United States Patent [19]

Gusmer et al.

[11] E **Re. 29,665**

[45] Reissued **June 13, 1978**

[54] **APPARATUS FOR EJECTING A MIXTURE OF A PLURALITY OF LIQUIDS**

[75] Inventors: **Frederick E. Gusmer**, Mantoloking, **Carl W. Sundberg, Jr.**, Chatham, both of N.J.; **Joseph E. Hayes, Jr.**, Woodland Park, Colo.

[73] Assignee: **Gusmer Corporation**, Old Bridge, N.J.

[21] Appl. No.: **771,810**

[22] Filed: **Feb. 24, 1977**

Related U.S. Patent Documents

Reissue of:

[64] Patent No.: **3,876,145**
Issued: **Apr. 8, 1975**
Appl. No.: **435,685**
Filed: **Jan. 23, 1974**

[51] **Int. Cl.**[2] **B05B 15/02**

[52] **U.S. Cl.** **239/112**; 239/414; 239/569

[58] **Field of Search** 239/112, 115–118, 239/113, 379, 414, 415, 527, 528, 569, 2

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,144,210	8/1964	Levy	239/415
3,263,928	8/1966	Gusmer	239/414 X
3,687,370	8/1972	Sperry	239/414 X
3,786,990	1/1974	Hagfors	239/414 X

Primary Examiner—Joseph F. Peters, Jr.
Assistant Examiner—Gene A. Church
Attorney, Agent, or Firm—Young & Thompson

[57] **ABSTRACT**

Apparatus for ejecting a mixture of liquids, e.g. urethane foam, comprises a cylindrical chamber into which the liquids are separately introduced under pressure and mixed and ejected from the open end of the chamber. A reciprocable plunger alternately exposes the inlets in its rear portion and seals the inlets from each other and purges the chamber in its forward position. The inlets are axially spaced apart and separated from each other by a throat that has interference fit with the plunger in the forward position of the plunger, the plunger having for this purpose an elastic deformable surface.

18 Claims, 5 Drawing Figures

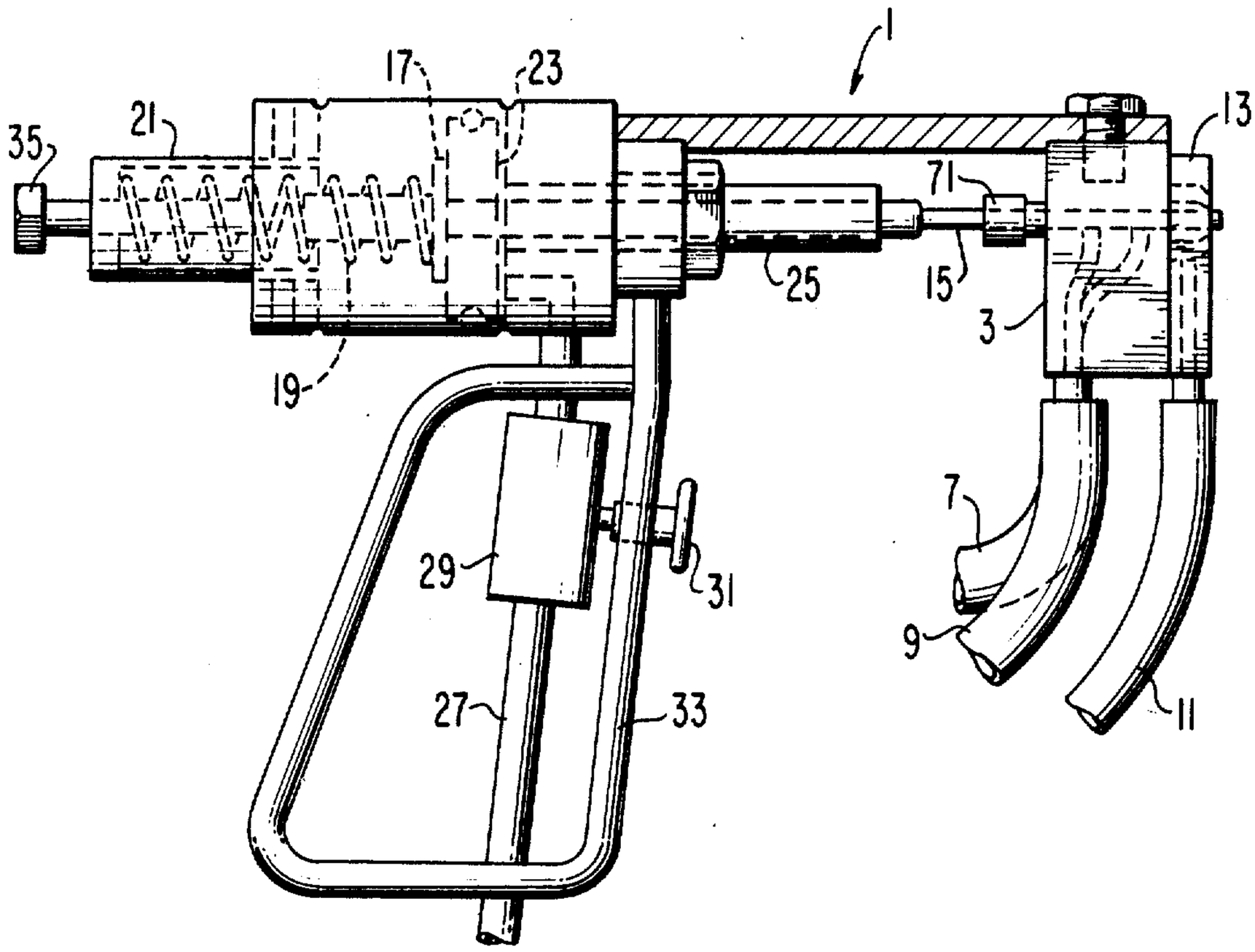


FIG.1

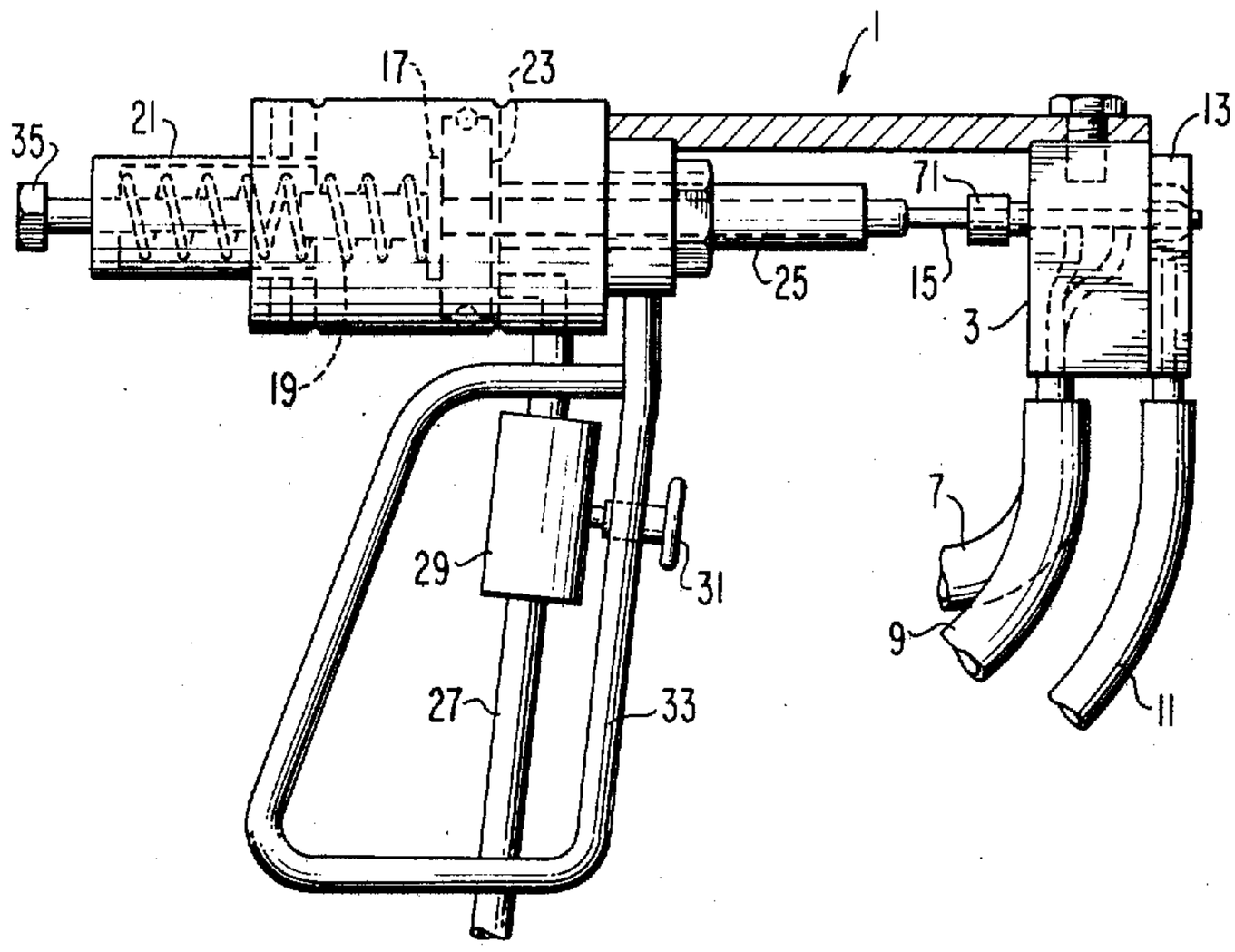
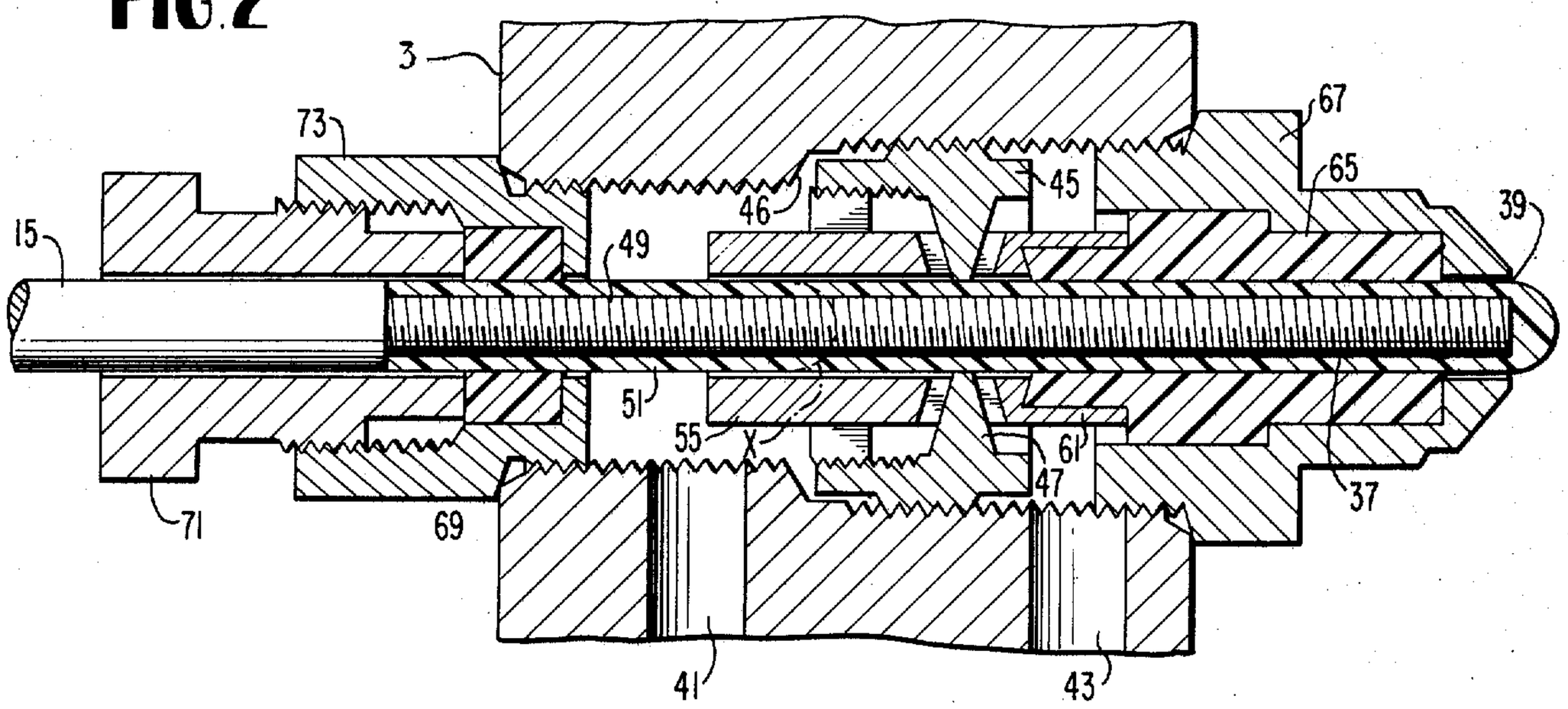


FIG.2



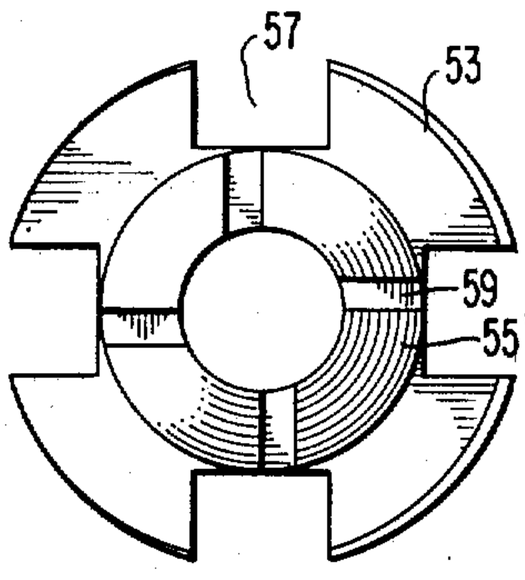


FIG.3

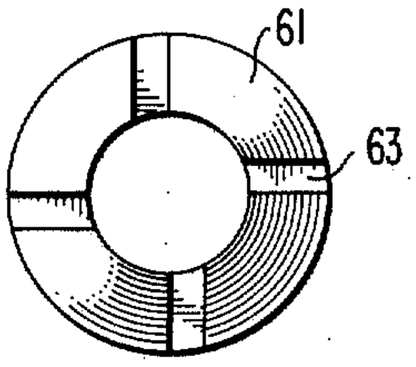


FIG.4

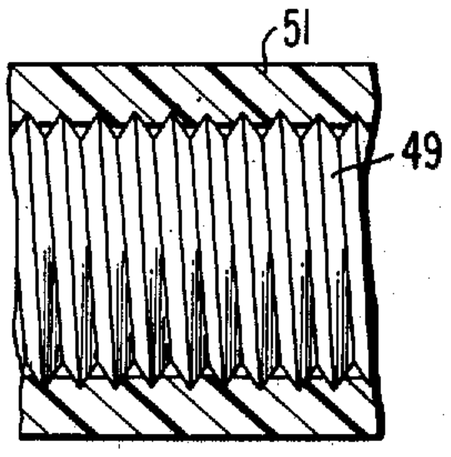


FIG.5

APPARATUS FOR EJECTING A MIXTURE OF A PLURALITY OF LIQUIDS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

The present invention relates to apparatus for ejecting a mixture of liquids, and more particularly to ejecting a homogeneous mixture of liquid which must be mixed as nearly concurrently with ejection as possible. The invention has utility in a number of fields, such as the ejection of foam, of highly exothermic mixtures, and of thermosetting resin formulations. It will be disclosed, by way of example, in connection with the ejection of foam, particularly foam of the urethane type.

For some applications, the present invention will be used to eject mixtures in a divided form such as spray or droplets or larger cohesive units. However, it is to be understood that the present invention is also useful for the ejection of mixed liquids in a continuous stream.

It is also to be understood that although some of the ejection of mixed liquids according to the present invention will be against a solid substrate, it is also within the purview of the present invention to eject mixed liquids into a partially or completely enclosed region such as a chamber. Thus, the present invention is amenable to such applications as spray coating on a solid substrate, caulking by injection of a continuous stream into a joint or seam or the like, the insertion of insulation by the ejection of a continuous or particulate stream into a space to be insulated, the formation of shaped bodies of foamed or unfoamed plastics by ejection of a mixture of liquids into a mold cavity, the formation of unshaped bodies of foamed plastics by ejection of the mixture onto a moving conveyor, packaging such as polyurethane packaging, or other processes which will be obvious to persons having ordinary skill in this art.

The present invention is an improvement on U.S. Pat. No. 3,263,928, Aug. 2, 1966. In the device of that patent, as in other devices in this field, liquids have been mixed and ejected by separately introducing them into a mixing chamber having an open outlet end, from spaced inlets that open into the chamber at about the same distance from the outlet along the axis of the chamber, in a region of the chamber that is swept by a plunger that in its rearward position exposes the inlets and permits the liquids to flow into the chamber and mix in the chamber and be ejected from the open end of the chamber, and upon movement toward its forward position simultaneously closes all the inlets and then sweeps the remaining mixed liquids forwardly out of the chamber.

The aim of such devices is to prevent the retention or accumulation in the chamber of any substantial quantity of the mixture of liquids. These liquids are ordinarily mutually reactive to set up to a solid which would impede operation of the device if not completely purged by the plunger.

It has been found, however, that in practice, the plunger still has a tendency to stick both in the closed and in the open position. It has also been found to be difficult, with the known devices, to maintain good distribution of material across the spray pattern. Finally, there is a tendency in such known devices, for the reactive liquids to seep past the parts of the apparatus in the off position, and to mix and react and impede operation of the device.

Accordingly, it is an object of the present invention to provide apparatus for ejecting a mixture of a plurality of liquids, in which the tendency toward sticking of the plunger in the open and/or closed position is reduced.

Another object of the present invention is the provision of such apparatus, which has good distribution of material across the spray pattern.

Still another object of the present invention is the provision of such apparatus, in which seepage of the liquids in the closed position is eliminated.

Still another object of the present invention is the provision of such apparatus, having improved plunger construction.

Finally, it is an object of the present invention to provide such apparatus, which will be relatively simple and inexpensive to manufacture, easy to operate, maintain and repair, and rugged and durable in use.

Other objects, features and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawing, in which:

FIG. **1** is a side elevational view of apparatus according to the present invention;

FIG. **2** is an enlarged cross-sectional view of the valve and ejector outlet assembly of the present invention;

FIG. **3** is an end view of the rear impinger viewed from the right in FIG. **2**;

FIG. **4** is an end view of the front impinger viewed from the left in FIG. **2**; and

FIG. **5** is an enlarged fragmentary cross-sectional view of the plunger.

Referring now to the drawing in greater detail, there is shown a gun according to the invention, indicated generally at **1**, and including a head **3**. Conduits **7** and **9** each supplies a different liquid to head **3**. Sources of supply for these different liquids under pressure to conduits **7** and **9** are not shown but may take any usual form. An air hose **11** supplies compressed air to an air cap **13**. Air cap **13** directs air against and along the exterior of valve nozzle **67** for the purpose of cleaning the front end of the apparatus. For this purpose, compressed air can be used at a relatively low gauge pressure, for example, about 1 to 10 p.s.i.g. In this way, the accumulation of deposits of reactive material about the outlet of the spray equipment is avoided. This compressed air is not intended to assist in atomizing when spraying.

A plunger **15** is reciprocable in head **3**. The plunger **15** adjacent its forward or free end is of cylindrical contour and of uniform external diameter. Adjacent its rear end, plunger **15** carries an adjustment nut **17** screw-threadedly thereon. A coil compression spring **19** bears between adjustment nut **17** and the rear end of a housing **21** carried by the gun and continuously urges plunger **15** forwardly. A piston **23** is slidable in a cylinder formed in the rear of the gun. A hollow tubular sleeve **25** extends forwardly from piston **23** and encompasses plunger **15** to guide and support plunger **15** and also to guide piston **23**.

An air hose **27** under the control of valve **29** brings compressed air to the forward side of piston **23** to force piston **23** rearwardly against adjustment nut **17** and to force adjustment nut **17** and with it plunger **15** rearwardly against the action of spring **19**. Valve **29** is selectively opened and closed by actuation of an actuating

button **31** carried by the handle **33** of the gun. Depressing button **31** opens valve **29** to admit compressed air **27** to the chamber forwardly of piston **23**, to drive the piston rearwardly until the rear end of plunger **15** contacts an adjustable plunger stop **35** screw-threadedly received in the rear of housing **21** and rotatably adjustable to advance or retract its forward end thereby to fix the rearmost position of plunger **15**. The forwardmost position of plunger **15** is set by manipulation of adjustment nut **17**.

The forward end of plunger **15** is disposed in a mixing chamber **37** within head **3**. Mixing chamber **37** has an outlet end **39** and is of substantially uniform cross-sectional configuration from end to end thereof, including outlet end **39**. In general, it is preferred that mixing chamber **37** and outlet end **39** thereof have a substantially uniformly cylindrical shape.

Thus far, the arrangement of the present invention can be generally as in the above-identified patent. The particular novelty of the present invention is as follows:

Remembering that in the prior art, the inlets for the different liquids are generally opposed to each other, in the present invention, the inlets of the different liquids, shown at **41** and **43** in FIG. **2**, are axially spaced apart lengthwise of the chamber **37**, and are separated from each other by the plunger **15** in the closed position. In the open position, however, when the plunger is withdrawn to the position indicated for example at x in FIG. **2**, then the inlets **41** and **43** both communicate with the mixing chamber and the different liquids can enter and mix therein and exit through the outlet end **39**.

An annular throat **45** is externally screw threadedly secured in head **3** and can be rotated into sealingly seated engagement against a conical shoulder **46** in head **3** and has a radially inwardly extending annular projection **47** thereon of generally truncated conical cross-sectional configuration that terminates inwardly in a radially innermost surface of throat **45** which has an interference fit with plunger **15**. That is, the inner diameter of throat **45** is less than the normal outer diameter of plunger **15**. To accommodate this interference fit, the forward end of plunger **15** is comprised by an externally screw threaded metal rod **49** that is surrounded by a sleeve **51** of elastic deformable material having a low coefficient of sliding friction, preferably an elastomer and more preferably an organic elastomer, for example solid polyamide, e.g. nylon. The outer diameter of the screw threads on rod **49** is greater than the inner diameter of sleeve **51**, so that sleeve **51** in turn has an interference fit with rod **49**. For example, if sleeve **51** were one-eighth-inch outside diameter nylon tubing with a wall 0.020 inch thick, then the threads of rod **49** could have an outside diameter of 0.090 inch, so that they are greater in diameter than the inside diameter of sleeve **51** by 0.005 inch. Similarly, the inside diameter of throat **45** may for example be 0.0025 inch, ± 0.0005 inch, smaller than the outside diameter of sleeve **51**.

The interference fit between throat **45** and sleeve **51** prevents seepage of liquid past throat **45** in the closed position shown in full line in FIG. **2**, and also provides a sweeping or cleaning action of the throat relative to the plunger in both directions of movement of the plunger. The interference fit between sleeve **51** and threaded rod **49**, on the other hand, assures retention of sleeve **51** on rod **49**; and as the material of sleeve **51** does not entirely fill up the grooves between the threads on rod **49**, as seen in FIG. **5**, these unfilled spaces permit displacement of the material of sleeve **51** radially inwardly as the sleeve passes through throat **45**. Thus the interference fit between throat **45** and sleeve **51** does not cause a wave or lump of material of sleeve **51** to move axially along plunger **15**. In this way, the arrangement shown in FIG. **5** performs the unique dual function of properly retaining sleeve **51** on the plunger, and also of permitting radially inward deformation of sleeve **51** while passing through throat **45**.

Throat **45** is internally screw threaded to receive and retain the radially outwardly extending flange **53** of a rear impinger **55** through which plunger **15** passes. Flange **53** is slotted at **57** to permit liquid from inlet **41** to pass through slots **57**, and then through smaller slots **59** to mixing chamber **37**. The forward end of impinger **55** is conical and of the same shape as the adjacent face of throat **45**, so that the adjacent conical face of throat **45** closes the forward sides of slots **59**. Slots **59** are forwardly inclined at an angle of about 20° and are axially offset as seen in FIG. **3** to produce a desirable vortical movement in chamber **37** to promote mixing.

On the other side of throat **45**, a front impinger **61** is provided, with a conical rear end traversed by slots **63** to provide communication for the other liquid from inlet **43** through slots **63** to mixing chamber **37**. The rear end of front impinger **61**, which is the left end as seen in FIG. **2**, is conical and of the same shape as the adjacent face of throat **45** and so that face of throat **45** closes the rear side of slots **63**. Slots **63** are rearwardly inclined at an angle of about 20° and are axially offset as seen in FIG. **4**, to promote a desirable vortical motion for mixing purposes.

The provision of impingers **55** and **61** that bear against opposite sides of throat **45** and that have slots cut in their ends adjacent throat **45** with throat **45** closing the slots, greatly facilitates the provision of openings for the passage of the liquids into the reaction chamber, because it is much easier to machine slots in the ends of the impingers, than it would be to provide accurate holes through a cylindrical sleeve.

The axial spacing of slots **59** and **63** makes it possible to increase the total number of the slots, and this has several beneficial results. In the first place, increasing the number of slots and spacing them apart axially improves the dispersion of the liquid as it leaves the gun and thus helps to distribute the liquid better within the spray pattern. In the second place, increasing the number of slots decreases the cross section of each slot and hence the cross section of the streams prior to mixing and so facilitates the fine division and mixing of the streams.

Front impinger **61** is secured to a packing sleeve of elastic deformable material having a low coefficient of sliding friction, preferably an elastomer and more preferably an organic elastomer, such as polytetrafluoroethylene. The rear end of sleeve **65**, in turn, is loosely disposed in nozzle **67** that is screw threadedly secured in head **3**, so that front impinger **61** and the rear end of packing sleeve **65** float together as a unit relative to nozzle **67**, with the result that the front end assembly is self-aligning and the problem of maintaining extremely small manufacturing tolerances is thereby avoided. The front end of packing sleeve **65** seals in nozzle **67**.

To the rear of the mixing chamber, the assembly is completed by a packing sleeve **69** of a material such as that of sleeve **65**, which may be tightened with a packing adjustment screw **71** screw threadedly received in a sleeve **73** which in turn is screw threadedly received in head **3**.

In operation, the user of the gun can actuate the device by depressing button **31**, thereby opening valve **29** and causing piston **23** to move to the rear until the rear end of plunger **15** contacts plunger stop **35**. In this position, the forward or free end of plunger **15** moves to the rear of slots **59** and **63**, to the position x in FIG. **2**, and the different liquids that are supplied under pressure to conduits **7** and **9** rush into mixing chamber **37**, where they are given a rotary or swirling movement with resultant shearing and mixing of the streams, by virtue of the offset of slots **59** from each other, and the offset of slots **63** from each other. The mixing liquids thus move toward and out of outlet end **39** with a largely helical movement. The high kinetic energy of the stream may cause the stream to subdivide into discrete particles or drops, or not, depending on process variables well known to persons in this field. Among these variables is the degree of offset of the slots from the axis of chamber **37**.

When the operator releases button **31**, compressed air to the forward side of piston **23** is cut off and spring **19** forces piston **23** forwardly until the piston contacts the front of its piston chamber. In this position, which is the position of the parts shown in FIG. **2**, the forward or free end of piston **15** occupies substantially all of outlet end **39** and preferably protrudes somewhat out of outlet end **39**. By this forward movement of plunger **15**, substantially all of the mixed liquid within chamber **37** is mechanically expelled. If the liquid is of the type that sets up into a relatively hard substance a short time after mixing, then the advantages of the present invention will be obvious in that substantially no mixed liquid will be left in chamber **37** to harden. On the other hand, the gun will be ready for use again and can begin to function immediately upon a further retraction of plunger **15**. It is thus unnecessary to clean the gun after every actuation, as substantially no mixed liquids remain in the gun.

The advantage of the operation of the present invention, with its axially spaced inlets, as compared to the known arrangements with axially opposed inlets for the different liquids, is as follows.

In the closed position, the interference fit of throat **45** prevents any movement of any liquid past the throat along plunger **15**, and so effectively isolates the reactive liquids from each other. Moreover, in the closed position, it is impossible for any mixed liquids to move toward the rear packing, because this space is already occupied by the liquid from inlet **41**. Thus the rear packing is bathed in liquid from inlet **41**, which serves as an additional seal against liquid from inlet **43**.

Even in the open position of the parts, the rear packing is protected from contact by any mixed liquid. This is because the slots **59** and **63** serve as restrictive orifices, which let down the pressure of the liquids from inlets **41** and **43**, respectively. For example, if the pressure in both inlets **41** and **43** were, say, 800 psi, and the reduced pressure in chamber **37**, by virtue of the pressure loss due to passage through the slots, were, say, 300 psi, then it is obvious that the mixed liquid at 300 psi could not migrate rearward into and contaminate the unmixed liquid from inlet **41** at 800 psi.

Moreover, even plunger **15** cannot carry backward or forward any liquid on its surface, and thus promote even a small degree of undesired mixture of liquids, because the interference fit between plunger **15** and throat **45** wipes plunger **15** clean in both directions of movement.

It is also to be noted that the forward liquid, that is, the liquid that enters through inlet **43**, is the first to enter the chamber **37** upon rearward movement of plunger **15** and the last to leave the chamber upon forward movement of plunger **15**, that is, the slots **63** are exposed before slots **59** and are closed after slots **59**. As a result, there may be a slight excess of this forward liquid at the beginning and end of ejection. However, this is not necessarily undesirable and can in fact even be highly desirable. It is not necessarily undesirable, because if for example the mixture of liquids forms a polyurethane and the rear liquid through inlet **41** is the resinous component and the forward liquid through inlet **43** is its activator containing isocyanate, then this slight excess of isocyanate may itself react with ambient moisture even in the absence of resin admixed therewith. On the other hand, the fact that slots **63** are closed later than slots **59** may be highly desirable, as it ensures that plunger **15** in its closed position, to the extent that it is wetted at all, will be wetted with the single liquid from inlet **43**, rather than with the reactive mixture that previously filled chamber **37**.

From a consideration of the foregoing disclosure, therefore, it will be evident that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with a preferred embodiment, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

Having described our invention, we claim:

1. Apparatus for ejecting a mixture of a plurality of liquids, comprising a mixing chamber having an outlet opening and a plurality of spaced inlets which are spaced different distances from said outlet opening, means for separately introducing different liquids into the chamber through said inlets, a plunger reciprocable in the chamber between forward and rear positions, the differently spaced inlets communicating with the chamber and with each other in said rear position of the plunger, and means sealing against the plunger in the forward position of the plunger to seal said inlets from each other, the forward end of the plunger being forward of all said inlets in said forward position of the plunger and being rearward of all said inlets in said rear position of the plunger, *the surface of one of said plunger and sealing means being an elastic deformable material, said sealing means comprising an annular throat in which said plunger reciprocates with an interference fit, said plunger being in sealing contact with said throat in said forward position and exposing all said inlets to each other in said rear position, said forward end of said plunger being disposed on opposite sides of said throat in said forward and rear positions, said inlets being disposed on opposite sides of said throat.*

[2. Apparatus as claimed in claim **1**, in which the surface of one of said plunger and sealing means is an elastic deformable material.**]**

3. Apparatus as claimed in claim **[2]** *1*, in which the surface of said plunger is an elastic deformable material.

[4. Apparatus as claimed in claim **1**, said sealing means comprising an annular throat in which said plunger reciprocates with an interference, said plunger being in

sealing contact with said throat in said forward position and exposing all said inlets to each other in said rear position, said forward end of said plunger being disposed on opposite sides of said throat in said forward and rear positions, said inlets being disposed on opposite sides of said throat.]

5. Apparatus as claimed in claim [4] *1*, said inlets extending through slots formed in the ends of separable members that abut said throat on opposite sides of said throat, said throat closing one side of each of said slots.

6. Apparatus as claimed in claim 5, said opposite sides of said throat converging radially inwardly.

7. Apparatus as claimed in claim 6, said slots on opposite sides of said throat converging radially inwardly.

8. Apparatus for ejecting a mixture of a plurality of liquids, comprising a mixing chamber having an outlet opening and a plurality of spaced inlets which are spaced different distances from said outlet opening, means for separately introducing different liquids into the chamber through said inlets, a plunger reciprocable in the chamber between forward and rear positions, the differently spaced inlets communicating with the chamber and with each other in said rear position of the plunger, and means sealing against the plunger in the forward position of the plunger to seal said inlets from each other, said plunger adjacent said sealing means comprising a sleeve of elastic deformable material on a metal rod, *said rod having grooves on its outer surface which are only partially filled by the material of said sleeve.*

[9. Apparatus as claimed in claim 8, said rod having grooves on its outer surface which are only partially filled by the material of said sleeve.]

10. Apparatus for ejecting a mixture of a plurality of liquids, comprising a mixing chamber having an outlet opening and a plurality of spaced inlets which are spaced different distances from said outlet opening, means for separately introducing different liquids into the chamber through said inlets, a plunger reciprocable in the chamber between forward and rear positions, the differently spaced inlets communicating with the chamber and with each other in said rear position of the plunger, and means sealing against the plunger in the forward position of the plunger to seal said inlets from each other, said sealing means comprising an annular throat in which said plunger reciprocates with an interference fit, said plunger being in sealing contact with said throat in said forward position and exposing all said inlets to each other in said rear position, said forward end of said plunger being disposed on opposite sides of said throat in said forward and rear positions, said inlets being disposed on opposite sides of said throat, said inlets extending through slots formed in the ends of separable members that abut said throat on opposite sides of said throat, said throat closing one side of each of said slots, said separable member on the same side of said throat as said outlet opening being carried by a floating packing sleeve through which said plunger extends in said forward position.

[11. Apparatus for ejecting a mixture of a plurality of liquids, comprising a mixing chamber having an outlet opening and a plurality of spaced inlets which are spaced different distances from said outlet opening, means for separately introducing different liquids into the chamber through said inlets, a plunger reciprocable in the chamber between forward and rear positions, the differently spaced inlets communicating with the chamber and with each other in said rear position of the plunger, and means sealing against the plunger in the forward position of the plunger to seal said inlets from each other, there being a plurality of said inlets for each said liquid, all the inlets for one said liquid being equally peripherally spaced about said chamber and being the same distance from said outlet opening.]

[12. Apparatus as claimed in claim 11, all said inlets for each said liquid being offset the same distance and in the same direction from the axis of the chamber.]

13. Apparatus for ejecting a mixture of a plurality of liquids, comprising a mixing chamber having an outlet opening and a plurality of spaced inlets which are spaced different distances from said outlet opening, means for separately introducing different liquids into the chamber through said inlets, a plunger reciprocable in the chamber between forward and rear positions, the differently spaced inlets communicating with the chamber and with each other in said rear position of the plunger, and means sealing against the plunger in the forward position of the plunger to seal said inlets from each other, said inlets farthest from said outlet opening being inclined forwardly and said inlets nearest said outlet opening being inclined rearwardly.

14. Apparatus as claimed in claim 1, said inlets being defined between said throat and separable members on opposite sides of said throat, the inside diameter of said separable members being greater than the inside diameter of said throat.

15. Apparatus as claimed in claim 1, said plunger adjacent said sealing means comprising a sleeve of elastic deformable material on a rod, said rod having grooves on its outer surface which are only partially filled by the material of said sleeve.

16. Apparatus as claimed in claim 10, said inlets farthest from said outlet opening being inclined forwardly and said inlets nearest said outlet opening being inclined rearwardly, said separable members both having conical surfaces in contact with said throat.

17. Apparatus as claimed in claim 13, said sealing means comprising an annular throat in which said plunger reciprocates, said plunger being in sealing contact with said throat in said forward position and exposing all said inlets to each other in said rear position, said forward end of said plunger being disposed on opposite sides of said throat in said forward and rear positions, said inlets being disposed on opposite sides of said throat, said inlets being defined between separable members that abut said throat on opposite sides of said throat, said throat closing one side of each of said inlets, said separable members both having conical surfaces in contact with said throat.

18. Apparatus as claimed in claim 17, in which said inlets are in the form of slots formed in said conical surfaces.

19. Apparatus for ejecting a mixture of a plurality of liquids, comprising a mixing chamber having an outlet opening and a plurality of spaced inlets which are spaced different distances from said outlet opening, means for separately introducing different liquids into the chamber through said inlets, a plunger reciprocable in the chamber between forward and rear positions, the differently spaced inlets communicating with the chamber and with each other in said rear position of the plunger, and means sealing against the plunger in the forward position of the plunger to seal said inlets from each other, said sealing means comprising an annular throat in which said plunger reciprocates, said plunger being in sealing contact with said throat in said forward position and exposing all said inlets to each other in said rear position, said forward end of said

plunger being disposed on opposite sides of said throat in said forward and rear positions, said inlets being disposed on opposite sides of said throat and being defined between said throat and the ends of separable members that abut said throat on opposite sides of said throat, said throat closing one side of each of said inlets, said separable member on the same side of said throat as said outlet opening being carried by a packing sleeve of elastic deformable material through which said plunger extends in said forward position.

20. Apparatus as claimed in claim 19, said inlets nearest said outlet opening being inclined rearwardly and the surface of said separable member on the same side of said throat as said outlet opening being conical and being in contact with a conical surface of said throat.

21. Apparatus as claimed in claim 20, in which the inside diameter of said separable member on the same side of said throat as said outlet opening is greater than the inside diameter of said throat.

22. Apparatus for ejecting a mixture of a plurality of liquids, comprising a mixing chamber having an outlet opening and a plurality of spaced inlets which are spaced different distances from said outlet opening, means for separately introducing different liquids into the chamber through said inlets, a plunger reciprocable in the chamber between forward and rear positions, the differently spaced inlets communicating with the chamber and with each other in said rear position of the plunger, and means sealing against the plunger in the forward position of the plunger to seal said inlets from each other, said sealing means comprising an annular throat in which said plunger reciprocates, said plunger being in sealing contact with said throat in said forward position and exposing all said inlets to each other in said rear position, said forward end of said plunger being disposed on opposite sides of said throat in said forward and rear positions, said inlets being disposed on opposite sides of said throat, the surface of said plunger in and adjacent said throat being an elastic deformable material, the inside diameter of said throat being less than the normal outer diameter of said surface of elastic deformable material.

23. Apparatus as claimed in claim 22, said plunger adjacent said throat comprising a sleeve of said elastic deformable material on a rod, said rod having grooves on its outer surface which are only partially filled by the material of said sleeve.

* * * * *