Feb. 1, 1966 J. B. WINN, JR 3,232,557

CONTROL OF CONTINUOUS FIBER ROVINGS

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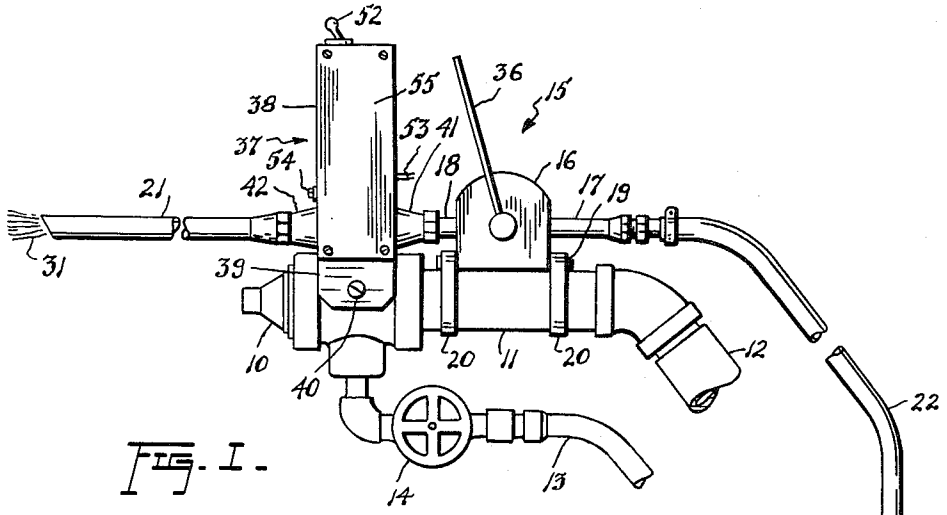
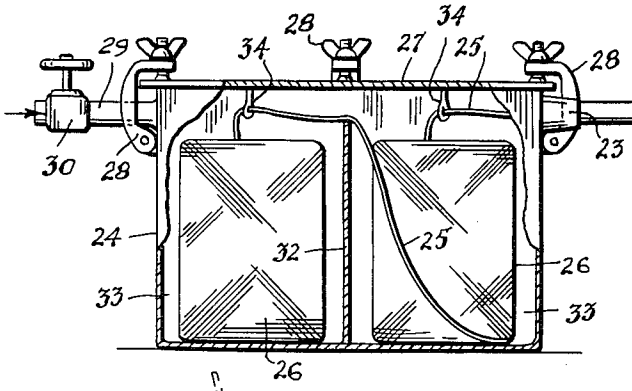


Fig. 1.



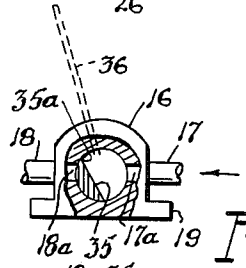


Fig. 3.

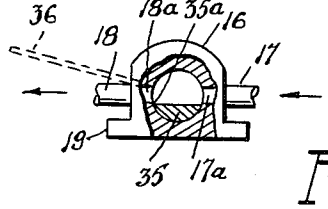


Fig. 3a

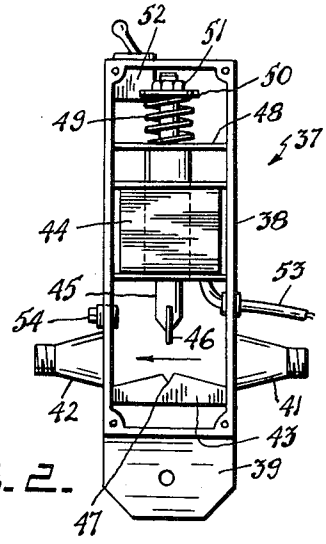


Fig. 2.

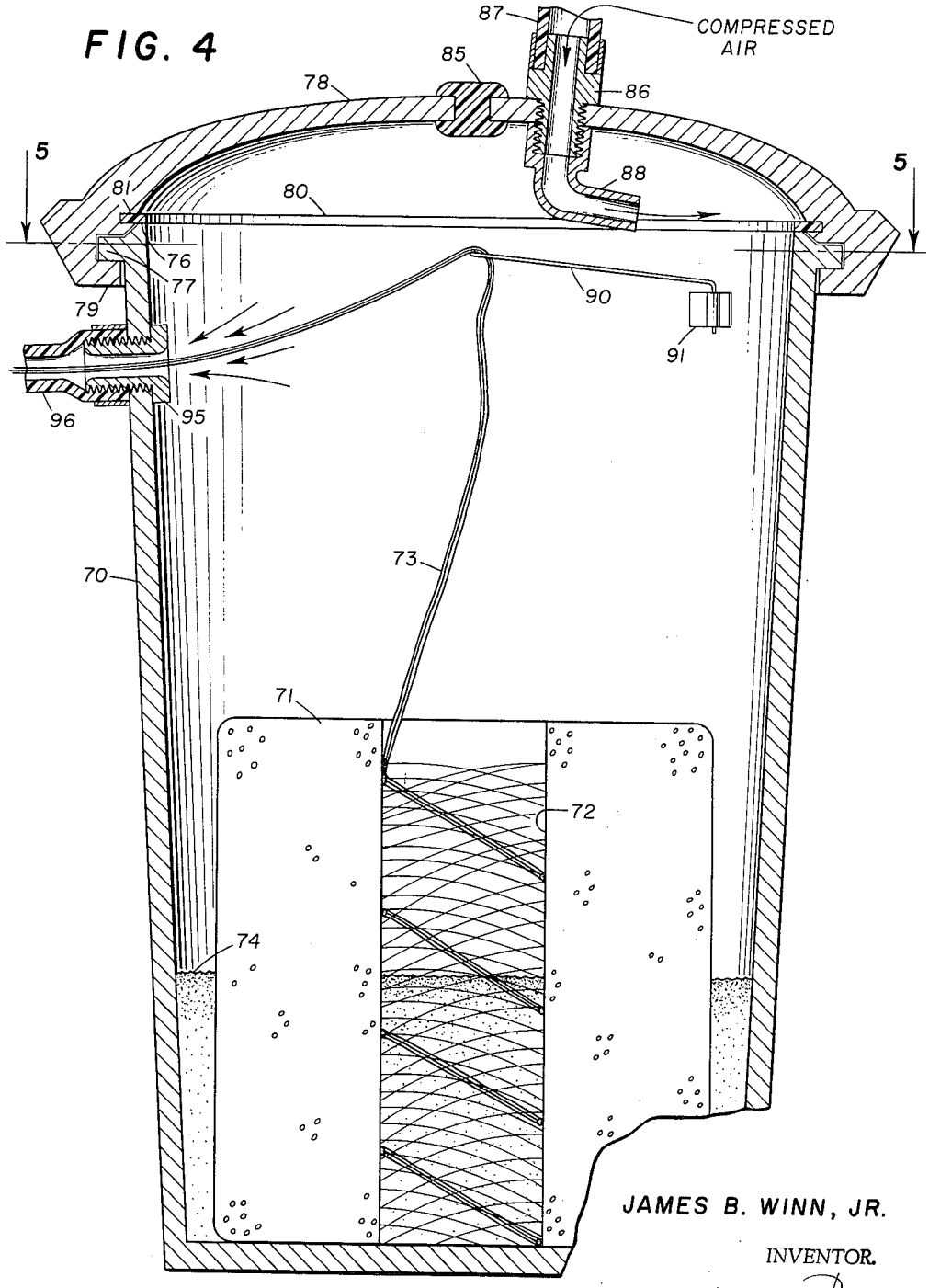
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FIG. 4



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CONTROL OF CONTINUOUS FIBER ROVINGS

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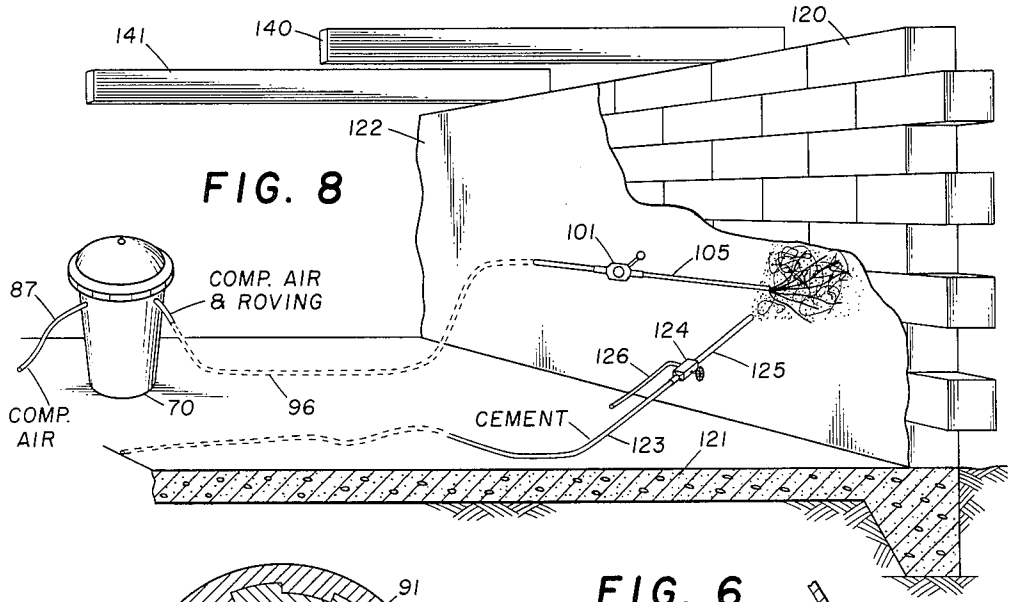


FIG. 8

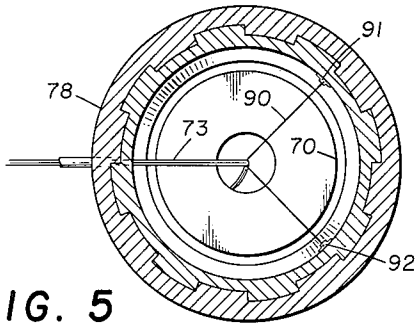


FIG. 5

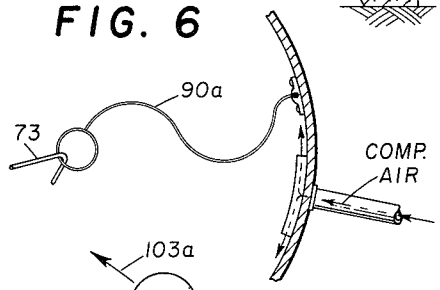


FIG. 6

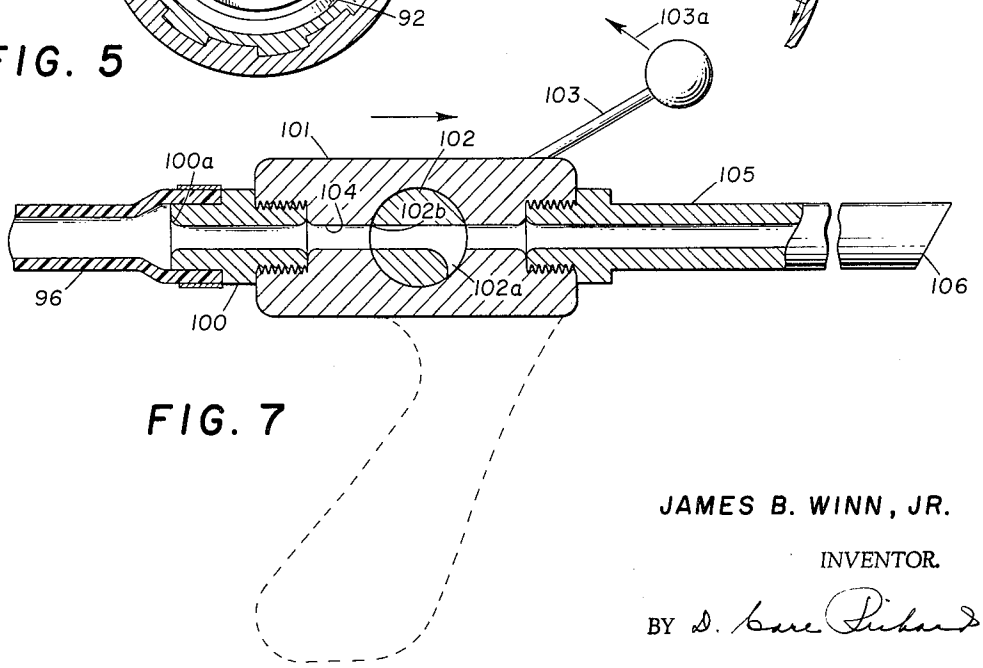


FIG. 7

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United States Patent Office 3,232,557 Patented Feb. 1, 1966

3,232,557

CONTROL OF CONTINUOUS FIBER ROVINGS

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Filed June 29, 1962, Ser. No. 206,504
4 Claims. (Cl. 242—146)

This invention relates to dispensing and use of fibrous material and more particularly to disposition of and transport by continuous fiber rovings of an auxiliary cooperating agent such as a powdered lubricant or the like.

The present invention relates to certain improvements in the invention disclosed in prior application Serial No. 672,723, filed July 18, 1957, now U.S. Patent No. 3,034,732, and also disclosed in continuation-in-part application Serial No. 722,678, filed March 20, 1958, now abandoned, of which this application is a continuation-in-part. It is to be understood that the present invention is not limited to the environment of the specific disclosure in said earlier application Serial No. 672,723, now Patent No. 3,034,732, and that it may be used generally to facilitate dispensing of fibrous material under pressure, without or with dispensers for fluid cementitious material.

It is an object of the present invention to provide for coating and transporting of such coating by a continuous fiber roving such as fiber glass bundled together in continuous untwisted strands.

In accordance with prior techniques, the use of commercially available fiber rovings ordinarily packaged in spools has been found to introduce undesirable effects. It has been found to be difficult to maintain a dispensing system in operation for extended periods by reason of the accumulation of unwanted debris which tends to foul the dispensing system. In addition, the movement of highly insulating fiber strands generates electrostatic charges which produce undesirable force fields.

Applicant has found that fibers suitably treated can be dispensed, avoiding the difficulties above mentioned.

More particularly, applicant has provided a combination in a system where continuous fibers are to be dispensed which includes a spool of rovings of continuous filaments. To said spool there is provided preferably a conductive powdered solid disposed as to enshroud the roving as it travels from the spool to provide lubrication therefor while maintaining electrostatic forces thereon at a minimum.

In accordance with a further aspect of the invention, there is provided an article of manufacture which comprises a spool of fiber glass strands bundled to form a continuous roving. Preferably a talcum power is dispensed throughout the spool to coat the fibers for lubrication and control thereof upon withdrawal from the spool.

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a side elevational view of the present invention showing the dispensing gun connected to the pressurized container for the material to be dispensed and also showing means for attaching the gun to a suitable dispensing nozzle for cementitious material, said nozzle being shown by dotted lines and said container being shown partly in section to illustrate the construction thereof;

FIGURE 2 is a side elevational view of the comminuting means of the gun with its side cover plate removed;

FIGURE 3 is a side elevational view, partly in section, of the improved valve in its closed position;

FIGURE 3*a* is a side elevational view, similar to that shown in FIGURE 3 but with the valve in its open position;

FIGURE 4 is a sectional view of a preferred embodiment of the pressurized chamber for dispensing fibrous materials;

FIGURE 5 is a reduced sectional view taken along the line 5—5 of FIGURE 4;

FIGURE 6 is a partial sectional view, similar to FIG. 5, which illustrates a modification of a guide and a compressed air entry port;

FIGURE 7 is a sectional view of an improved fiber control gun; and

FIGURE 8 is a perspective view which illustrates a new method of forming a structure wherein brick are initially laid dry and subsequently reinforced with a mat of cement and fiber rovings.

Referring now to the drawings, a dispensing gun for fibrous material of the type provided in accordance with the present invention is shown in FIGURE 1. The gun is attached to and carried by a suitable structure forming apparatus which includes an outlet nozzle **10** at the end of a pipe or duct **11** which is connected by a hose **12** to a supply of fluid cementitious material, there also being provided a compressed air line **13**, equipped with a suitable valve **14**, which line enters the nozzle **10** for discharging the cementitious material through the nozzle under substantially large pressure. The structure thus far described is disclosed in Patent No. 3,034,732, and while rovings of the present invention are particularly well suited for use in conjunction with that structure, it is to be understood that the present invention may also be used with any suitable conventional dispensing means for cementitious material or in dispensing fibrous material alone.

In any event, the fibrous material dispensing gun is designated generally by the reference numeral **15** and comprises a control valve **16** having an inlet **17** and an outlet **18**, and also having base members **19** whereby the entire valve may be secured to the aforementioned pipe or duct **11** by suitable clamps **20**.

The outlet **18** of the valve **16** may communicate directly with a jet pipe or nozzle **21** which is substantially parallel with and projects beyond the nozzle **10** as shown, so that the fibrous material discharged from the jet pipe or nozzle **21** may become embedded in the cementitious material discharged from the nozzle **10** for purposes of reinforcement of the structure which is being formed.

The inlet **17** of the valve **16** is suitably connected to a flexible hose **22** which, in turn, communicates with an outlet nipple **23** on a hermetically sealed pressurized container **24**. The container **24** is adapted to receive therein fibrous material of the character provided by the present invention. Preferably the fiber roving is in continuous thread form as indicated at **25**, such material being wound on rolls as illustrated at **26**.

Access to the interior of the container **24** may be had upon removal of a cover **27** which is securely held in place by suitable clamp fasteners **28**, or the like, and the interior of the container is pressurized by compressed air admitted through an inlet pipe **29**. The latter is provided on the container **24**, preferably at a remote point from the outlet nipple **23**, and is equipped with a control valve **30**. The pipe **29**, of course, communicates with a suitable source of compressed air, and the resultant pressure existing in the container causes the fibrous material to pass from the container through the hose **22** and valve **16** for discharge under pressure through the jet pipe or nozzle **21**, as indicated at **31**.

The container **24** is adapted to accommodate two or more of the rolls **26** of the fibrous material and is pref-

erably provided with one or more partitions 32 to separate the interior thereof into compartments 33 for reception of the respective rolls of material so that the material does not become fouled when the supply on each roll is exhausted. The material 25 passes through guide eyes 34 at the underside of the cover 27 and over the top edge of the partition 32 as shown in FIGURE 1, the top edge of the partition being spaced downwardly from the cover thereby to maintain all the compartments of the container in communication.

As shown in FIGURES 3 and 3*a*, the valve 16 is of the rotary type, including a segment-shaped valve member 35 which is rotated by a suitable valve handle 36 and clears the inlet and outlet valve ports 17*a* and 18*a* when the valve is open as shown in FIGURE 3*a*. However, when the valve is closed as shown in FIGURE 3, the valve member 35 covers the outlet port 18*a* and prevents the passage of the fibrous material and compressed air through the valve to the nozzle 21. During the closing of the valve, the edge 35*a* of the valve member 35 moves with a shearing action over the port 18*a* and effectively cuts or severs the fibrous material passing through the valve. In this manner the valve 16 functions not only to control the flow of material through the same, but also as cutting or severing means for the fibrous material.

As already noted, the fibrous material is fed through the dispensing gun in a continuous thread form, which is satisfactory for most types of wall construction. However, in some instances it may be desirable to dispense the fibrous material in a comminuted form, that is, in the form of short cut fibers. For this purpose the dispensing gun may embody in its construction a comminuting device which is designated generally by the reference numeral 37 and comprises a vertically elongated housing 38 provided at its lower end with a suitable saddle 39 whereby it may be secured to the aforementioned nozzle 16, such as by suitable screws 40.

The lower portion of the housing 38 is equipped with axially aligned nipples 41, 42 for connection to the valve outlet nipple 18 and the jet pipe 21, respectively, and a chopping block 43 is mounted in the housing, somewhat below the level of the nipples 41, 42, so that it is disposed under the path of travel of the fibrous material passing from the valve 16 to the pipe 21.

The housing 38 also accommodates a solenoid 44, including a reciprocative armature 45, the lower end of which is equipped with a chopping blade 46 receivable in a transverse groove 47 formed in the chopping block 43. The upper end of the armature passes slidably through a horizontal partition 48 provided in the housing and carries a compression spring 49 which is retained thereon by a washer 50 and a nut 51. The spring 49 urges the armature 45 upwardly, but when the solenoid 44 is energized, the armature is drawn downwardly. The operation of the solenoid is controlled by a suitable switch 52 at the top of the housing and electric current is delivered to the switch and solenoid through a conductor 53 from any convenient source of intermittent or pulsating current, so that when the solenoid is in operation the armature 45 is rapidly reciprocated and the chopping blade 46, co-acting with the block 43, comminutes the fibrous material into short cut pieces.

The housing 38 is provided with a suitable plug 54 and with a removable side cover plate 55, whereby access to the interior of the housing may be had.

Since the flexible hose 22 and the electric conductor 53 constitute the only operative connections to the dispensing gun, the gun as a whole may be freely manipulated in conjunction with the apparatus 10, 11, 13, as will be clearly understood. It may be also noted that the arrangement of dispensing the fibrous material gives the operator positive control between zero and full volume of intermixing with cementitious material which may be also correspondingly controlled, whereby a wide range in proportions of the ingredients is effectively attained.

In the foregoing description of FIGURE 1 the cement gun 11 has been shown coupled to and integral with the fiber gun. It was noted, however, that the dispensing of fibers may be quite independent of any cementing operation. It has been found that the control of fiber glass rovings and the like can be accomplished, in accordance with the present invention, to provide a new measure of flexibility in the operations. In FIGURE 4, for example, there is illustrated an improved and preferred embodiment of a pressure vessel which receives a spool of glass rovings particularly adapted to dispense the glass rovings. A relatively deep vessel 70 is provided with inwardly sloping shaped walls and a flat bottom. The diameter of the vessel 70 preferably is larger than the diameter of a spool of rovings so that a spool can be loaded or unloaded from the vessel with ease. The spool of rovings 71 is of the type in which the supply may be unwound from the inner wall 72 of the spool. The roving strand 73 will be understood generally to comprise a bundle of parallel, untwisted, separate strands of glass fibers or the like. Glass fiber rovings are commercially available in spools of bundles of twenty, thirty, one hundred or two hundred strands. The specific features of the control system for dispensing rovings of various numbers of strands will depend upon the bundle size to some degree as will hereinafter be pointed out.

The vessel 70 is provided with an upper shoulder 76 for sealing purposes. It is also provided with an outwardly extending segmented rib 77 which mates with locking means provided on a lid 78. More particularly, the lid 78 is provided with a segmented, inwardly extending rib 79. As best seen in FIGURE 5, the ribs 77 and 79 are intermeshed so that the lid can be placed over the vessel 70 and rotated to engage the ribs 77 and 79. A gasket 80 is carried in an annular recess 81 in the lid 78 so that, when the lid is locked onto the vessel 70, the gasket will bear on the upper shoulder 76.

The lid is provided with a blowout gasket or plug 85. The construction of the plug will be dependent upon the pressures to be employed in the given system. Also extending through the top of the lid 78 is structure forming a flow channel. More particularly, a threaded bushing 86 and a supply line 87 are provided for introduction into the vessel 70 of compressed air or gas. The bushing 86 is threaded into the lid 78 and a fitting 88 is secured inside the lid onto the threaded extension of the bushing 86. The fitting 88 comprises an elbow in which the direction of flow of the compressed air is diverted as to be parallel to the inner surface of the lid and is thus prevented from impinging directly onto the spool 70 and the roving strand 73 as it courses upward from the spool 71.

A roving guide 90 is provided in the upper region of the vessel 70. The guide 90 in the form shown in a V-shaped yoke which extends from anchor tabs 91 and 92 upward and toward the center of the vessel 70 to an apex which is located generally in the region of the axis of the vessel 70. The guide 90 is formed of a rigid smoothed-surface wire so that there will be minimized any entanglement or tendency to interrupt or interfere with the flow of the strand 73.

The strand 73 is threaded over the guide 90 and then extends through an outlet bushing 95 which is threaded into the wall of the vessel 70. A flexible hose 96 is secured to and extends from the bushing 95. The bushing 95 is provided with a central flow channel through which the strand 73 passes. The bushing is formed with a faired or rounded entry which is smooth so that there will be a minimum of wear or friction on the fibers as they enter therein. The fibers then course through the flexible hose 96 to a control gun such as shown in FIGURE 6.

Before proceeding with a description of FIGURE 6, it is emphasized that a fiber gun which will operate for extended periods is dependent upon the manner of control exercised upon the roving 73. In the course of pro-

ducing spooled rovings, small segments or short lengths of fiber glass are found interspersed in the spool. Further, the movement of fiber rovings at relatively high velocities serves to establish electrostatic charges in the system so that there is a tendency to pull to the discharge port in the fitting **95** debris and bits of glass fibers. Such debris tends to clog or disrupt the uniform flow of the fibers.

In accordance with the present invention, control is materially enhanced by the inclusion of a suitable treating substance in or on the spool **71**. More particularly, there is provided a lubricant for the fiber roving which in one form is a talcum powder. As indicated in FIGUSE 4, the spool **71** is set on the bottom of the vessel **70**. Talcum powder is then provided in quantity sufficient to fill the center void and the annulus around the spool **71** to a suitable level generally indicated by the level **74**. Some of the powder will be heaped onto the upper surface of the spool **71** so that the fiber as it is withdrawn from the spool will be coated with talcum which serves to lubricate the fiber in its course through the hose **96**. Additionally, the talcum serves to assist in the removal of any electrostatic charge accumulated on the fiber roving as it is entrained for movement from vessel **70**.

In a further aspect of the invention, a spool of fiber rovings having the lubricant impregnated therein and distributed throughout the entire spool facilitates the handling of the rovings. Other lubricants than talcum powder have been employed with satisfactory results. Powdered asbestos, carbon and aluminum have been used satisfactorily. Furthermore, by incorporatinng such materials into the spool of rovings itself, they can be dispensed in measured amounts proportional to the amount of roving drawn from the spool. In systems where the rovings are to be incorporated in a matrix of cementitious material applied by spraying or other means, chemical additives such as catalysts, foaming agents or setting agents or inorganic binders such as lime are dispensed along with the fiber roving. Thus, not only are the mechanics of handling the roving facilitated by lubrication and static electricity control but constituents employed in the ultimate matrix can be and are dispensed in accordance with this aspect of the invention.

Chemicals dispersed preferably uniformly throughout the spool of rovings **71** may selectively accelerate or inhibit foaming or the like in any matrix in which the fiber rovings are ultimately deposited. Thus, there is provided a measure of control built into the spool of fiber rovings.

In FIGURE 5, the fiber control gun is illustrated as being coupled by way of the hose **96** leading from the vessel **70** of FIGURE 4. Hose **96** is connected to a bushing **100**. The bushing **100** is part of a flow channel extending through the gun structure **101**. A plug valve **102** is adapted to be rotated by a control handle **103**. As indicated, the plug valve **102** is positioned in a cylindrical opening in the valve body **101** and permits fiber flow thorugh channel **104** in the open position. A pipe **105** extends from the forward end of the valve body **101**. The flow channel **104** continues through the pipe **105** to a discharge point **106**.

It will be noted that the channel through the valve body **102** is generally cylindrical and is tapered at the downstream section **102***a*. By this means, there is avoided the cutting of small segments of rovings when the valve is closed. Closure of the valve is brought about by moving the handle **103** in the direction of the arrow **103***a*. The edge **102***b* of the valve body serves to sever the rovings as the valve is closed. However, since the diametrically opposite edge of the channel passing through the valve **102** is relieved as at section **102***a*, the trailing edge of the glass roving is permitted to continue on through the nozzle section **105** and is thus discharged, leaving the gun free and clear for re-establishing flow immediately upon opening of the valve.

It has been found necessary to make the valve substantially pressure-tight when closed. Otherwise, leakage of air therethrough causes the rovings to pile up in the flow channel **96** adjacent to the valve and thus cause the operation to become fouled upon attempted resumption.

It will be noted that the fitting **100** is provided with smooth entry sections such as the faired entry port **100***a*. In addition, each connection element is similarly faired so that mecahnical working of the glass fibers as they pass therethrough is minimized. Production of debris in the channel which would foul the flow channel is substantially eliminated.

In FIGURE 8 the construction of a load bearing wall employing rovings of the present invention is illustrated. The wall **120** is erected using concrete blocks or similar components without the necessity of placing motor between the blocks. The structural elements are merely dry stacked by any suitable means including hand labor. Required only is that the stack be self-supporting or otherwise maintained erect temporarily. After the elements are stacked, two opposed exterior surfaces are sprayed with a concrete or cementitious mix into which there is also sprayed a mass of fiber strands such as roving **73** of FIGURE 4. When the cement sheath thus reinforced is cured, the wall is of load bearing capabilities substantially in excess of those of walls ordinarily produced. Structural strength is obtained greater than ordinarily found in structures produced by conventional methods of mortaring or bricklaying. This is for the reason that there is applied to the surfaces of the wall the reinforced concrete sheath which is adherent to the wall and thus is given body by the wall. At the same time, the reinforcing fibers in the concrete sheath serve to distribute stresses over the wall surfaces, minimizing local application of high stresses as would exceed the ultimate strength thereof.

In FIGURE 8, the stacked block wall is illustrated as extending along the edge of a concrete slab **121**. While the blocks are shown uniformly arranged with offset joints, they can be stacked in any manner such as will permit them to stand freely until the reinforced concrete sheath is applied. A reinforcing sheath **122** is shown substantially covering the inside surface of the wall as it would appear during application. A cement mixture is sprayed onto the wall surface from a conduit **123** leading to a control valve **124** and thence to a nozzle **125**. If desired or necessary, an auxiliary air line such as line **126** may be employed to facilitate the dispersion and application of the cement over the wall surface.

Also shown in FIGURE 8 are means for adding reinforcing fibers to the sheath **122**. The vessel **70** is shown with the compressed air input line **87** leading into the side thereof (in contrast with the lid coupling of FIGURE 4). The line **96** leading from the vessel **70** serves to convey glass rovings in an air stream to the control valve **101**. In practice, the valves **101** and **124** may be interconnected as to form a single unit with dual controls. Such a unit is shown in FIGURE 1. Both cement and fiber can be controlled by a single operator.

Alternatively, as disclosed in FIGURE 8, the fiber and cement guns are separate and are designed to be handled by two operators coordinating their efforts to apply a cement film onto the wall surface with a suitable quantity of reinforcing fibers embedded therein. As illustrated, the fibers issuing from the gun barrel **105** are dispersed due to the turbulence in the air stream as it issues from the nozzle **105**. As a result, they are deposited in a completely random pattern within the cement sheath **122**.

Production of a stacked block wall through the method above described incorporates load supporting capabilities not heretofore achieved in mortar construction. This results from the fact that the monolithic membrane or

sheath **122** joins the elements of the wall and strengthens the wall throughout the entire inner and outer surfaces. This permits transference of loads and stresses throughout the entire structure. As an example, the stacked block wall has greater than normal resistance to shearing and damage caused to foundations by beam loads as ordinarily encountered on isolated sections of the wall. The monolithic system, in other words, will support and withstand greater beam loads than conventional masonry construction because of the capability of this wall to act as a monolithic structure even though it is formed from basically separate elements such as the blocks illustrated in FIGURE 8. The wall may be formed to utilize broken blocks or bricks and second grade elements ordinarily unacceptable in usual construction. The practical result is to permit far more economical construction with substantially greater tensile and support strength characteristics. The method is also adaptable to incorporate various treatments of exterior designs, color and texture.

A wide variety of final finishes can be applied either as an integral part of the membrane **122** or by plastering, painting or spraying the exterior. In some operations it has been found convenient to incorporate the final color and finish onto the wall during the course of the application of a final cement coating. The latter coating may be applied by merely spraying cement onto the wall. Beams or timbers, such as beams **140** and **141**, may be anchored directly to the top of the wall **120** and may support floor or roof loads without further reinforcement of the wall structure.

Not only does the wall itself embody features not heretofore found in masonry type walls, but the erection and ultimate construction costs are substantially less than conventional brick or block walls in which mortar is placed between the blocks by trowel or by hand or by other conventional methods. A given wall section can be constructed more rapidly as well as more economically than conventional walls and resists not only load forces as applied by way of the beams **140** and **141**, but also resists impact forces applied laterally thereto by reason of the distribution of stress throughout the reinforcing fiber membrane **122**.

In carrying out construction operations such as illustrated in FIGURE 8, a concrete mix forming the cementitious material for the matrix of the shell **122** of the following constituents and relative proportions has been found to be satisfactory:

Table I

Portland cement	cubic feet	2
Polyvinyl alcohol or type such as Elevanol grade 51–05, available from Du Pont of Wilmington, Delaware	pounds	6
Perlite concrete aggregate (8 pounds per cubic foot)	cubic feet	2
Perlite aggregate 60–40	do	2
Standard plaster sand	do	3
Fly ash	pounds	12
Water	gallons	17

There results a light weight aggregate having a modulus of elasticity of the order of two to six million p.s.i. By reason of its relatively low modulus of elasticity and the inclusion therein of the alcohol, it is wholly compatible with fiber glass strands.

In a representative operation, a spray of such mixture was applied in a first application with approximately two and a half to three pounds of continuous fiber rovings per one hundred square feet. A three-sixteenth inch to one-fourth inch coating thickness was thus first applied. This was followed by an identical second coat to both faces of the wall **120**. Thereafter, a thin finish coat or cover of a suitable concrete mix only, without the fiber reinforcing, was applied to finish the wall surface.

Cement specified in Table I has been found to be suitable, the components being adjusted in different localities to utilize local aggregates. Other cementitious materials such as resins or synthetic cements may also be employed. Also, cores other than the hadite or concrete block core illustrated in FIGURE 8 may be employed. The requirements as to vertical load capacity and insulation would, in general, determine the type and thickness of the materials forming the core of the wall. The stressed skin or sheath of glass reinforced grout **122** would provide the flexural and compressive strengths necessary.

The wall illustrated in FIGURE 8 has been described as having been formed with the wall erected vertically in a final location. For non-load bearing walls, a simple scrim such as chicken wire or woven mesh paper or expanded metal, such as is ordinarily used as lathers diamond mesh could be used. Wall construction is characterized by erection of a suitable core and applying thereto a stressed skin over either one or both faces to receive the distribute lateral as well as vertical loads.

The method and system for dispersing the fiber rovings disclosed herein are described and claimed in an application of James B. Winn, Jr., filed concurrently herewith, entitled Dispensing of Fibrous Material, Serial No. 206,497, filed June 29, 1962.

Having described the invention in connection with certain specific embodiments thereof, it is to be understood that further modifications may now suggest themselves to those skilled in the art and it is intended to cover such modifications as fall within the scope of the appended claims.

What is claimed is:

1. In a system where continuous fibers are to be dispensed, the combination which comprises a spool of rovings of continuous fibers of electrically insulating material, a container for receiving said spool therein, and a bath of conductive powdered solid at least partially immersing said spool in said container as to enshroud the roving as it travels from said spool thereby to lubricate the same while maintaining at a minimum the electrostatic forces generated thereon by reason of movement thereof.

2. The combination set forth in claim **1** in which said bath is formed of talcum powder and said spool is fiber glass rovings.

3. In a system where continuous fibers are to be dispensed, the combination which comprises:

(a) a spool of rovings of continuous fibers of electrically insulating material,

(b) a container for receiving said spool therein, and

(c) a conductive powdered solid for enshrouding the roving as it travels from said spool thereby to lubricate the same while maintaining at a minimum the electrostatic forces generated thereon by reason of movement thereof.

4. In a system where continuous fibers are to be dispensed, the combination which comprises:

(a) a spool of rovings of continuous fibers of electrically insulating material,

(b) a container for receiving said spool therein, and

(c) a conductive powdered solid dispersed through said spool as to enshroud the roving when it travels from said spool thereby to lubricate the same while maintaining at a minimum the electrostatic forces generated thereon by reason of movement thereof.

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