Dec. 1, 1953 T. L. KATOVSICH 2,661,194

MIXER FOR USE IN JETTING APPARATUS

Filed Sept. 29, 1950

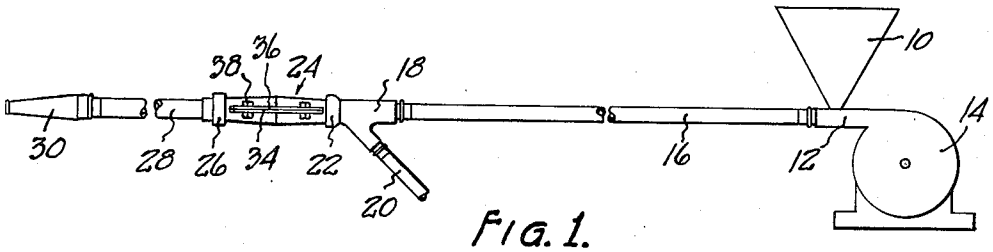

FIG. 1.

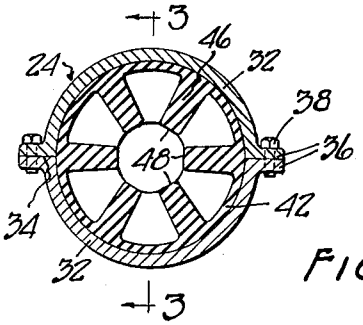

FIG. 2.

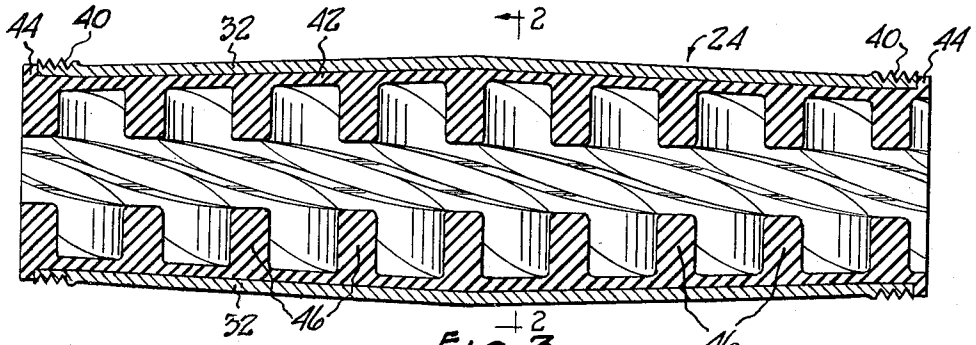

FIG. 3.

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Patented Dec. 1, 1953

2,661,194

UNITED STATES PATENT OFFICE

2,661,194

MIXER FOR USE IN JETTING APPARATUS

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Application September 29, 1950, Serial No. 187,416

12 Claims. (Cl. 259—151)

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This invention relates to mixers for use in jetting apparatus, and more particularly to a mixer for materials, such as concrete, which are discharged at high pressure and velocity in the nature of a jet against a surface which is to be coated.

Considerable difficulty has been experienced heretofore in connection with the use and operation of jetting equipment with respect to the complete and effective admixture of the material prior to supply thereof to a nozzle or other outlet member for discharge. The usual practice in jetting apparatus is to force the dry components of the material to a mixing point under pressure, such as air pressure, and to supply a liquid in proper proportions to said dry components so that the mixing action occurs in the device just ahead of the discharge point. In cases where concrete is being jetted, this is advantageous because it eliminates the possibility that long lines will have cement or concrete setting up therein or tending to block the same after usage of the equipment, for example, over night. Also the handling of equipment in this manner reduces the amount of pressure required, increases the flexibility of the unit, and has numerous other advantages.

Effective mixing of the ingredients of the material to be jetted and the uniformity of the mixture discharged has not been achieved by previous apparatus. Thus it has been found in many instances where cement is being jetted that the water will not completely mix with the Portland cement and the dry aggregate by the time the material is discharged, so that the Portland cement remains in powdered form as discharged, causing occurrence of or discharge of large amounts of dust which is objectionable from the standpoint of danger of silicosis to the operator and obstruction to the vision of the operator by coating of the goggles worn by the operator.

Other objections are that the lack of uniform mixing results in loss of a large amount of material, and in some instances the percentage of material lost with prior devices has run as high as fifty per cent of the total amount of material supplied. Still another disadvantage resulting from lack of uniformity of mixture has been that the material, as actually applied to a wall or other surface incident to the jetting operation, will not be uniform in consistency or in texture.

Therefore it is the primary object of this invention to provide a device which will overcome the aforementioned deficiencies and which will

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assure the uniform and accurate mixing of liquid and dry constituents of a plastic material to be discharged in a jet under pressure.

A further object of the invention is to provide a device which will withstand the abrasive action of material adapted to be ejected from a jetting nozzle while mixing such material effectively and uniformly insofar as moisture absorption and uniformity of composition is concerned.

Other objects will be apparent from the following specification.

In the drawing:

Fig. 1 is an assembly view illustrating jetting apparatus employing my improved mixing device.

Fig. 2 is a transverse sectional view of the mixer taken on line 2—2 of Fig. 3.

Fig. 3 is a longitudinal sectional view of this device taken on line 3—3 of Fig. 2.

Referring to the drawing which illustrates the preferred embodiment of the invention, and particularly to Fig. 1 which illustrates the assembled jetting apparatus, the numeral 10 designates a hopper or container for the dry components of the material to be jetted. For instance, if cement or concrete is to be jetted, the hopper will contain the mixture of Portland cement and sand and other mineral aggregate in the proportions and in the nature desired for the particular surface. It will be understood, of course, that cement is referred to herein strictly for purposes of illustration and that the apparatus may be employed for other materials, such as for use in jetting refractory material such as fire clay, for use with hydraulic or watertight plastic materials, and in fact for any material which is of a character that contains a certain amount of liquid and is rendered plastic when liquid is mixed therewith. The hopper 10 discharges preferably by gravity into a portion 12 of an air line. In the form illustrated, the part 12 constitutes the outlet of an air pump 14. Where cement is to be jetted, it is desirable that the pump shall be of a character which will generate pressures in the order of 80 pounds per square inch in a system or pipe having an interior bore of at least one inch in diameter.

The conduit or passage, of which the member 12 forms a part, is preferably formed principally from flexible conduit material, such as a rubber hose, suitably reinforced to withstand the pressures involved, such as a rubber hose having a wire or fabric reinforcement. Such a rubber or flexible hose or conduit 16 may be of any length found suitable and will preferably have a detachable joint or connection with the part 12 as

by means of a screw-threaded coupling member carried by the hose 16 and fitting into the part 12. The hose 16 may be of any length required for the purpose and location and requirements of the place at which the apparatus is to be used. At its free end, the flexible conduit 16 is preferably connected to a Y-shaped member 18 of the character commonly known in the art as a water ring. The conduit 16 is connected by any suitable detachable connector with one of the converging legs of the Y-member or water ring. Another conduit 20 containing water under pressure is attached to the other of the two converging legs of the water ring 18. The conduit 20 may constitute an ordinary flexible water hose, and water may be supplied therethrough at ordinary city water pressure in the order of 20 to 40 pounds per square inch in most instances. In the event a higher water pressure is required, it can, of course, be provided by the use of a supplementary pump. The water ring or Y-member preferably has an internally screw-threaded mouth or end portion 22, and my improved mixer 24 is preferably screw-threaded into that mouth at one end. The opposite end of the mixer is connected preferably by a detachable or screw-threaded coupling or fitting 26 with an elongated conduit 28 of a length in the order of about three feet, mounting upon its outer end a nozzle member 30 of the character well known in the art, which permits the discharge or ejection of a plastic mass in a stream or jet.

My improved mixer is best illustrated in Figs. 2 and 3 and comprises a metal sleeve or tube 32 which is split longitudinally along the parting plane 34 and whose parts or sections include radially outwardly projecting longitudinal flanges 36. The flanges 36 are apertured to receive securing members 38 for fixedly securing the sleeve parts together in register in a manner to withstand the application of high pressure and to withstand impact. The flanges 36 preferably terminate spaced from the ends of the sleeve sections, and the terminal portions of the sleeves are preferably provided with external screw threads 40 outwardly of the ends of the flanges 36.

The sleeve 24 is preferably in the order of 14 inches in length and is of greatest cross-sectional size at its center and tapers from its center toward its ends. The wall thickness of the sleeve is preferably substantially uniform throughout so that the interior of the bore of the assembled sleeve is frusto-conical in shape with its large diameter portion substantially at the longitudinal center of the sleeve. In one preferred embodiment of the invention for use in jetting concrete, the bore of the sleeve will preferably be in the order of 2¾ inches in diameter at its center and approximately 1¾ inches in diameter at its opposite ends. These dimensions are cited as illustrative and are not critical. Thus the rate of taper may be more or less than has been indicated herein, and the overall length of the unit and its dimensions may vary according to the purpose and usage intended and the nature of the plastic material to be jetted.

Within the metal sleeve is inserted a liner 42 which is preferably made from natural rubber or synthetic rubber, such as Buna N (butadiene and acrylonitrile copolymer plus various percentages of vinylchloride-Buna N; vinyl chloride-acetate-Buna N; polyvinyl acetate-Buna A; polyvinylidene chloride-Buna N; polyvinyl alcohol-Buna N), rubber hydrochloride, Buna S (butadiene-styrene copolymers), Buna N butadiene-acrylonitrile copolymers, polychloroprene (neoprene) and polyethylene, or from materials such as polyvinyl chloride resins which are characterized by flexibility and resilience, or vinyl resins such as polyvinyl chloride-acetate copolymers, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, polyvinyl alcohol, or mixtures of vinyl resins and natural or synthetic rubber. This liner is unitary in character and preferably has an outer shape or contour which conforms or coincides with the shape or contour of the bore of the assembled sleeve, that is, the outer contour of the sleeve or liner is such that it tapers from each end portion to the center at a gradual or uniform frusto-conical taper, the length of which is equal to the overall length of the metal sleeve, and the diameter of which is such at each point along its length that it fits snugly within the metal sleeve.

The liner 42 is preferably provided at its opposite ends with enlarged or outwardly projecting annular flanges 44 whose outer diameter is slightly less than the diameter of the threaded portions 40 of the metal sleeve and whose inner faces bear against the end edges of the sleeve. A plurality of helical or spiral ribs or vanes 46 are formed integrally with the liner 42. These ribs or vanes have a very long helical lead and are of a depth or radial dimension progressively increasing from each end to the center of the sleeve at a rate equal to the rate at which the outer surface of the liner and the bore of the sleeve are tapered or increase in diameter from ends to center. As a result the inner edges or surfaces 48 of the ribs lie in a cylindrical pattern or uniform dimension throughout the length of the liner. In a preferred embodiment of the invention adapted for use in jetting concrete, six ribs or vanes 46 are employed, which are of a depth and thickness at their ends of approximately one-fourth inch and which are spaced apart in a circumferential direction approximately one-fourth inch at the ends of the sleeves. The outer or tubular portion of the liner 42 is of substantially uniform thickness throughout its length, and this factor, together with the fact that the inner surfaces 48 of the ribs lie in a uniform cylindrical pattern, results in the progressive increase in radial dimension of each of the ribs from its end toward the center of the mixing unit. In one embodiment of the invention the lead of the helical ribs is approximately 12 inches, that is, each rib makes one complete revolution in each 12 inches of length of the sleeve. Thus in a case where the sleeve is approximately 14 inches in length, each rib will make approximately one and one-quarter revolutions in its length. The liner is formed integrally as a unit, that is, it is not split or divided into sections.

When a mixer of the character described above is introduced into the jetting system in the position illustrated in Fig. 1 so that approximately three feet of space intervenes between it and the jet nozzle 30, the mixer is highly effective for use in the jetting apparatus, that is, uniformity of the mixture is secured and a complete, effective and uniform moistening or wetting of all of the solid or dry constituents of the plastic material to be used is secured. Consequently, the loss of material due to incomplete or improper mixing is entirely avoided. The device is particularly well suited for use in jetting concrete and, in actual practice, has been found to withstand successfully the abrasive action of the sand and other

mineral components used in the cement. The flexibility of the rubber enables it to yield as the abrasive particles impinge thereon and thereby to avoid the wear which would normally occur if a harder or non-yielding material were employed. The reverse taper of the unit herein described, while preferred, is not wholly essential or may be reduced in amount compared to that herein shown. However, greatest effectiveness has been found to occur where the double or reverse conical shape is utilized. The metal sleeve fully supports the rubber liner to prevent deforming, stretching, and extension or expansion of the yielding liner incident to usage, thus holding the parts in their desired shape while at the same time, as mentioned, accommodating a certain minimum amount of yielding as required to avoid wear. The double taper results in a variation of speed of travel of the material in the device at different sections thereof, and this difference in the speed of travel, coupled with the helical or spiral shape of the ribs, insures uniformity of mixing. If desired, the inner surfaces of the ribs may lie in a conical pattern rather than in a developed cylindrical pattern, that is, the ribs may be of substantially uniform depth or height throughout their length.

Another advantage of the device is that it is formed of sections so that the liner can be removed readily and quickly. Thus, if plastic material should tend to cake within the liner, the metal sheath could be removed and the liner thus exposed, and, because of the flexibility of the liner, the same may then easily be flexed so as to break up the set plastic material. Thus, if any obstructions accrue within the device, they can easily be broken up and released. The removability of the parts also facilitates general cleaning purposes after usage.

Another advantage of the device is the fact that the enlarged flanges **44** at the end of the sleeve serve the dual purpose of holding the rubber liner in proper endwise or longitudinal position within the sleeve, that is, prevent longitudinal displacement of the liner within the sleeve and prevent exposure of any part of the interior of the metal sleeve to the action of the material to be jetted. Still another advantage of the flanges is that they constitute integral or built-in washers or gaskets which avoid the necessity of the use of separate washers or gaskets at the separable connectors, such as the connector parts **22** and **26**.

The device may also be used for wet sand blasting where sand or abrasive material is mixed with water and discharged against a surface to be cleaned. Wet sand blasting is commonly employed for the purpose of cleaning the exterior of buildings formed of stone, terra cotta, brick or other masonry materials. In such instances a uniform wetting or mixture of the sand and water for uniform entrainment of the sand in the water is secured.

The various types of materials which are usable in the device have been indicated above, and from these materials may be selected those necessary to perform any of a large number of services. Thus the device is well suited for the use of applying coatings or linings to building walls, to water tanks, to culverts and to any other concrete structure where it is desired to produce a waterproof surface, to reduce the porosity of the concrete at the surface or otherwise to treat the surface of the concrete. It can also be used to apply plastic materials in desired thickness to walls formed of materials other than concrete where such walls have secured thereto, at the surface to which the material is to be adhered, wire mesh or other structural material to which the coating material can be applied and bonded and which will serve both to reinforce that material and to anchor the coating to the wall. The device is also well suited for use for lining the walls of boilers and cupolas with refractory material, and in this service, as in the other services, is particularly effective from the standpoint of reducing the amount of time, labor and effort which is required to apply the coating.

While the preferred embodiment of the invention has been illustrated and described herein, it will be understood that changes in the construction may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. A mixer for mixing solids and a liquid and adapted to be interposed in a conduit, comprising a rigid tubular housing having a smooth inner surface and means at each end for attachment to a conduit, and a tubular liner formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of said liner, the inner edges of said ribs outlining a central passage through said liner.

2. A mixer for mixing solids and a liquid and adapted to be interposed in a conduit, comprising a rigid tubular housing having a smooth inner surface and means at each end for attachment to a conduit, and a tubular liner formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of said liner, said housing being formed in two longitudinally divided parts, and means for securing said parts detachably, said liner being formed independently of and being removable from said housing, the inner edges of said ribs outlining a central passage through said liner.

3. A mixer for mixing solids and a liquid and adapted to be interposed in a conduit, comprising a rigid tubular housing having a substantially smooth bore and means at each end for attachment to a conduit, and a tubular liner formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of said liner, said liner having an outwardly projecting circumferential flange at one end bearing against an end of said housing, said liner having a central longitudinal unobstructed passage defined by the inner edges of said rib.

4. A mixer for mixing solids and a liquid and adapted to be interposed in a conduit, comprising a rigid tubular housing having a substantially smooth bore means at each end for attachment to a conduit, and a tubular liner formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of said liner with their inner edges outlining a central passage through the liner, said housing being formed of two separable longitudinally divided parts, and said liner having an enlarged circumferential flange at each end adapted to engage the adjacent end of said housing.

5. A mixer for mixing solids and a liquid and adapted to be interposed in a conduit, comprising a rigid straight unobstructed tubular housing having means at each end for attachment to a conduit in communication with said conduit, and a liner for said housing formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of the liner and each having a longitudinal lead per revolution exceeding the diameter of said liner, the inner edges of said ribs outlining a central passage through said liner.

6. A mixer for mixing solids and a liquid and adapted to be interposed in a conduit, comprising a rigid straight unobstructed tubular housing having means at each end for attachment to a conduit in communication with said conduit, and a liner for said housing formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of the liner and each having a longitudinal lead per revolution exceeding the circumferential dimension of said liner, the inner edges of said ribs defining a central unobstructed longitudinal passage through said liner.

7. A mixer adapted to be interposed in a conduit through which solids and a liquid are passed under pressure, comprising a rigid straight unobstructed tubular housing having means at each end for attachment to a conduit in communication with said conduit, and a liner for said housing formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of the liner and each having a longitudinal lead per revolution in the order of 12 inches, said ribs being of a depth less than the radius of the inner periphery of said liner.

8. A mixer adapted to be interposed in a conduit through which plastic-forming materials are passed under pressure, comprising a rigid substantially straight and unobstructed tubular housing having means at each end for attachment to a conduit in communication with said conduit, and a liner for said housing formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of the liner, each of said housing and liner being of maximum diameter at its longitudinal central portion, tapering toward its ends, and being of substantially uniform wall thickness throughout the inner edges of said ribs defining a central passage of substantially uniform diameter.

9. A mixer adapted to be interposed in a conduit through which concrete constituents are propelled under pressure, comprising a rigid substantially straight and unobstructed tubular housing having means at each end for attachment to a conduit in communication with said conduit, and a liner for said housing formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of the liner, each of said housing and liner being of maximum diameter at its longitudinal central portion, tapering toward its ends, and being of substantially uniform wall thickness throughout, the depths of said ribs increasing progressively from the ends to the central portion thereof whereby the inner edges of the ribs define a central unobstructed passage of uniform diameter.

10. A mixer adapted to be interposed in a conduit through which cementitious materials are forced under pressure, comprising a rigid tubular housing having a substantially smooth bore and means at each end for attachment to a conduit in communication with said conduit, and a liner for said housing formed of resilient material and having a plurality of spaced integral inwardly projecting helical ribs of substantial height extending for substantially the full length of the liner, each of said housing and liner being of maximum diameter at its longitudinal central portion, tapering toward its ends, and being of substantially uniform wall thickness throughout, the inner edges of said ribs lying in a cylindrical outline through their full length.

11. A mixer adapted to be interposed in a conduit through which concrete constituents are forced under pressure, comprising a rigid substantially straight tubular longitudinally split multi-part housing having external screw threads at its opposite ends and a smooth exterior surface, said parts having longitudinal marginal flanges extending for the major portion of the length thereof and between said screw threads, means cooperating with said flanges to secure said housing parts together, and a resilient unitary liner fitting detachably within said housing and having a plurality of substantially similar and uniformly spaced internal integral helical ribs of substantial height but less than one-half the inner diameter of said liner.

12. A device for forming plastic material from fluent dry material and a liquid, comprising a flexible conduit for said fluent dry material, a flexible liquid conduit, a water ring connected to both conduits and having an outlet, a tubular mixer connected at one end to said outlet, a flexible outlet conduit connected to the other end of said mixer, and a discharge member connected to said outlet conduit, said tubular mixer including a rigid sheath portion and a tubular liner formed of resilient material and having a plurality of integral inwardly projecting helical ribs of substantial height extending for substantially full length of said liner.

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