Feb. 14, 1967 J. H. CANTRELL ET AL 3,304,010

MIXING AND SPRAYING APPARATUS

Filed Aug. 12, 1964 2 Sheets-Sheet 1

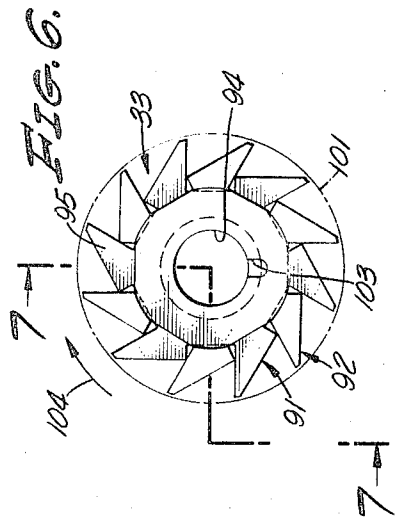

FIG. 6.

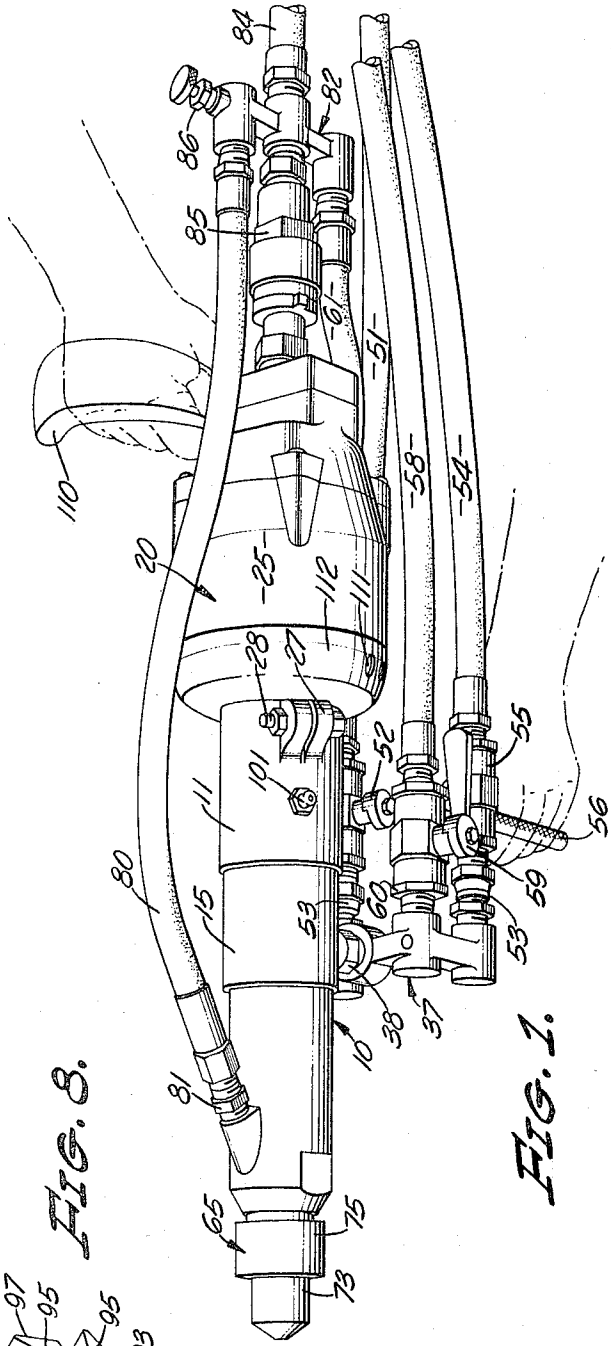

FIG. 1.

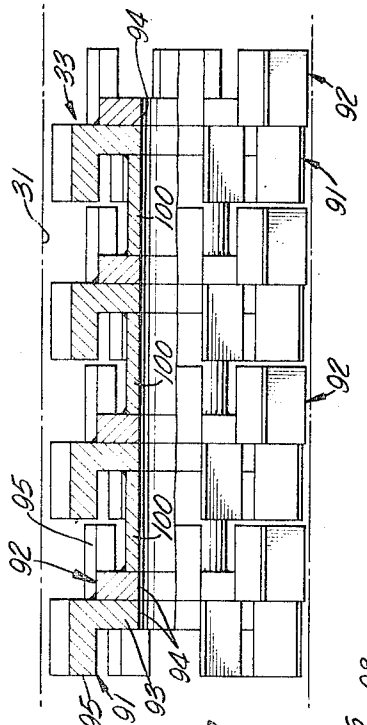

FIG. 7.

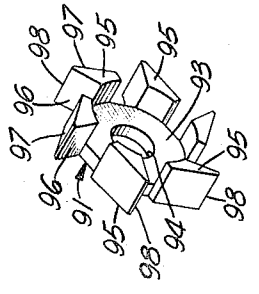

FIG. 8.

JAMES H. CANTRELL
CHARLES FARO
INVENTORS.

BY Lyon & Lyon
ATTORNEYS

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MIXING AND SPRAYING APPARATUS

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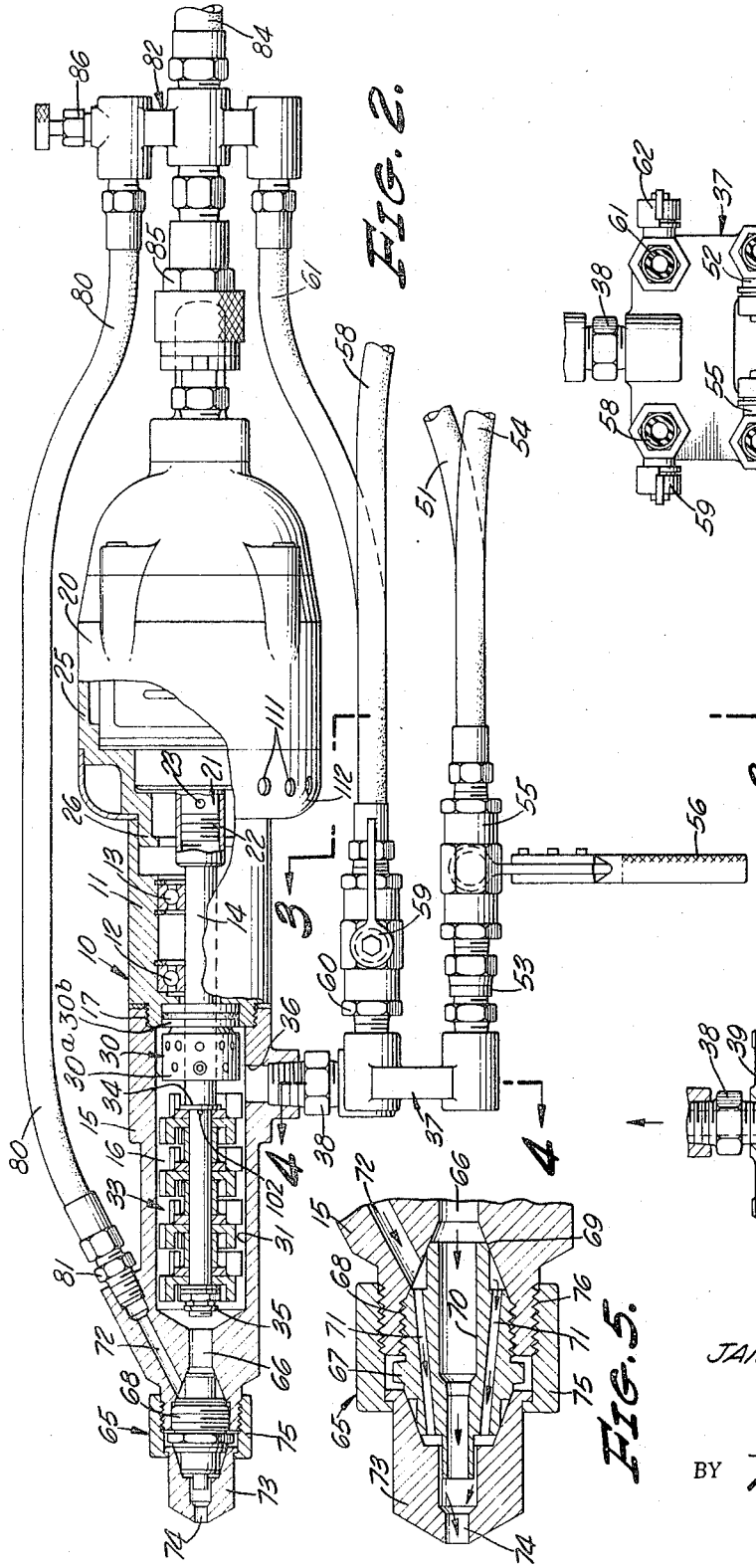

FIG. 2.

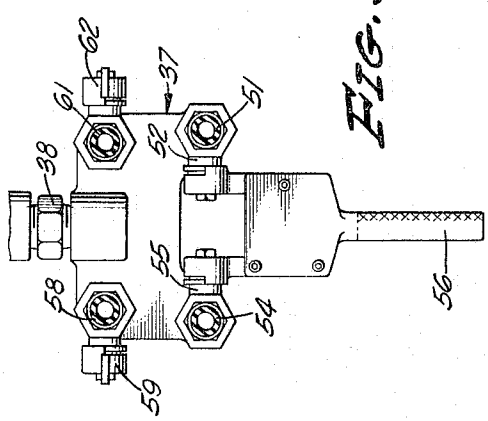

FIG. 3.

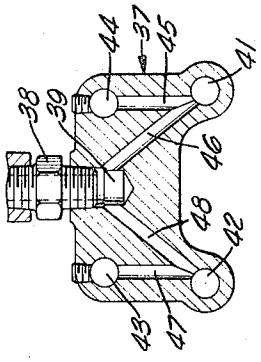

FIG. 4.

FIG. 5.

JAMES H. CANTRELL
CHARLES FARO
INVENTORS.

BY Lyon & Lyon

ATTORNEYS

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MIXING AND SPRAYING APPARATUS

James H. Cantrell and Charles Faro, Riverside, Calif., assignors to The Flintkote Company, New York, N.Y., a corporation of Massachusetts

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7 Claims. (Cl. 239—142)

This invention relates to apparatus for mixing two streams of liquid and spraying them from a common nozzle. This invention is particularly directed to apparatus for mixing and spraying two liquid components which will polymerize at room temperature to form a solid product.

An important object of this invention is to provide a novel form of unitary mixing and spraynig apparatus in which intimate mixing of two component streams is accomplished prior to delivery to a common nozzle.

Another object is to provide a device of this type having improved means for cleaning all parts of the apparatus contacted by the mixture, and without disassembly of any parts of the mixing apparatus.

A more detailed object is to provide an improved form of power-driven rotary mixer for use in a spraying gun.

A related object is to provide a novel form of header for delivering two fluid components to the mixing chamber.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

FIGURE 1 is a perspective view showing a preferred embodiment of our invention.

FIGURE 2 is a side elevation partly in section showing details of construction.

FIGURE 3 is a transverse sectional view partly broken away and taken on lines 3—3 as shown in FIGURE 2.

FIGURE 4 is a transverse sectional view taken substantially on the lines 4—4 as shown in FIGURE 2.

FIGURE 5 is a longitudinal sectional view partly broken away and showing an enlargement of the nozzle parts illustrated in FIGURE 2.

FIGURE 6 is an end elevation of the mixer rotor.

FIGURE 7 is a longitudinal sectional view taken substantially on the lines 7—7 as shown in FIGURE 6.

FIGURE 8 is a perspective view, on a smaller scale, showing one of the ring parts used to construct the mixer rotor.

Referring to the drawings, the housing generally designated **10** includes a first housing portion **11** containing axially spaced bearings **12** and **13** for supporting the rotary drive shaft **14**. The housing **10** also includes the second housing portion **15** containing the mixing chamber **16** and connected to the first housing portion **11** by means of threads **17**. An air-motor assembly **20** of conventional design has a stub shaft **21** connected by threads **22** and a transverse pin **23** to the drive shaft **14**. The enclosing shell **25** of the air motor **20** has a projection **26** which extends into one end of the housing portion **11** and is clamped in position by means of the split ears **27** and clamp bolt **28** (see FIGURE 1).

Drive shaft **14** extends into the housing portion **15** through a rotary seal assembly **30**, which includes the rotary portion **30***a* fixed to the shaft **14** and engaging the side face of the stationary portion **30***b* fixed within the housing portion **11**. A mixer rotor generally designated **33** is fixed on the forward portion of the drive shaft **14** and is clamped between a collar **34** and the nut **35**. From this description, it will be understood that the air motor turns the drive shaft **14** and that the drive shaft **14** turns the rotor **33** within the mixing chamber **16**.

A lateral inlet opening **36** is provided in the housing portion **15**, forward of the rotary seal **30** and communicating with the mixing chamber **16**. A header **37** is connected to this inlet opening **36** by means of the threaded fitting **38**. This header **37** has a central discharge opening **39** connected to the fitting **38** and has four parallel inlet ports **41**, **42**, **43**, and **44**. The port **41** for liquid base material is connected to the air port **44** by internal passage **45** and connected to the outlet port **39** by internal passage **46**. The port **42** for catalyst is connected to the cleaning solvent port **43** by internal passage **47** and is connected to the outlet port **39** by internal passage **48**. Polymerizable liquid material, for example, tolylene diisocyanate, is delivered under pressure to inlet port **42** through conduit **51**, valve **52**, and fittings **53**. Liquid base material or copolymer, for example, hydroxyl-rich polyester, is delivered under pressure to inlet port **41** through conduit **54**, valve **55**, and through fittings similar to those shown at **53**. Valves **52** and **55** are arranged to be operated in unison by means of a common operating handle **56**. Cleaning solvent under pressure is delivered to port **43** through conduit **58**, valve **59**, and fitting **60**. Air under pressure is delivered to inlet **44** through conduit **61**, valve **62**, and an inlet fitting similar to fitting **60**. Cleaning solvent valve **59** and air valve **62** are operated separately by separate valve handles.

A nozzle assembly generally designated **65** is positioned at the forward end of the housing part **15** in alignment with the outlet passage **66**. The nozzle assembly **65** includes the ported plug **67** connected to the housing portion **15** by means of threads **68**, which serve to hold abutting conical surfaces **69** in contact. Mixed reactive materials pass through outlet **66** and through the stepped central bore **70**, which extends axially through the member **67**. Additional passages **71** in the member **67** communicate with the air passage **72** in the forward end of the housing portion **15**. The nozzle head **73** has a central discharge opening **74** through which the mixed reactive materials pass from stepped bore **70** and through which air under pressure passes from the passages **71**. The nozzle head **73** is held in place by means of the retainer ring **75** connected by threads **76** to the housing portion **15**.

The air conduit **80** is connected ot the air passage **72** by means of the fitting **81**. Both of the air conduits **61** and **80** are connected to the crosshead **82** upstream from the air motor **20**. Air under pressure is supplied through conduit **84** to the crosshead **82** and is then distributed to the conduit **61**, to the air motor **20** through fittings **85**, and to the air conduit through the needle valve assembly **86**.

As shown in FIGURES 6–9, the mixer rotor **33** comprises a plurality of rings **91** and rings **92** positioned in pairs and placed back-to-back. The rings **91** each have an annular flange **93** provided by the central opening **94**. Blades **95** are integrally formed with the annular flange **93** and are circumferentially spaced on the periphery thereof. The blades **95** are wedge-shaped, and each is provided with converging flat surfaces **96** and **97**, which intersect to form a blade edge **98**. The rings **92** are identical to the rings **91**, except that the blades project axially in the opposite direction. Thus, as shown in FIGURE 7, the blades **95** on the rings **91** project axially to the left while the blades **95** on the rings **92** project axially to the right. The blades on adjacent rings are circumferentially staggered. Tubular spacers **100** are interposed between each pair of rings **91** and **92**, and the parts are then brazed together to form a unitary rotor **33**. The blade edges **98** are then ground so that the tips of the blades **95** have close running clearance within the cylindrical bore **31** of the mixing chamber **16**.

The mixer rotor **33** is installed in the chamber **16** by separating the housing parts **11** and **15** on the threads **17**. A crosspin **102** on the drive shaft **14** (FIGURE 2) pro-

jects into a recess **103** (FIGURE 6), provided on one of the ring flanges in order to key the mixer rotor **33** to the shaft **14**. The shaft **14** passes through the central openings **94** in the rings **91** and **92** and through the central opening in the tubular spacers **100**. Rotation of the mixer rotor **33** occurs in the direction of the arrow **104**, as shown in FIGURE 6. The wedge-shaped blades **95** act to mix the two materials in a thorough and intimate fashion. The materials are admitted into the mixing chamber **16** through the inlet **36**, just in advance of the seal assembly **30**, and the materials pass axially through the mixing chamber **16** and emerge throguh the nozzle **65**. The intimate mixing achieved by the rotating blades **95** produces a substantially homogeneous product which passes through the discharge opening **66** and through the nozzle **65**. Very efficient mixing occurs in a very short period of time.

In operation, the device is grasped in one hand by means of the handle grip **110**, which is secured to one end of the air motor **20**. The other hand is used to operate the valve handle **56**, which controls the flow of the two reactive component streams delivered under pressure to the conduits **51** and **54**. The air motor is rotated by a supply of air delivered through the conduit **84**, and the exhaust air is discharged through holes **111** in the ring **112**. Spraying of the mixture by means of the nozzle **65** is accomplished by air supplied to the nozzle through the needle valve **86**, conduit **80**, and passageway **72**.

When it is desired to interrupt the spraying operation, the valve handle **56** is swung manually to closed position, thereby cutting off the supply of the reactive materials. Cleaning solvent and air are then passed through the header **37** and inlet **36** into the mixing chamber **16** without delay. This is accomplished by manually opening the valves **59** and **62**. The solvent cleans all of the internal surfaces of the device which have been contacted by both component streams, and this is quickly accomplished without shutting off the air motor. The two streams of reactive materials admitted through ports **41** and **42** in the header **37** first meet in the discharge opening **39** in the header. The cleaning solvent and air admitted into the header, following simultaneous shutoff of the reactive materials by means of the common handle **56**, serve to clean out the header **37** as well as all of the internal parts downstream from the header. This is accomplished quickly without any need for disassembling the parts of the tool.

It will be noted that the seal **30** prevents the reactive materials from reaching the shaft bearings **12** and **13**, and that these bearings may be supplied with lubricants through the conventional fitting **101**.

Having fully described our invention, it is to be understood that we are not to be limited to the details herein set forth, but that our invention is of the full scope of the appended claims.

We claim:

1. Mixing and spraying apparatus comprising a housing having a cylindrical bore defining a mixing chamber, a mixer rotor mounted coaxially within said bore, the rotor comprising a plurality of axially spaced rings each having a series of wedge-shaped blades fixed on the periphery thereof, the blades having running clearance within said bore, the blades on adjacent rings being circumferentially staggered, a power driven shaft projecting into the bore for rotating the rotor, means for introducing liquid materials under pressure into the mixing chamber, a spray nozzle assembly mounted on the housing, and a discharge passage in the housing connecting the mixing chamber to the nozzle assembly.

2. Mixing and spraying apparatus comprising a housing having a cylindrical bore defining a mixing chamber, a mixer rotor mounted coaxially within said bore, the rotor comprising a plurality of axially spaced rings each having a series of wedge-shaped blades fixed on the periphery thereof, the blades having running clearance within said bore, the blades on adjacent rings being circumferentially staggered, a power driven shaft projecting into the bore for rotating the rotor, means for introducing liquid materials into the mixing chamber, a spray nozzle assembly mounted on the housing, a discharge passage in the housing connecting the mixing chamber to the nozzle assembly, and means for introducing air under pressure into said nozzle assembly to spray the mixture therefrom.

3. Mixing and spraying apparatus comprising a housing having a cylindrical bore defining a mixing chamber, a mixer rotor mounted coaxially within said bore, a power-driven shaft projecting into the bore for rotating the rotor, means for introducing liquid materials into the mixing chamber, a spray nozzle assembly mounted on the housing, a discharge passage in the housing connecting the mixing chamber to the nozzle assembly, the rotor comprising a plurality of axially spaced rings each having a series of wedge-shaped blades fixed on the periphery thereof, the blades having running clearance within said bore, and means for introducing air under pressure into said nozzle assembly to spray the mixture therefrom.

4. Mixing and spraying apparatus comprising a housing having a cylindrical bore defining a mixing chamber, a mixer rotor mounted coaxially within said bore, a plurality of axially spaced rings each having a series of wedge-shaped blades fixed on the periphery thereof, each blade having surfaces defining an axially extending leading edge, the leading edges of the blades having running clearance within said bore, the blades on adjacent rings being circumferentially staggered, a power driven shaft projecting into the bore for rotating the rotor, means for introducing liquid materials into the mixing chamber, a spray nozzle assembly mounted on the housing, a discharge passage in the housing connecting the mixing chamber to the nozzle assembly, and means for introducing air under pressure into said nozzle assembly to spray the mixture therefrom.

5. Mixing and spraying apparatus comprising a housing having a cylindrical bore defining a mixing chamber, a rotor mounted coaxially within the bore, said rotor having a plurality of axially spaced rings each having a series of wedge-shaped blades thereon, a power driven shaft extending into the bore for rotating the rotor, means including a nozzle assembly connected to the housing to receive materials discharged from the mixing chamber, an inlet passage on the housing for delivering materials to be mixed into the mixing chamber, a header having a plurality of inlet ports and a single outlet port, means connecting the outlet port of the header to the inlet passage to the mixing chamber, the header having two internal passageways one extending from a first inlet port to the header outlet and the other extending from a second inlet port to said header outlet, and the header having an additional passageway extending from the first inlet port to a third inlet port, and means including valve means for controlling flow into each of said header inlet ports.

6. Mixing and spraying apparatus comprising a housing having a cylindrical bore defining a mixing chamber, a rotor mounted coaxially within the bore, said rotor having a plurality of axially spaced rings each having a series of wedge-shaped blades thereon, a power driven shaft extending into the bore for rotating the rotor, means including a nozzle assembly connected to the housing to receive materials discharged from the mixing chamber, an inlet passage on the housing for delivering materials to be mixed into the mixing chamber, a header having four separate inlet ports and a single outlet port, means connecting the outlet port of the header to the inlet passage to the mixing chamber, the header having first and second internal passageways for supplying reactive materials to said outlet port of the header, the first of said internal passageways extending from a first inlet port to the header outlet and the second of said internal passageways extending from a second inlet port to said header outlet, and the header having third and fourth internal passageways for respectively supplying air and a solvent through said first and second internal passage-

ways to said outlet port of said header, said third passageway extending from the first inlet port to a third inlet port and the fourth passageway extending from the second inlet port to a fourth inlet port, and means including valve means for controlling flow into each of said header inlet ports.

7. Mixing and spraying apparatus comprising a housing having a cylindrical bore defining a mixing chamber, a rotor mounted coaxially within the bore, said rotor having a plurality of axially spaced rings each having a series of wedge-shaped blades thereon, a power-driven shaft extending into the bore for rotating the rotor, an inlet on the housing for delivering materials to be mixed into the mixing chamber, a nozzle assembly connected to the housing to receive materials discharged from the mixing chamber, a header having four separate inlet ports and a single outlet port, means connecting the outlet port of the header to the inlet passage to the mixing chamber, the header having first and second internal passageways for supplying reactive materials to said outlet port of the

header, the first of said internal passageways extending from a first inlet port to the header outlet and the second of said internal passageways extending from a second inlet port to said header outlet, and the header having third and fourth internal passageways for respectively supplying air and a solvent through said first and second internal passageways to said outlet port of said header, said third passageway extending from the first inlet port to a third inlet port and the fourth passageway extending from the second inlet port to a fourth inlet port.

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EVERETT W. KIRBY, *Primary Examiner.*