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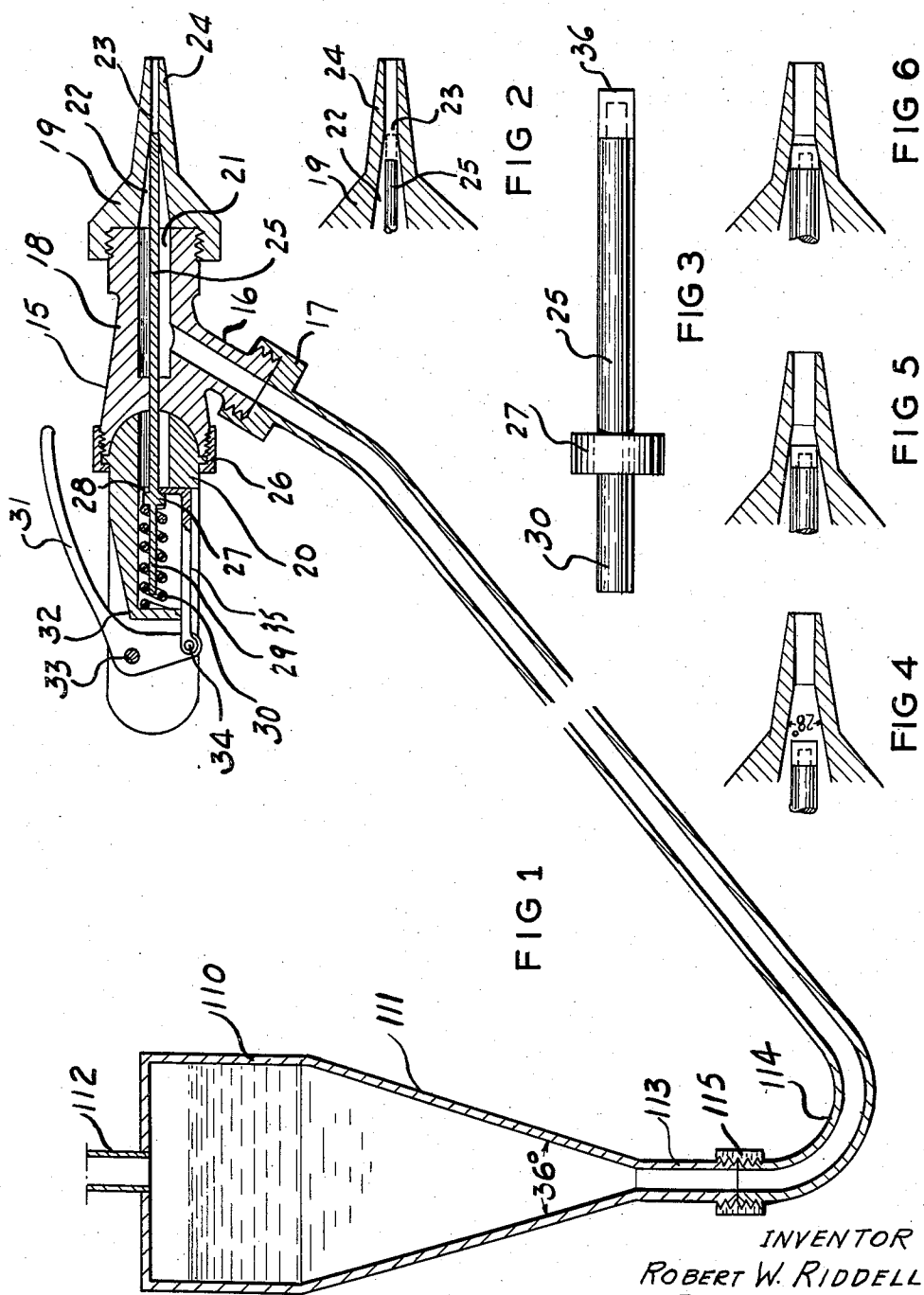
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3,022,955

APPLICATOR

Filed Jan. 9, 1957

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

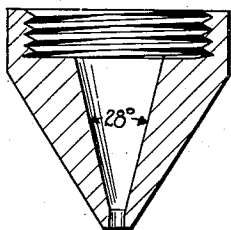


FIG 7

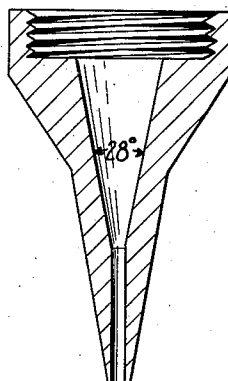


FIG 8

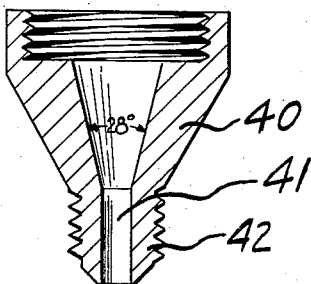


FIG 9

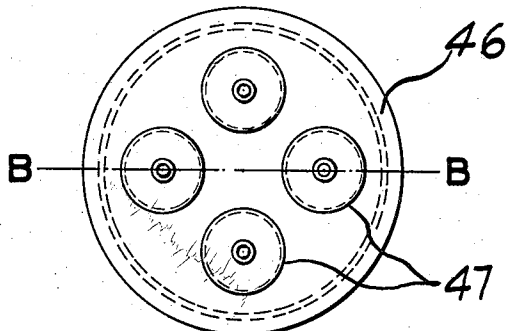


FIG 13

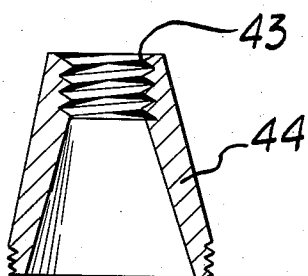


FIG 10

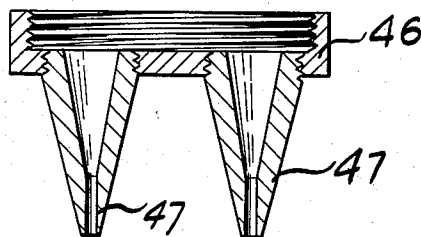


FIG 14



FIG 11

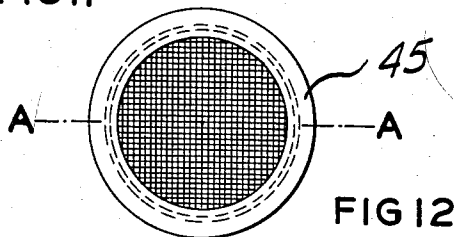


FIG 12

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1

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4 Claims. (Cl. 239—456)

My invention relates to pressure type applicators for fluent solids and pastes including a variety of industrial pastes such as solders, brazes, greases and the like. In a particular aspect, it provides apparatus capable of operating with economy and efficiency at high speed in production line work. In other aspects, it provides for such apparatus a novel applicator gun including a novel valve and ejection nozzle means permitting flexible operation for a variety of application requirements under a variety of operating conditions.

Numerous attempts have been made to design applicators for industrial pastes, e.g. solders, which are suitable for production line operations such as production line brazing and soldering. Conventionally designed applicators, however, have been plagued with plugging and leaking difficulties and resulting erratic operation which have made them unsuitable for production work. Pressure type applicators have required excessively high pressures for operation, that is higher than available for the usual plant air supply, which rarely exceeds about 100 p.s.i.g. Moreover, when the required high pressure air is supplied, plugging problems are accentuated. Operation at high pressure can cause separation of solid and liquid components used in solders and brazes. The liquid carrier medium sprays from the applicator nozzle while the metal, or other solid particles in the paste, remains in the nozzle system, resulting in rapid plugging. The resulting shutdown is costly, and maintenance and cleaning are difficult.

In accordance with my invention, a pressure type applicator system is provided which comprises a supply tank, a delivery tube and an applicator gun. The applicator gun, the design of which represents a special aspect of the invention, includes a smooth bore barrel containing an inlet port at one end and an outlet at the other end. A valve in the barrel is adapted to close the outlet so as to effect periodic controlled discharge from it. The valve essentially consists of a rod-like elongated cylindrical closure member and a conical-faced seat opening into the outlet. The conical valve seat is characterized by an included angle not exceeding about 28°. The outlet port defines a nozzle orifice which may be integrated into a variety of nozzle designs. Means are provided for supplying liquid from the supply tank to the applicator gun and for actuating the valve in a manner, whereby controlled discharge of the liquid through the nozzle orifice may be effected.

Several variants of the invention will be described in connection with the accompanying drawings but other modifications of the invention will be apparent to those skilled in the art. The drawings comprise 14 figures of which:

FIGURE 1 is a sketch in somewhat simplified and schematic form of a sectionalized view of a pressure type applicator of the invention.

FIGURE 2 is a view in section of the nozzle portion of the applicator gun of FIGURE 1 illustrating the discharge position of the valve.

FIGURE 3 is an enlarged sketch of a valve closure member of a type employed in the applicator gun of FIGURE 1.

FIGURES 4, 5 and 6 are enlarged views in section of

2

the nozzle valve and orifice of FIGURE 1 in various stages of operation.

FIGURES 7 and 8 are views in section of two different types of nozzle members.

FIGURES 9 and 10 are views in section of a modified nozzle member and adaptor therefor.

FIGURES 11, 12, 13 and 14 illustrate in respective sectional and plan views two types of discharge members adapted for use with the nozzle member and adaptor of FIGURES 9 and 10.

Referring to FIGURE 1, the applicator system employs a pressure supply tank 110 which is provided with a conical bottom 111. For the purpose of the invention it is advantageous that the included angle of the conical bottom should be less than about 45°, preferably about 20–36°, and more advantageously about 25–30°. As illustrated in the drawing the included angle of the conical bottom is about 36°. Supply tank 110 in the drawing is not drawn accurately to scale and only a single inlet pipe 112 is shown. It will be understood that air pressure is applied, and charge paste periodically is supplied through pipe 112, but that a separate fill pipe may be provided if desired to permit continuous or intermittent charging of paste to the tank. Means can be provided in the tank for agitation if such should be desired.

Outlet line 113 is centrally located in conical bottom 111 and makes a flush connection with delivery tube 114 by means of connector 115. It is advantageous to avoid ledges or protuberances of any kind in the passage from conical bottom 111 through outlet pipe 113 to delivery tube 114 and indeed throughout the paste delivery system. Delivery tube 114 may be any type of flexible hose or tubing but advantageously is a smooth plastic tubing such as vinyl tubing, nylon, polyethylene, etc. The plastic materials appear to be more suitable than rubber. Delivery tube 114 is joined to applicator gun 15 at inlet 16 by means of threaded connector 17.

Applicator gun 15 comprises barrel member 18, a nozzle member 19 and a valve actuating member 20. Barrel member 18 contains a smooth bore chamber 21 into which inlet 16 opens at an acute angle to the axis thereof. Nozzle member 19 is threadedly attached to barrel member 18. The bore of nozzle member 19 is flared inwardly from a point of attachment to member 18 so as to provide a conical valve seat 22 opening into orifice 23. Nozzle member 19 also is provided with a discharge tip 24.

A rod type closure member 25 is mounted along the internal axis of barrel member 18 in position to cooperate with conical seat 22 and provide a valve controlling flow through orifice 23.

It is an essential feature of the invention that the included angle of conical valve seat 22 be not more than about 28°. Preferably, the included angle is as small as feasible and less than 24°. In operation, it is desirable that the cross sectional clearance area within the conical valve opening should be at least 150% that of the nozzle orifice when the valve is in the open position.

In the design of the applicator gun, it is desirable to have the diameter of inlet 16 equal to that of delivery tube 114 and to have each tubular member smoothly aligned. In the internal design of barrel member 18 it is important that the cross sectional area of bore 21, excluding that of rod valve closure member 25, shall approximate at least 4 times that of the cross sectional area of inlet tube 16. In this way smooth operation in rapid production work is facilitated since the excess capacity of the gun barrel compared to that of the delivery tube acts as a plenum chamber. A variety of known valve actuating mechanisms can be employed to actuate the rod valve of applicator gun 15. For example, the valve can be pneumatically or hydraulically

3

operated for automatic high speed operation, or it can be controlled by the electric solenoid lifting mechanism. In the example of the drawing, a simplified hand operated system is illustrated. The valve actuating member is fitted to barrel member 18 by means of threaded connector 26. A collar or collet 27 on the upper portion of rod member 25 acts as a stop in conjunction with shoulder 28. Rod valve member closure is held in the closed position by the tension of a spring 29 surrounding the stem 30 against collet 27 and thence against shoulder 28. Hand lever 31 is mounted above the spring housing 32 on member 20 by pins 33 and 34. When pressure is applied to hand lever 31, rod 35 is moved in a direction forcing valve collet 27 by pressure from shoulder 28 against spring 29, thereby drawing rod closure member 25 clear of the nozzle conical seat 22 and nozzle orifice 23.

The position of rod closure 25 in the retracted or open position is shown in FIGURE 2. The structure of the rod closure 25 is better shown in FIGURE 3, illustrating the advantageous use of a plastic tip 36 which may be screwed on the end of stainless steel rod 25. It has been found in the practice of the invention that the use of a plastic tip for the rod closure member provides substantial advantages. As indicated in FIGURES 4, 5 and 6, the plastic tip combines a scraping action (FIG. 5) as the valve begins to close with a wiping or "squeegee" action (FIG. 6) as the rod closure reaches full extension. The plastic tip may be constructed of any high melting plastic material, e.g. nylon, polyethylene, Teflon, Buna S or N, synthetic rubber, etc. Advantageously the material should be resistant to oils and hydrochloric acid, or other chemicals which may be encountered in handling the pastes. Compared to the use of a metal tip, the plastic tip provides a valuable wiping or squeegee action which adds considerably to the operational life of the nozzle with soft solders. The metal to metal contact which results from the use of an all metal rod tends to build up a ridge of metal on the valve seat caused by plating out of metal from the solder, particularly in the case of soft solders, by the hammering action of the valve closure although metal to metal valve closure contact may be better with the hard solders.

In the operation of the applicator gun, supply tank 110 is filled with the appropriate paste, and then air pressure is applied to the surface of the paste in tank 110 forcing paste to flow through delivery tube 114 and inlet 116 into bore 21 of applicator gun 15. The pressure required will vary considerably depending upon the type of paste, the dimensional relationships of the equipment, and the particular applicator required. For example, in dotting with soft solder pastes, pressures as low as 10-12 p.s.i.g. may be sufficient. However, a pressure of about 25-35 lbs. is recommended with paste solders, about 40 lbs. with copper braze pastes, and about 60 lbs. with silicone greases. The nozzle orifice opening can be varied within considerable limits to meet the requirements of particular paste and service. With an orifice opening of 0.0550 inch, I have operated applicator guns of the invention for over 300,000 cycles without shut-down for cleaning or repair. The valve rods comprised 1/4-in. diameter stainless steel rods with Buna S and Teflon tips, and the included angle of the valve seat surrounding the nozzle orifice was 22°. With the same equipment but using an included angle of 24°, trouble free operation extended to 85,000 cycles, while with a 28° angle, it was difficult to obtain as many as 25,000 cycles. When the included angle was increased to as much as 30°, the system became inoperable; the valve closure was inadequate, bad wear resulted and ridges of plated out paste quickly built up on the valve seat.

A variety of nozzles of different designs for different types of paste application can be used with my invention. FIGURE 7 illustrates a short nozzle which is designed as a high velocity, squirt type nozzle, operating

4

at about 60-70 p.s.i.g. FIGURE 8 illustrates an elongated tip nozzle which can be used for dotting or stripping and which permits access to small or restricted openings. This type nozzle works with soft solder pastes at pressures as low as 8 to 40 p.s.i.g.

In FIGURES 9 and 10, a nozzle assembly is illustrated which includes nozzle member 40 containing orifice 41 within threaded tip 42 which is adapted to engage with corresponding threads 43 in nozzle adaptor 44. Nozzle adaptor 44 is flared outwardly to provide an enlarged discharge outlet which can be fitted with nozzles of special design; e.g. the screen nozzle 45, illustrated in plan view in FIGURE 12, and in section in FIGURE 11. This wire mesh nozzle can be used in a flexible manner to apply selected designs on a surface with a solder or paste. Another special nozzle outlet which can be fitted to the applicator gun by means of the adaptor assembly of FIGURES 9 and 10 is shown in FIGURES 13 and 14 which illustrate respectively in plan view and vertical section a multi-dot orifice 46 which is equipped with a plurality of elongated small diameter nozzle tips 47.

As has been described above, the applicator gun of the invention provides substantial advantages in production line soldering or application of other industrial pastes. It is capable of considerable variation in design and can be flexibly adapted to a variety of uses. It is advantageously operated by air pressure but other hydraulic pressuring means can be used as known in the art.

I claim:

1. A pressure type applicator gun which comprises a smooth bore barrel containing an inlet port at one end thereof, an outlet port at the other end of said barrel defining a discharge orifice of cylindrical cross section, a conical faced valve seat opening from the bore of said barrel into said port wherein said valve seat is defined by a cone having a section an included angle of not more than 28°, a rod type cylindrical valve closure member having a plastic tip comprising a high melting polymeric plastic material and having a greater cross sectional area at its tip than that of said outlet port, and means for actuating said rod closure member, whereby the valve closure member and seat are characterized in closing by the plastic tip of the closure member seating above the outlet port in end edge to conical surface contact with the internal face of the conical valve seat thereby effecting a wiping squeegee action on said internal face, and in opening by a cross sectional clearance area of the conical valve opening of at least 150% that of the outlet port.

2. The applicator gun of claim 1 wherein the included angle of the conical valve seat is about 18 to 22 degrees.

3. The applicator gun of claim 1 which comprises as separate members the barrel and a discharge nozzle section containing said outlet port and conical faced valve seat, and wherein the internal cross sectional area of the barrel exclusive of the valve closure member is at least four times that of the inlet port.

4. A pressure type applicator for solder pastes which comprises in combination a supply tank having a cone-bottom with central outlet whereof the included angle of the cone is about 20 to 36 degrees, means for applying pressure to material in said tank, an applicator gun comprising a smooth bore barrel containing an inlet port at one end wherein the internal cross sectional area of the barrel (exclusive of a valve closure member hereinafter defined) is at least four times that of the inlet port, a delivery tube of equivalent cross section to that of said inlet port connecting the outlet of the tank with the inlet port of the barrel, an outlet port at the other end of said barrel defining a discharge orifice of cylindrical cross section, a conical faced valve seat opening from the bore of said barrel into said port wherein said valve seat is defined by a cone having in section an included angle of not more than 28°, a rod type cylindrical valve closure member having a plastic tip comprising a high melting poly-

3,022,955

5

meric plastic material and having a greater cross sectional area at its tip than that of said outlet port, and means for actuating said rod closure member, whereby the valve closure member and seat are characterized in closing by the plastic tip of the closure member seating above the outlet port in end edge to conical surface contact with the internal face of the conical valve seat thereby effecting a wiping squeegee action on said internal face, and in opening by a cross sectional clearance area of the conical valve opening of at least 150% that of the outlet port. 10

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