end or outlet end of conduit **10** terminates in an inclined end portion **14** which is sloped forwardly and downwardly and preferably lies in a plane at an angle of approximately 45° relative to a horizontal plane taken through the axis of said conduit. It should be appreciated that the principles of this invention envisage the end portion **14** to be sloped at angles greater or less than 45°, if desired. For purposes of this description, the front or forward end is taken to be the outlet end or the right-hand side of conduit **10** as viewed in FIG. 2. Also, the terms top, bottom, upper, lower and the like as used herein are referenced to FIGS. 2 and 3 and are applied only for convenience of description and should not be taken as limiting the scope of this invention.

Rigidly secured within conduit **10** adjacent the inner upper surface **15** thereof is a core or insert plug, generally designated **16**, of lesser cross-sectional area than the inside of conduit **10**, said core having an upper arcuate surface portion **18** abutting the inner upper surface **15** of conduit **10**. An aperture **22** is provided in the upper wall of conduit **10** for receiving suitable securing means such as a bolt **24** having suitable threads thereon engageable with a threaded bore **26** of insert plug **16**.

As shown in FIG. 2, the forward portion of insert plug **16** preferably protrudes outwardly beyond a plane of the end portion **14** of conduit **10** and is provided with an end face **28** which slopes forwardly and downwardly at approximately the same angle as the plane of end portion **14**. However, if desired, face **28** may lie substantially in the plane of end portion **14** or rearwardly thereof within the purview of the present invention.

Insert plug **16** is substantially a truncated cone in shape with the upper peripheral arcuate surface portion **18** thereof milled to conform to the inner upper surface **15** of conduit **10** so that said portion **18** lies flush with the inner surface **15**. The remaining peripheral surface portion **30** of the plug converges toward the longitudinal axis thereof and is preferably tapered at an angle of approximately 2.5° as shown exaggerated in FIG. 2. Thus, it will be seen that the cross section of insert plug **16** is progressively reduced in cross section from the rear end thereof toward the front face **28** to form a divergent exhaust port or passageway **32** of a crescent shaped cross section. It should be realized that taper angles greater or less than 2.5° may be employed within the purview of the present invention. Furthermore, the principles of this invention contemplate the use of insert plugs which are cylindrical in shape, if desired.

Insert plug **16** is provided with a passageway, generally designated **34**, extending from the rear end of the plug **16** to the front face **28**. Passageway **34** is substantially circular in cross section for the major portion of its length as indicated at **36** and is elliptical in cross section for the remaining portion of its length as indicated at **38**, said elliptical shaped portion terminating at the front face

28 to form another exhaust port or outlet. It should be appreciated by those skilled in the art that the cross section of the remaining portion 38 of passageway 34 may take various forms, such as circular, arcuate, rectangular, a V-shape, an inverted V-shape, etc., as desired.

In operation, the outlet end of the nozzle is so positioned that its axis lies in a substantially horizontal direction to release a high velocity blast of gas of crescent shaped cross section formed by the crescent shaped opening 32 between nozzle 10 and insert plug 16. A stream 40 of molten inorganic material is released so as to fall vertically just forwardly of the outlet end of the nozzle into the trough shaped formation or "pocket" of the gaseous blast. With conventional nozzles, the molten material is turned 90° in a substantially horizontal direction and fragmented into numerous globules or droplets which are, in turn, attenuated into fibers.

With the present invention, a jet of gas 42 is directed by way of passageway 34 into the molten stream 40 to deflect the stream angularly from its vertical path, as illustrated in FIG. 5, and to separate the thick mass into a plurality of thinner streams prior to their contacting the "pocket" of the main gaseous blast 44 to facilitate fragmentation of the streams into globules and attenuate the same into fibers.

FIG. 4 shows an end view of another embodiment of the nozzle of this invention which is very similar to the above-described embodiment with the exception that the insert plug 16′ has a substantially oval shaped cross section and an arcuate exhaust port or outlet 38′ formed in the front face 28′ of said plug. In this embodiment, the same numbers primed are used to identify elements which are similar to those used in the first embodiment.

The cresent shaped gas stream resulting from the cres-cent shaped opening between the bottom of the plug and the nozzle provides the thickest gas stream at the bottom and a continually decreasing thickness up each recurving side. The bottom must have enough energy and thickness to prevent the melt from penetrating through it since the fragmentation process results from the initial exchange of energy between the two streams. The expansion and entrainment of ambient air around the upper portion of the gas stream provides an envelopment of the molten fragments in the fiberizing zone as opposed to non-recurving streams which simply enlarge by entrainment and may push fragments out of the fiberizing zone entirely. A problem arises when handling high pour rates of molten streams, such as 1000 lbs./hour by way of example, because this large a stream cannot be readily contained in the pocket of the crescent shaped gas stream and excessive flaring out of the top of the pocket results. The second embodiment has an advantage over the embodiment first described in that the oval plug creates a deeper pocket and thereby improves melt control.

As a result of the present invention, a new and improved nozzle is provided for forming fibers from a molten inorganic material in an improved and more efficient manner. By the provision of a novel designed insert plug having a passageway therethrough, a secondary jet of gas is directed into the molten stream to increase the percentage of pure fiber obtained from the blown mass of material collected. By the provision of an oval shaped insert plug, a deeper pocket of the crescent shaped gas stream is formed to materially improve melt control.

Preferred embodiments of the principles of this invention having been hereinabove described and illustrated, it is to be realized that modifications thereof can be made without departing from the broad spirit and scope of this invention.

I claim:

1. A nozzle comprising: a conduit having an inner surface and an outlet end through which a gas stream passes; an insert plug disposed within said conduit adjacent said outlet end thereof and having a first peripheral portion abutting said inner surface of said conduit; means for securing said first peripheral portion of said insert plug to said inner surface of said conduit; said insert plug having a lesser cross-sectional area than the cross-sectional area of the inside of said conduit to define an exhaust port of generally crescent cross-section; and a passageway extending longitudinally through said insert plug to provide a second exhaust port.

2. A nozzle as defined in claim 1 in which said outlet end of said conduit has an end portion lying in a plane that is inclined relative to the longitudinal axis of said conduit.

3. A nozzle as defined in claim 2 in which said insert plug terminates in an end face that is inclined relative to the longitudinal axis of said plug and protrudes outwardly beyond said outlet end of said conduit.

4. A nozzle as defined in claim 3 in which said plug has a second peripheral portion converging toward the longitudinal axis of said plug and tapering toward said end face.

5. A nozzle as defined in claim 3 in which said plug is substantially oval shaped in cross section, the major diameter lying in a vertical plane.

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EVERETT W. KIRBY, Primary Examiner

U.S. Cl. X.R.

239—424, 428, 553.5, 601, 599