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3,005,576

MIXING AND DISPENSING APPARATUS

Filed April 22, 1958

4 Sheets-Sheet 1

Fig. 1

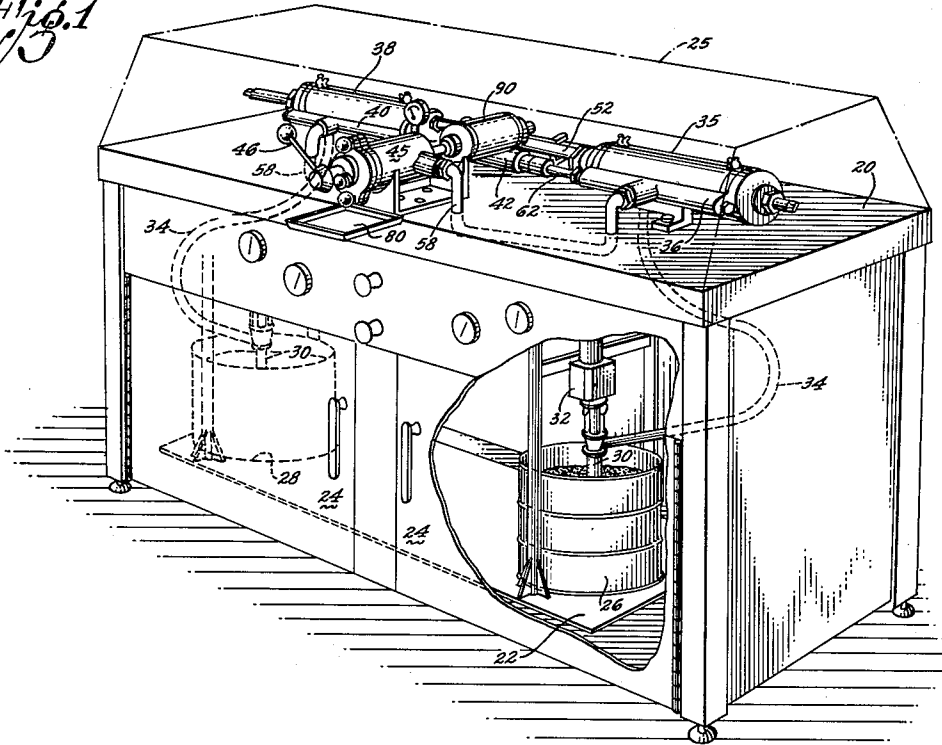


Fig. 2

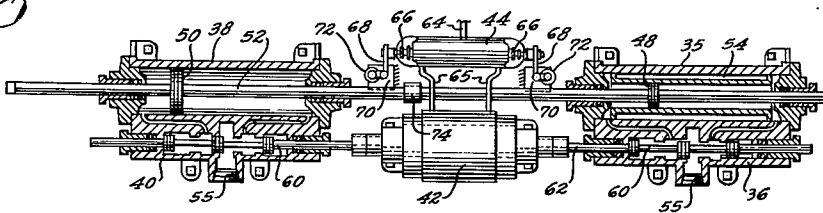
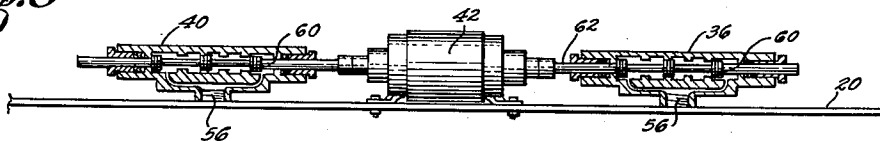


Fig. 3



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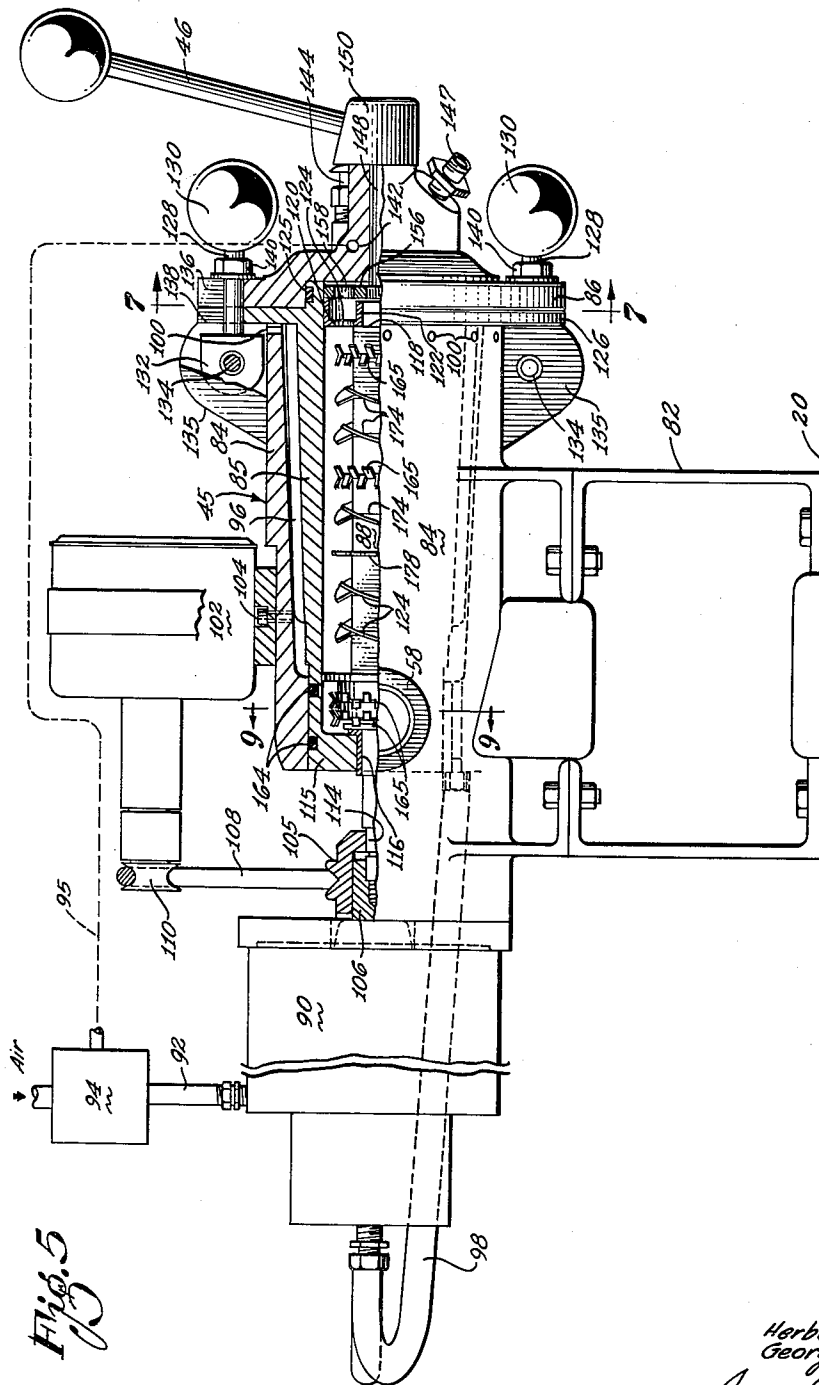
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

Fig. 6

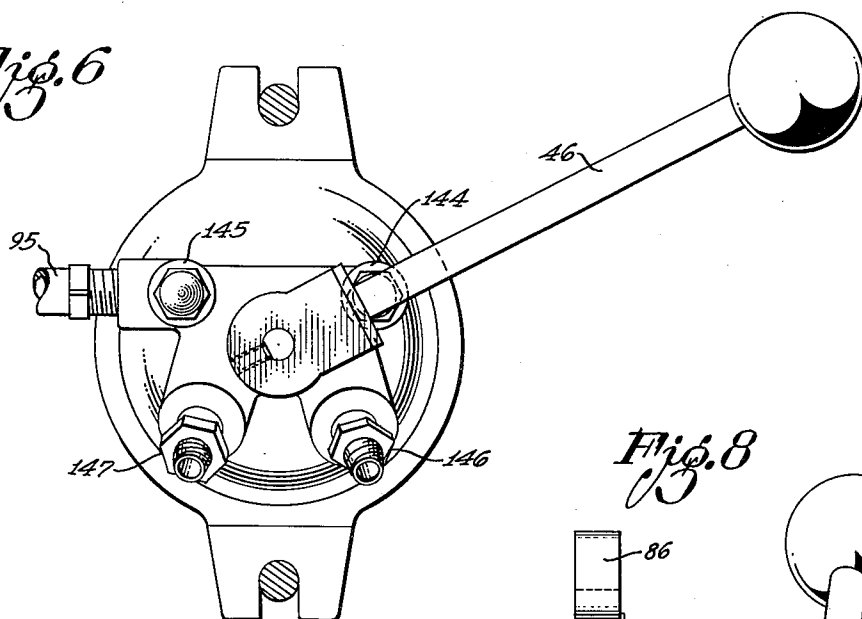


Fig. 7

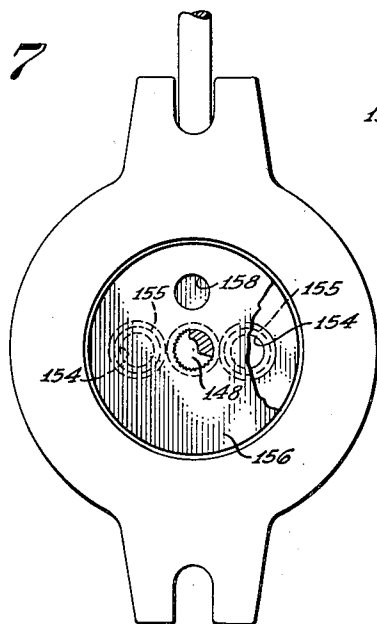


Fig. 8

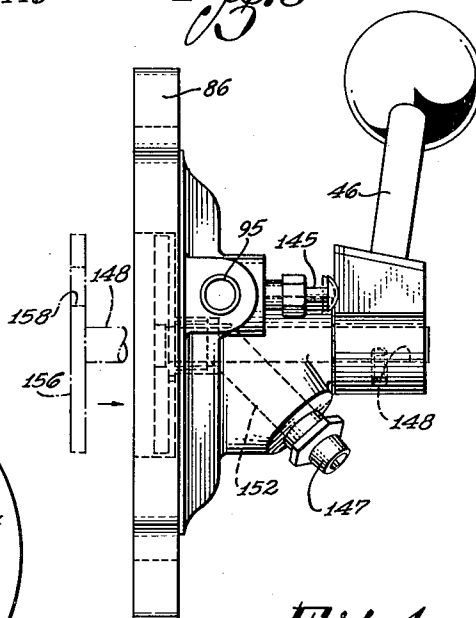
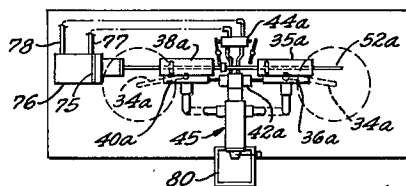


Fig. 4



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1

3,005,576

MIXING AND DISPENSING APPARATUS

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12 Claims. (Cl. 222-146)

This invention relates to an apparatus for intermixing a plurality of ingredients including at least one highly viscous ingredient and, more particularly, is directed to such an apparatus for producing a homogeneous mixture with the ingredients thereof in accurately predetermined proportions.

The invention has been initially embodied in an apparatus for the specific purpose of mixing ingredients including a catalyst or accelerator to provide a highly viscous sealant composition of the general character of a synthetic rubber-like sealant known to the trade as Thiokol. This particular practice of the invention is described herein by way of example and will provide adequate guidance for those skilled in the art who may have occasion to apply the same principles to the solution of other mixing problems.

One of the problems to which the invention is directed is to provide an apparatus that may be used for the continuous production of such a mixture with the ingredients thereof in accurately predetermined proportions at all times. The ingredients are fed to a mixing device and to carry out this concept, the different ingredients must be accurately metered and correlated in feeding the mixing device.

The invention meets this problem by using a plurality of metering cylinders corresponding to the plurality of ingredients and by employing pistons in the respective cylinders with the pistons interconnected for operation in unison. In such an arrangement the proportions of the ingredients in the mixture are determined by the relative diameters of the metering cylinders and the invention teaches that the proportions may be readily varied by providing interchangeable liners and corresponding pistons to vary the effective diameter of at least one of the metering cylinders.

One practice of the invention is characterized by the concept of placing the individual ingredients under pressure and utilizing the pressure of the ingredients themselves to actuate the metering cylinders and thus feed the ingredients under pressure to the mixing device. Each pressurized ingredient enters the corresponding metering cylinder through a corresponding 4-way valve and returns through the same 4-way valve to feed into the mixing device.

The advantage of this arrangement is that not only the various metering pistons but also the various 4-way valves may be positively interlocked for absolute synchronism as required for close accuracy in proportioning the ingredients. In this regard a special feature of the invention is the provision of a power cylinder to reverse the 4-way ingredient valves and the provision of an additional 4-way valve to reverse the operation of the power cylinder in response to the reciprocations of the metering pistons. Thus when the metering pistons reach the opposite limits of their common range of reciprocation, they trip the additional 4-way valve of the power cylinder to cause the power cylinder to reverse the 4-way ingredient valves thereby to reverse the travel of the metering pistons in the metering cylinders.

An important advantage of this practice of the invention is that the whole metering system may be controlled solely by suitable dispensing valve means that releases the mixture from the mixing device. As long as the dispens-

2

ing valve means is open to release the pressurized mixture from the mixing device, the metering cylinders and the corresponding 4-way ingredient valves reciprocate automatically. Closing the dispensing valve hydraulically locks the metering pistons against operation.

In an alternate practice of the invention, the material is fed to the metering cylinders under lesser pressure, the interlocked metering pistons are reciprocated by a main power cylinder and the 4-way ingredient valves are reciprocated by an auxiliary power cylinder. A feature of this second arrangement is that a single 4-way valve may control both of the power cylinders and may, in turn, be controlled by reciprocation of the metering pistons. Here again, the operation of the whole metering system may be controlled by opening and closing a dispensing valve means.

Certain important features of the invention relate to the construction and mode of operation of the mixing device that is supplied by the interlocking metering system. The mixing device comprises a mixing cylinder with a rotor assembly mounted coaxially therein. When an aircraft having the applied sealant climbs to a high altitude air bubbles entrapped in the sealant expand and, of course, expansion of such bubbles can weaken or actually rupture sealed joints. It has been found, however, that air bubbles do not cause trouble if they are exceedingly small and the mixing device of the present invention successfully subdivides the air bubbles to the required degree.

As will be described in detail, the cylindrical mixer accomplishes its purpose by a series of mixer elements spaced longitudinally along an elongated rotor. Several of the mixer elements operate on the ingredients with a chopper action. In the preferred practice of the invention, a plurality of the chopper elements are inclined blades that promote axial travel of the intermixed ingredients by a screw action and other chopper elements are provided by apertures or peripheral recesses in transverse disks of the rotor assembly.

One of the features of the preferred embodiment of the mixer is the use of baffles at longitudinally spaced points in the mixing cylinder to divert the longitudinal flow radially outward and radially inward. For example, a baffle disk with a continuous central surface may be used to divert the axial flow radially outward, while a baffle disk with an apertured inner radial zone and a continuous outer radial zone in close fit with the surrounding wall of the cylinder may be used to divert the axial flow radially inward. These two opposite effects at different longitudinal points of the mixing cylinder facilitate homogeneous intermixture of the ingredients and facilitate subdivision of air bubbles to the required degree of fineness.

Another feature of the preferred mixer is the use of solid baffle disks, each of which is provided with chopper blades in the form of peripheral tongues. The peripheral tongues are turned laterally of the disks, i.e. longitudinally of the mixer cylinder and preferably the alternate tongues are turned in alternate directions. A special advantage of such a mixer element is that the mixed ingredients are spread out to form a thin restricted annular stream close to the surface of the mixer cylinder where the numerous chopper tongues cut transversely into the flowing stream at maximum peripheral speed.

Still another feature of the preferred mixer is that all of the mixer elements including the spaced baffles are mounted on a rotor shaft of noncircular cross-sectional configuration. Such a shaft, for example, a square shaft, has a desirable pulsating effect on the stream of ingredients.

A further feature of the mixer is the use of an air motor to drive the mixer rotor with the exhaust of the air motor cooling the mixing cylinder. A still further

feature is the provision of a cylindrical mixer of the character described that may be easily and quickly completely dismantled to expose all of its parts for a cleaning operation with all working surfaces readily accessible.

The various features and advantages of the invention may be understood by reference to the following detailed description and the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a perspective view of the presently preferred embodiment of the invention with a portion of the wall broken away to reveal concealed structure;

FIG. 2 is a view partly in plan and partly in section showing the metering mechanism on the top of the cabinet in FIG. 1, the mixer that is fed by the metering mechanism being omitted;

FIG. 3 is a view of the same mechanism partly in side elevation and partly in section;

FIG. 4 is a plan view on a reduced scale of an alternate form of mixing mechanism that may be employed to feed the ingredients to the mixer;

FIG. 5 is a view of the mixer that is supplied by the metering mechanism, the view being partly in section and partly in side elevation;

FIG. 6 is a front elevational view of the mixer with a pair of releasable screw members shown in section;

FIG. 7 is a transverse sectional view of the mixer with parts broken away, the section being taken along the line 7—7 of FIG. 5 and showing the construction of a dispenser valve for releasing the mixture selectively through two dispensing nozzles;

FIG. 8 is a side elevation of the removable head at the front of the mixer showing the dispenser valve member in phantom;

FIG. 9 is a fragmentary transverse section of the mixer taken along the line 9—9 of FIG. 5 and showing the structure in the region of the two opposite feed ports of the mixer;

FIG. 10 is a perspective view of the mixer rotor;

FIG. 11 is a front elevation of a disk of the rotor assembly that is cut and bent to form inclined blades for advancing the ingredients by screw action;

FIG. 12 is a side elevation of the same disk;

FIG. 13 is a front elevation of a baffle element of the rotor assembly that diverts the flowing ingredients radially outward;

FIG. 14 is a side elevation of the same baffle; and

FIG. 15 is a perspective view of a baffle element of the rotor assembly that is formed with a plurality of peripheral tongues for chopping action on the ingredients.

General arrangement

As indicated in FIG. 1, the apparatus may be incorporated in a cabinet having a top support plate 20 and an enclosed lower base plate 22 that is accessible through a pair of doors 24. The top support plate 20 may be provided with a hood 25 that is shown in phantom. Mounted on the lower base plate 22 are two supply receptacles 26 and 28, one of which contains the viscous base material of the sealant and the other of which contains a viscous catalyst. Each of the two supply receptacles 26 and 28 is provided with a corresponding pump 30 that is operated by a corresponding air motor 32 and each of these pumps discharges the viscous material into a corresponding supply hose 34 under high pressure, for example a pressure between 1000 and 2000 p.s.i. Suitable pumps for this purpose are available commercially.

Mounted on the top support plate 20 are: a metering cylinder 35 with an adjoining spool-type 4-way ingredient valve 36; a second metering cylinder 38 with a second adjoining spool-type 4-way ingredient valve 40; a power cylinder 42 to reverse the two 4-way ingredient valves; a third 4-way valve 44 to control the power cylinder 42 in response to the operation of the two metering cylinders; and a forward mixer, generally designated 45, having dispensing valve means controlled by a handle 46.

The two metering cylinders 35 and 38 have corresponding metering pistons 48 and 50, which are mounted on a common piston rod 52. The piston rod 52 may be made in separable sections to facilitate dismantling the two cylinders and pistons for cleaning operations. Since the proportions of the two materials that are mixed together depend upon the relative diameters of the two interconnected pistons 48 and 50, the proportions may be varied by changing the diameters of one of the pistons. For this purpose a graduated series of liners may be used interchangeably in one of the two cylinders 35 and 38 to cooperate with corresponding interchangeable pistons. Thus FIG. 2 shows a liner 54 that reduces the effective diameter of the metering cylinder 35, the liner being one of a series of interchangeable liners and the relatively small piston 48 being one of a corresponding series of interchangeable pistons.

As shown in FIG. 2, each of the two 4-way ingredient valves 36 and 40 for the metering cylinders 35 and 38 has an inlet port 55 for connection to the corresponding material supply hose 34 and, as shown in FIG. 3, each of the two 4-way ingredient valves also has an outlet port 56 for delivering material to the mixer 45. As shown in FIG. 1, the two outlet ports 56 of the 4-way ingredient valves 36 and 40 are connected to opposite sides of the mixer 45 by corresponding pipes 58. Each of the 4-way ingredient valves 36 and 40 has a valve spool 60 and the two valve spools are mounted on a common piston rod 62 which is united with a piston (not shown) in the power cylinder 42 for reciprocation in unison. The two valve spools 60 are shown at one of their limit positions in FIGS. 2 and 3 at which the two inlet ports 55 are in communication with the right hand ends of the two corresponding metering cylinders 35 and 38, the outlet ports 56 of the 4-way ingredient valves being in communication with the left hand ends of the metering cylinders.

The third 4-way valve 44 shown in FIG. 2 has a suitable exhaust port (not shown) and has an inlet port connected by a pipe 64 to a suitable source of compressed air. The 4-way valve 44 is connected to the power cylinder 42 in a well known manner by a pair of pipes 65. The 4-way valve 44 is operated by a pair of poppet pilot valves 66 on its opposite ends. Each of the two poppet pilot valves 66 is operated by a corresponding bell crank that is pivotally mounted on an adjacent support 70. One arm of each bell crank 68 is positioned to depress the corresponding pilot valve 66 and the other arm carries a roller 72 which lies in the path of a collar 74 that is adjustably mounted on the piston rod 52.

The path of the material through the left hand metering cylinder 38 and the associated four-way valve 40, for example, is as follows: With the parts positioned as shown in FIGS. 2 and 3, the fluid ingredient enters the inlet port 55 of the four-way valve 40 and passes into the right end of the cylinder 38. In the meantime, with the piston 50 of the cylinder 38 moving to the left, the material in the left end of the cylinder is returned to the four-way valve 40 to pass out through the outlet port 56 of the four-way valve that is shown in FIG. 3. Since the piston 48 on the right hand side of the apparatus is directly connected to the piston 50 by the piston rod 52, the material is metered out on the right hand side simultaneously with the material from the left hand side and in a definite ratio thereto. Since the valve members of the two four-way valves 36 and 40 are also on a common piston rod 62, the two four-way valves are reciprocated synchronously by means of the power cylinder 42, the power cylinder being controlled by the four-way valve 44.

In FIGS. 2 and 3 the piston rod 52 is moved to the right under the pressure of the two fluid materials from the two supply pipes 34. As the two pistons 48 and 50 approach the right ends of the two corresponding metering cylinders, the collar 74 on the piston rod 52 wipes

against the roller 72 of the right hand bell crank 68 and causes the bell crank to rotate clockwise to actuate the right pilot poppet valve 66. Opening of the right pilot valve 66 reverses the 4-way valve 44 to cause corresponding reversal of the power cylinder 42 to reverse the two 4-way ingredient valves 36 and 40 to reverse the direction of pressure application against the two metering pistons 48 and 50.

It is apparent that this arrangement results in automatic reciprocation of the two metering pistons 48 and 50 in the two metering cylinders 35 and 38 to cause the continuous feeding of the two materials to the mixer 45 as long as there is freedom for the material to flow through and out of the mixer. Thus when the handle 46 of the mixer 45 is in a position to release the completed mixture from the mixer, the two metering pistons 48 and 50 reciprocate automatically and swinging the handle 46 to a cut-off position creates back pressure in the two metering cylinders to immobilize the two metering pistons 48 and 50.

FIG. 4 illustrates an alternate manner in which two metering cylinders 35a and 38a may be employed to supply the two materials in predetermined proportions to the mixer 45. The two pistons in the two metering cylinders 35a and 38a are mounted on a common piston rod 52a which is operated by a piston 75 in a power cylinder 76. The two metering cylinders 35a and 38a have the usual associated 4-way ingredient valves 36a and 40a and these 4-way valves are controlled in the usual manner by a power cylinder 42a. The usual third 4-way valve 44a is operated by reciprocations of the piston rod 52a in the same general manner as heretofore described, but in this instance the third 4-way valve is not only connected to the power cylinder 42a to control reversals thereof but is also connected by a pair of pipes 77 and 78 to the power cylinder 76 to control reversals thereof. It is apparent that when the third 4-way valve 44a is reversed by the piston rod 52a, it reverses the power cylinder 76 to reverse the movement of the two metering pistons and it simultaneously reverses the power cylinder 42a to reverse the two 4-way valves 36a and 40a as required for reversal of the directions of flow through the two metering cylinders. In this alternate arrangement it is necessary that the material in the two supply hoses 34a be under only sufficient pressure to feed the two metering cylinders since the power cylinder 76 actuates the two metering pistons.

The mixer construction. FIGS. 5-15

As shown in FIGS. 1 and 4 the front dispensing end of the mixer 45 overhangs a drip tray 80 and as shown in FIGS. 1 and 5, the mixer is mounted on a support structure 82 that is anchored to the top support plate 20. The mixer 45 comprises a fixed cylindrical housing 84 together with a removable cylinder 85 and a removable end cap or cylinder head 86. The fixed cylindrical housing 85 is open at both ends and telescopically receives the removable cylinder 85.

Removably mounted in the mixer 45 is a rotor assembly comprising a rotor shaft 88 with a plurality of mixer elements thereon. The rotor of the mixer 45 is driven by an air motor 90 which is connected to a source of compressed air through a supply pipe 92 under the control of a pilot-type shutoff valve 94. In a well known manner, the shutoff valve 94 has a pilot tube which may be opened to the atmosphere to cause the shutoff valve to open and may be cut off from the atmosphere to cause the shutoff valve to close. As indicated by the broken line in FIG. 5, the pilot tube 95 is connected to the front end of the mixer 45 to be opened to the atmosphere whenever the mixer handle 46 is shifted from its normally closed position to a position for releasing the sealant mixture. Thus whenever the completed mixture is dispensed from the mixer, the air motor 90 is automatically ener-

gized to actuate the mixer rotor as long as the dispensing operation is continued.

Since a great deal of heat is generated by friction in the operation of intermixing the two ingredients, it is desirable to provide some expedient for cooling the mixer 45. A feature of the present embodiment of the invention is that the desired cooling is accomplished by the air exhausted from the air motor 90. For this purpose, the fixed cylindrical housing 84 of the mixer 45 is internally enlarged throughout the major portion of its length to form an annular air space 96 around the removable cylinder 85. The rear end of the annular air space 96 is connected to a tube 98 from the exhaust port of the air motor 90 and the fixed cylindrical housing 84 is provided with a circumferential series of discharge ports 100 near its forward end. Thus the expanded air exhausted from the air motor is introduced at above atmospheric pressure into one end of the annular air space 96 to flow the length of the air space with cooling action on the inner removable cylinder 85.

In the preferred practice of the invention, means is provided to indicate the speed of rotation of the mixer rotor. For this purpose a tachometer 102 may be mounted on the upper side of the cylindrical housing 84 by suitable screw means 104 (FIG. 10) and operatively connected to the air motor 90. A pulley 105 on the shaft 106 of the air motor 90 is connected by a belt 108 to a second pulley 110 on the shaft of the tachometer 102. The rotor shaft 88 is removably connected to the air motor shaft 106 and for this purpose the rotor shaft 88 has an inner end portion 112 (FIG. 10) of square cross section which removably fits into a square socket 114 in the pulley 105.

The removable cylinder 85 of the mixer 45 has a rear end wall 115 in which is mounted a suitable bearing sleeve 116 to journal the rear end of the rotor shaft 88 in a fluid-tight manner. The forward end of the removable cylinder 85 embraces a disk 118 which, as best shown in FIG. 10, has a peripheral flange 120, an inner hub 122 and a series of apertures 124 between the flange and hub. The hub 122 serves as a bearing to journal the forward end of the rotor shaft 88.

The cylinder head 86 is recessed to receive the forward end of the removable cylinder 85 and the joint is sealed by a suitable sealing ring 125. The cylinder head fits snugly against a forward radial flange 126 of the removable cylinder 85 and this flange in turn abuts the forward end of the fixed cylindrical housing 84. This assembly may be releasably held together by a pair of pivoted bolts 128 having knobs 130 on their outer ends. Each bolt 128 is anchored in a small body 132 that is mounted on a pivot pin 134 between a pair of ears 135 of the fixed cylindrical housing 84. The end cap 86 and the radial flange 126 are provided respectively with slots 136 and 138 to receive the pivoted bolts 128 and the pivoted bolts are provided with suitable nuts 140 for tightening the assembly.

The previously mentioned pilot tube 95 for control of the shutoff valve 94 of the air motor 90 is connected to the cylinder head 86 of the mixer in the manner shown in FIG. 6 and communicates with a transverse bore in the cylinder head that is indicated by numeral 142 in FIG. 5. This transverse bore 142 communicates with a pair of poppet valves 144 and 145 on opposite sides of the cylinder head so that when either of the two poppet valves is opened, the pilot tube 95 is vented to the atmosphere to cause the shutoff valve 94 to open.

The cylinder head 86 also has a pair of dispensing nozzles 146 and 147. The two poppet valves 144 and 145 correspond to the two dispensing nozzles 146 and 147 in the sense that the poppet valve 144 is actuated to energize the air motor 90 when the nozzle 146 is open to dispense the sealant mixture and the poppet valve 145 is opened to actuate the air motor when the second dis-

pensing nozzle 147 is used. The two dispensing nozzles may be used to fill dispensing tubes of a well known type or may be connected to dispensing hoses for direct application of the sealant to work in progress.

The mixer handle 46 is mounted on the outer end of a short valve shaft 148 by means of a cam member 150 which is shaped to actuate the two poppet valves 144 and 145 by cam action whenever the handle 46 is swung from a normal central position to either one of its lateral limit positions. The valve shaft 148 operates suitable valve means for controlling the release of the mixed sealant to the two dispensing nozzles 146 and 147.

As indicated in FIG. 8, each of the dispensing nozzles 146 and 147 is at the end of a corresponding passage 152 and the two dispensing passages 152 terminate at two corresponding valve ports 154 (FIG. 7) on the inner face of the cylinder head 86. Each of the valve ports 154 may be surrounded by a suitable sealing ring 155. A valve member in the form of a valve disk 156 is keyed to the inner end of the valve shaft 148, the inner end of the shaft being serrated for this purpose. This valve disk 156 has a single port 158 (FIGS. 7 and 8).

When the mixer handle 46 is turned to the right lateral limit position shown in FIG. 6 and thereby actuates the right poppet valve 144, the valve port 158 in the valve disk 156 registers with the corresponding right valve port 154 (FIG. 7) to release mixed sealant from the mixer to the dispensing nozzle 146. On the other hand, when the mixer handle 46 is swung to its opposite left limit position and thereby operates the poppet valve 145, the port 158 in the valve disk registers with the second valve port 154 to release the mixed sealant to the other dispensing nozzle 147. When the mixing handle 46 is in its neutral upright position, both of the dispensing nozzles 146 and 147 are cut off and the air motor 90 is de-energized.

The two pipes 58 for delivering the two materials from the two metering cylinders 35 and 38 to the mixer 45 are connected to opposite sides of the mixer at the rear end thereof in the manner indicated in FIG. 9. Each of the pipes 58 is threaded into a corresponding bore 160 in the outer fixed housing 84 and the removable inner cylinder 85 is provided with inlet ports 162 which register with the two bores 160. As shown in FIG. 5, a pair of sealing rings 164 embrace the inner removable cylinder 85 on opposite sides of the bores 160 and ports 162 to prevent leakage therefrom longitudinally of the mixer between the inner removable cylinder 85 and the outer fixed housing 84.

In the preferred practice of the invention, the rotor shaft 88 is of square cross-sectional configuration throughout the length of the inner removable cylinder 85 and the rotor assembly comprises the series of mixer units on the square shaft that are shown in FIGS. 5 and 10.

The material flowing from the two inlet ports 162 of the inner removable cylinder 85 to the two dispensing nozzles 146 and 147 first encounters a pair of axially spaced baffle disks 165 that are mounted on the square shaft for rotation therewith. Each of the baffle disks 165 diverts the axially flowing materials radially outward toward the inner circumferential surface of the inner cylinder 85 and each of the two baffle disks is formed with a series of peripheral tongues 168 to act on the flowing material. As may be seen in FIG. 10, the peripheral tongues 168 extend alternately in opposite directions laterally of the two baffle disks and longitudinally of the mixer.

After passing two baffle disks 165 the flowing materials encounter a heavy baffle disk 170 having a circular series of apertures 172. The baffle disk 170 is of relatively large diameter to substantially span the interior of the inner cylinder 85 and thus cause the two materials to be diverted radially inwardly to pass through the apertures 172 relatively close to the square rotor shaft.

The mixture of materials is then acted upon successive-

ly by two sheet metal elements 174 of the construction shown in FIGS. 11 and 12. Each of the sheet metal elements 174 comprises a disk that is cut and bent to form four inclined blades 175 that act upon the sealant mixture with a screw action to promote axial flow thereof.

The next mixer element on the rotor shaft is a baffle 176 which, as best shown in FIGS. 13 and 14, is cut away to provide a series of peripheral recesses 178. It is apparent that the baffle 176 diverts the axially flowing materials radially outward towards the inner circumferential surface of the mixer cylinder 85.

The mixture of materials is then acted upon successively by a third sheet metal element 174, a third tongued baffle disk 165, a fourth sheet metal element 174, a fifth sheet metal element 174 and, finally, a fourth tongued baffle disk 165. The mixture then flows through the apertures 124 of the previously mentioned disk 118 to encounter the previously mentioned valve disk 156.

The manner in which the apparatus operates for its purpose may be readily understood from the foregoing description. Whenever the handle 46 of the mixer is swung to the right or to the left to one of its limit positions, it actuates one of the two poppet valves 144 and 145 and at the same time releases the mixed material through the corresponding dispensing nozzle 146 or 147. The actuation of either of the two poppet valves releases air from the pilot tube 95 to open the shutoff valve 94 for energization of the air motor 90. As long as the handle 46 is in its upright neutral position cutting off dispensing flow from the mixer 45, the metering pistons 48 and 50 in the metering cylinders 35 and 38 are immobilized by back pressure, but whenever the handle is swung to either of its two limit positions, the metering pistons reciprocate repeatedly for continuous feeding of the two materials to the mixer.

The plurality of mixer elements on the rotor shaft 88 provide numerous cutting edges for chopping action on the intermixed materials. Thus the numerous peripheral tongues 168 of the baffle disks 165 and the numerous inclined blades 175 of the sheet metal elements 174 cut edgewise into the flowing mixture. In addition, there is a chopping action by the edges of the apertures 172 of the heavy baffle disk 170 and chopping action by the edges of the peripherally recessed baffle 176.

The noncircular cross-sectional configuration of the rotor shaft 88 is important because it acts on the flowing mixture with a pulsating effect that keeps striations of the two materials from wrapping around the shaft. As the result of this pulsating action and the chopping action of the numerous cutting edges of the rotor assembly, any bubbles of air that may be entrapped in the mixture are broken up to form exceedingly small bubbles that are not apparent at all in the finished product.

An important feature of the invention is the manner in which the various parts may be quickly and conveniently dismantled for exposure of all surfaces that need to be cleaned. The metering cylinders 35 and 38, as well as the associated 4-way ingredient valves 36 and 40, may be readily dismantled. To dismantle the mixer 45 it is merely necessary to loosen the nuts 140 and swing the pivoted bolts 128 out of the way for removal of the cylinder head 86 and the inner cylinder 85. The rotor assembly may then be separated from the inner cylinder 85.

Our description in specific detail will suggest various changes, substitutions and other departures from our disclosure within the scope and spirit of the appended claims.

We claim:

1. In an apparatus for mixing fluent materials, the combination of: an outer housing shell open at both ends; an inner mixer cylinder closed at its rear end and removably mounted in said shell, said inner mixer cylinder being open at its forward end and having a plurality

of ports near its rear end to receive the two materials; a bearing in said closed end of the cylinder forming an axial opening; a mixer rotor for operation in said mixer cylinder including a rotor shaft to fit removably in said axial opening to be journaled by said bearing with the rear end of the shaft extending beyond the bearing; removable closure means to close the forward end of said mixer cylinder; and means forming at least one discharge port for dispensing the mixed materials from the forward region of the mixer cylinder.

2. In a device for mixing at least two materials, at least one of which is a viscous material, said device having a mixing cylinder for movement of materials therethrough longitudinally thereof, a removable closure for one end of the cylinder and a rotor positioned in said cylinder coaxially thereof and removable through said one end, the combination therewith of: a plurality of mixer elements distributed along said rotor and mounted thereon for removal therewith, said elements including axially spaced elements with inclined blades to propel the material through the cylinder, at least one disc element with radially outwardly located openings to divert the moving material radially outward, and at least one disc with radially inwardly openings to divert the material radially inward.

3. A combination as set forth in claim 2 in which said elements include at least one disc having a peripheral series of mixer tongues bent to extend longitudinally of the rotor.

4. A combination as set forth in claim 2 in which said disc to divert the moving material radially outward has peripheral recesses forming said radially outwardly located openings.

5. In a device for mixing at least two materials, at least one of which is a viscous material, said device having a mixing cylinder for movement of materials therethrough longitudinally thereof, a removable closure for one end of the cylinder and a rotor positioned in said cylinder coaxially thereof and removable through said one end, the combination therewith of: a plurality of mixer elements distributed along said rotor and mounted thereon for removal therewith, said elements including axially spaced elements with inclined blades to propel the material through the cylinder; and a plurality of discs each having a circumferential series of peripheral tongues bent to extend longitudinally of the rotor whereby the moving material is diverted radially outward to pass said tongues to be chopped thereby.

6. A combination as set forth in claim 5 in which the alternate tongues of said series are bent in opposite longitudinal directions.

7. A combination as set forth in claim 5 which includes a transverse baffle means removably mounted in said cylinder and journaling said rotor, said baffle means having radially inwardly located openings to divert the moving material radially inward.

8. In a device for mixing at least two materials, at least one of which is a viscous material, said device having a mixing cylinder for movement of materials therethrough longitudinally thereof, a removable closure for one end of the cylinder and a rotor positioned in said cylinder coaxially thereof and removable through said one end, the combination therewith of: two axially spaced mixer discs on said rotor for rotation therewith, each disc being a blank disc to cause the material to flow radially outward around its periphery, each of said discs having a circumferential series of tongues bent longitudinally of the rotor to intercept the material flowing around its periphery; at least one mixer element on said rotor for rotation therewith between said two mixer discs, said mixer element having inclined blades to move the material by screw action.

9. A combination as set forth in claim 8 which includes an additional disc on said rotor between said

mixer discs, said additional disc having radially inwardly located openings to divert the materials radially inward from the outer circumferential region of the cylinder.

10. In a device for mixing at least two materials, at least one of which is a viscous material, the combination of: an elongated housing open at both ends; a mixing cylinder mounted in said housing for removal axially therefrom, said cylinder having an end wall at one end and being open at the other end and having an outer circumferential flange at said other end to abut the corresponding end of the housing; a cylinder head removably covering said open end of the cylinder; means interconnecting said cylinder head and said housing to clamp said flange between the cylinder head and the housing; and a removable rotor assembly positioned in said cylinder axially thereof and extending both through said end wall of the cylinder and through said cylinder head.

11. In a device for mixing at least two materials, at least one of which is a viscous material, the combination of: an elongated housing open at both ends; a mixing cylinder mounted in said housing for removal axially therefrom, said cylinder having an end wall at one end and being open at the other end and having an outer circumferential flange at said other end to abut the corresponding end of the housing, said cylinder defining with said housing an annular space extending longitudinally of the cylinder; a cylinder head removably covering said open end of the cylinder; means interconnecting said cylinder head and said housing to clamp said flange between the cylinder head and the housing; a removable rotor assembly positioned in said cylinder axially thereof and extending both through said end wall of the cylinder and through said cylinder head; means to actuate said rotor assembly with consequent frictional generation of heat in the material in the mixing cylinder; and means to circulate cooling fluid through said annular space to dissipate said heat.

12. In a device for mixing at least two materials, at least one of which is a viscous material, the combination of: an elongated housing open at both ends; a mixing cylinder inside said housing and forming therewith an annular space extending longitudinally of the housing said cylinder having an input end and a discharge end; means to feed said materials to said cylinder under pressure for movement therethrough from the input end thereof to the discharge end thereof; a rotor assembly in said cylinder extending axially thereof and having a plurality of axially spaced mixer elements to act on said materials with consequent frictional generation of heat in the materials; an air motor at said input end of the mixing cylinder to actuate said rotor assembly; means to convey the exhaust air from said air motor to said annular space to dissipate said heat; a control valve to control the flow of air through said motor and into said annular space thereby to control energization of the motor; a manually operable dispensing valve at said discharge end of the cylinder to control the release of the mixed materials from the discharge end of the cylinder; and a pilot valve connected to said control valve for control thereof, said pilot valve being positioned at the discharge end of the cylinder and being responsive to said dispensing valve to start said air motor and cause cooling air to flow through said annular space whenever the dispensing valve is opened.

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