Sept. 21, 1965 D. E. TRUMBULL ETAL 3,207,378

METERING PUMP ASSEMBLY

Filed Aug. 23, 1961 5 Sheets-Sheet 1

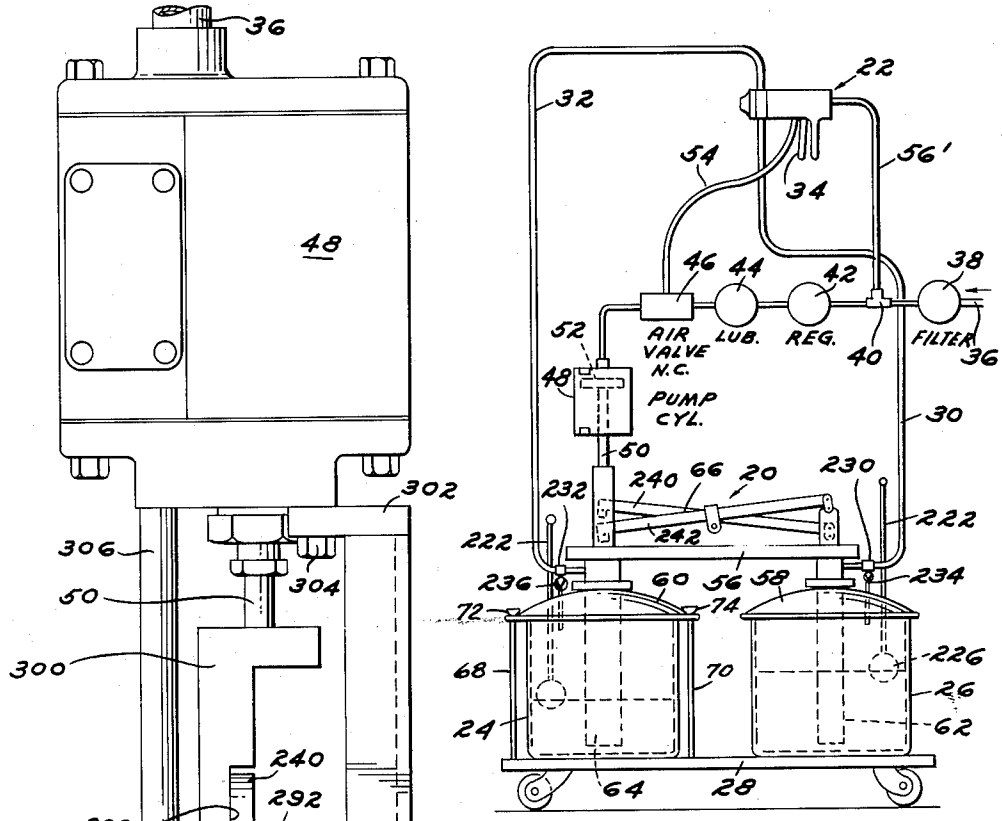


FIG. 1

FIG. 5

INVENTORS
DONALD E. TRUMBULL
ARTHUR D. POWERS JR.
BY
Burton & Parker
ATTORNEYS

Sept. 21, 1965 D. E. TRUMBULL ETAL 3,207,378

METERING PUMP ASSEMBLY

Filed Aug. 23, 1961 5 Sheets-Sheet 2

FIG. 3

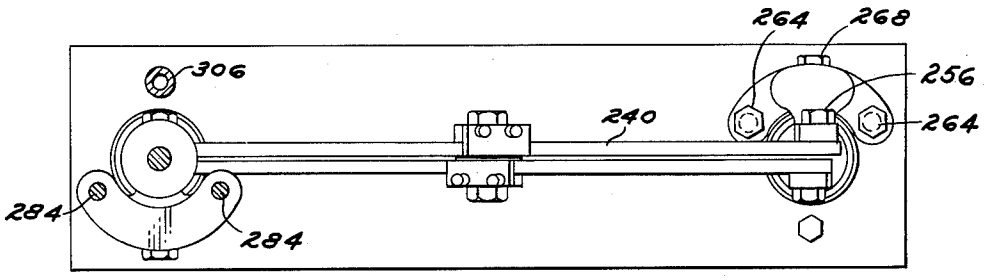


FIG. 4

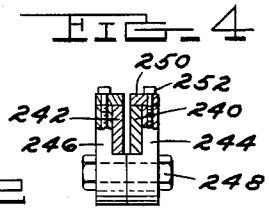
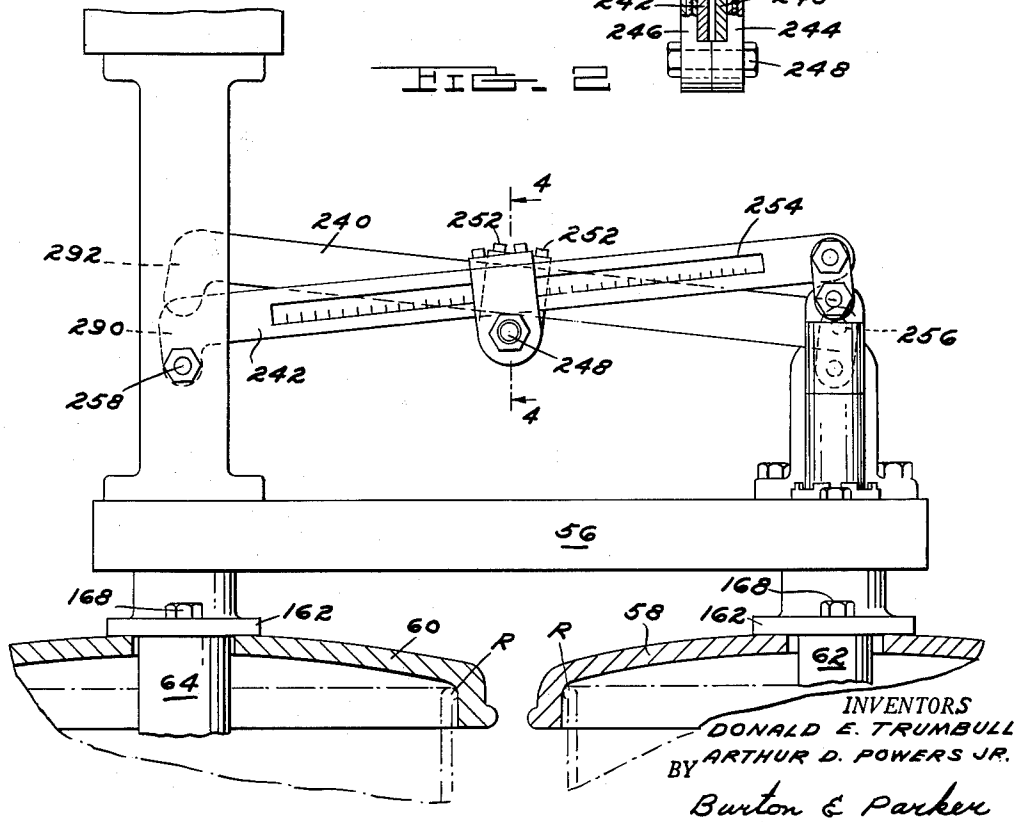


FIG. 2



INVENTORS
DONALD E. TRUMBULL
ARTHUR D. POWERS JR.
BY Burton & Parker
ATTORNEYS

Sept. 21, 1965 D. E. TRUMBULL ETAL 3,207,378

METERING PUMP ASSEMBLY

Filed Aug. 23, 1961 5 Sheets-Sheet 3

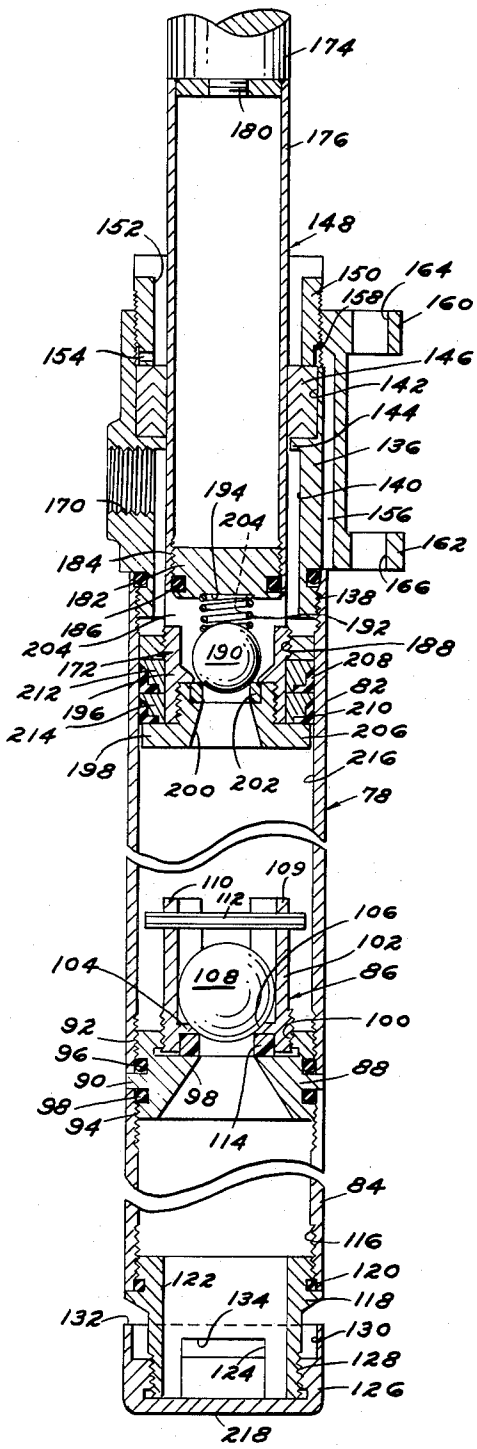


FIG. 7

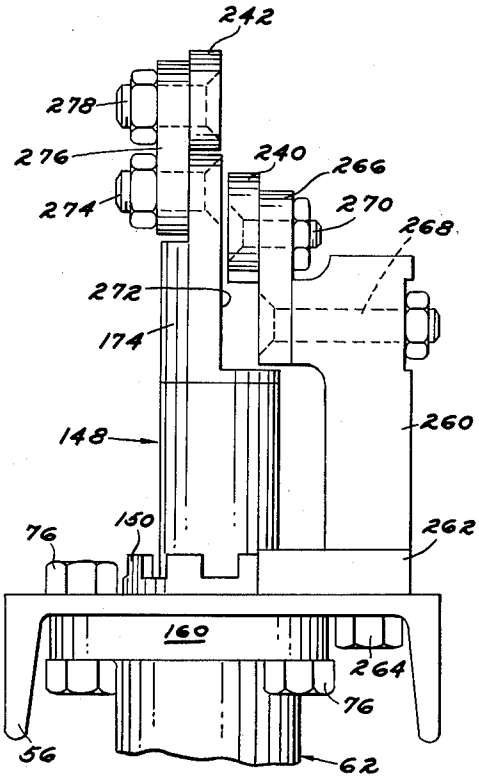


FIG. 8

INVENTORS
DONALD E. TRUMBULL
ARTHUR D. POWERS JR.

BY Burton & Parker
ATTORNEYS

Sept. 21, 1965 D. E. TRUMBULL ETAL 3,207,378

METERING PUMP ASSEMBLY

Filed Aug. 23, 1961 5 Sheets-Sheet 4

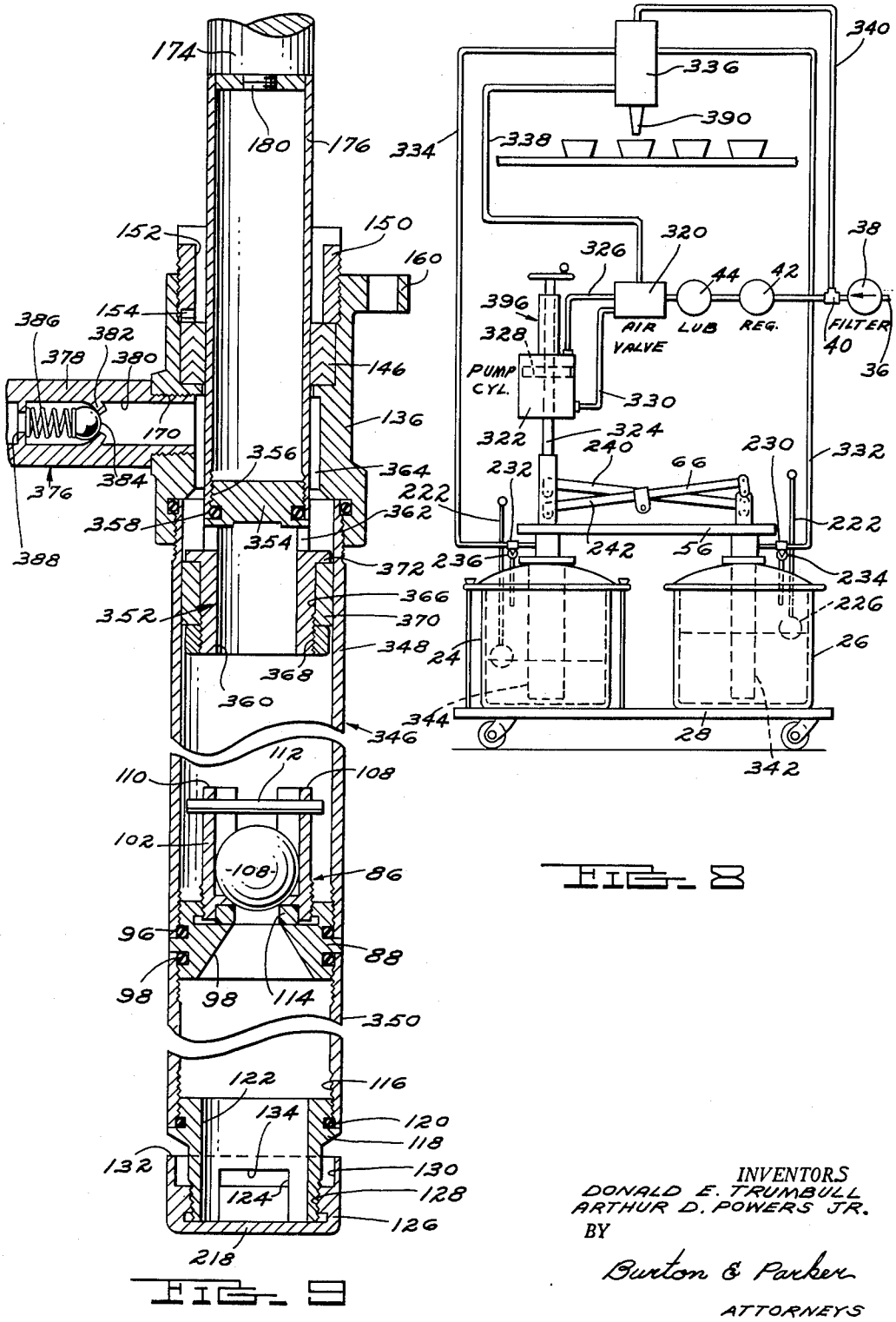


FIG. 8

FIG. 9

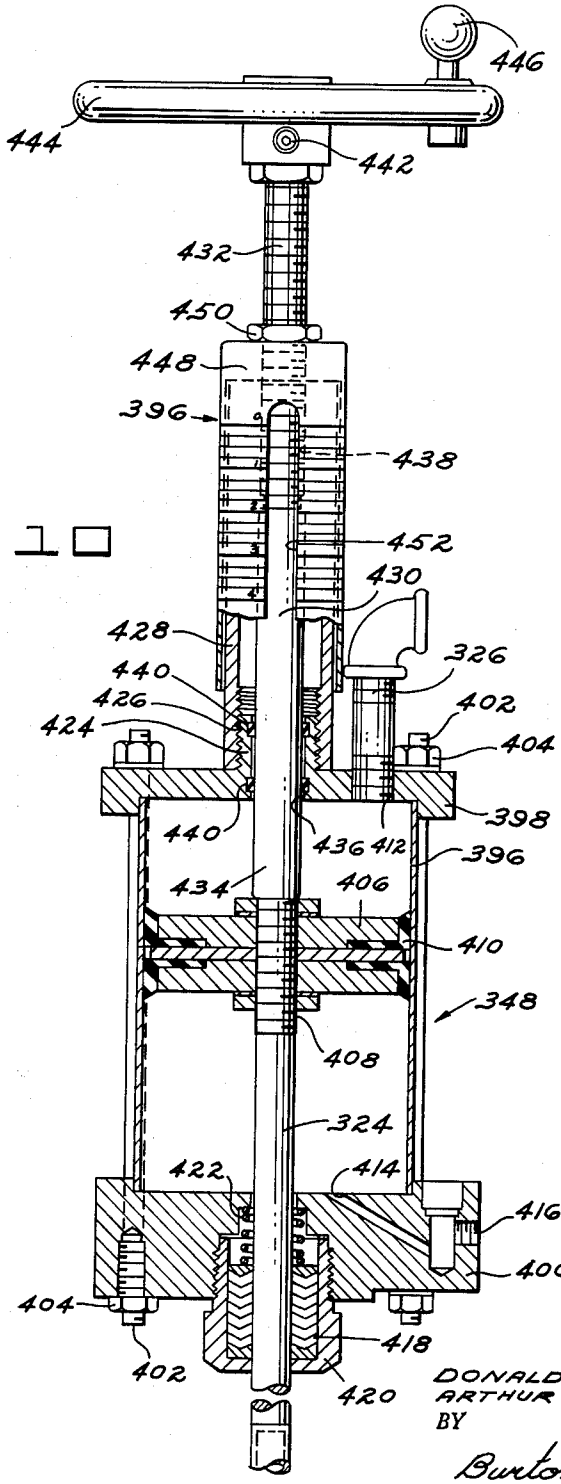
INVENTORS
DONALD E. TRUMBULL
ARTHUR D. POWERS JR.
BY
Burton & Parker
ATTORNEYS

Sept. 21, 1965 D. E. TRUMBULL ETAL 3,207,378

METERING PUMP ASSEMBLY

Filed Aug. 23, 1961 5 Sheets-Sheet 5

FIG. 10



INVENTORS
DONALD E. TRUMBULL
ARTHUR D. POWERS JR.
BY
Burton & Parker
ATTORNEYS

United States Patent Office 3,207,378 Patented Sept. 21, 1965

3,207,378

METERING PUMP ASSEMBLY

Donald E. Trumbull, Birmingham, and Arthur D. Powers, Jr., Southgate, Mich., assignors to Pyles Industries, Inc., Southfield, Mich., a corporation of Michigan

Filed Aug. 23, 1961, Ser. No. 133,530
10 Claims. (Cl. 222—134)

This invention relates to apparatus for pumping separate flowable materials in determined relative proportions directly from the containers in which such materials are delivered to the consumer, and has particular utility in systems for handling and dispensing plural component flowable adhesives, sealers, foams and the like of the types commercially known as epoxides, polyurethanes, polyesters, etc. Such materials generally comprise a base component and a catalyst or, as sometimes termed, an accelerator, which base and catalyst components must be accurately proportionally metered and thereafter intimately mixed and dispensed, with the catalyst reacting with the base to effect a curing of the mixture. This application is a continuation-in-part of our United States application Serial No. 59,327, filed September 29, 1960, now abandoned.

With the increasing use of these plural-component materials, a need has arisen for readily handling the materials under a variety of working conditions and in a variety of applications. Each component comprising the composition to be dispensed is generally delivered to the consumer in individual containers or drums, one drum, for example, containing the base material and another drum the catalyst or curing agent. The components in these drums must be removed therefrom, metered in predetermined relative proportional amounts, and thereafter intimately mixed and dispensed as a mixture, sometimes in the form of a spray, sometimes merely as a stream or bead. The size of the containers in which the components are delivered to the consumer may vary from relatively small containers, such as 5 or 10-gallon containers, up to 50 or 100-gallon barrels. In the larger sizes the barrels are quite heavy. Should it be necessary first to bodily empty the containers into equipment for metering, mixing, and dispensing the resultant composition, it necessitates equipment having component-holding reservoirs as well as the attendant labor in filling the reservoirs from the containers in which the component is delivered to the consumer.

In some instances special "pumps" have been provided. The containers are bodily placed in the pumps, and a large piston sized to closely fit each container is forced downwardly into the container to cause material therein to be in turn forced out of the container through a port in the piston to which a hose is attached. These pumps are of necessity quite massive in relation to the container size and can be relatively expensive. From the pumps the hoses lead the material to a metering or proportioning device, in which each component is proportionately relatively metered, and from such device the metered components are delivered to the mixer, from which they are dispensed to the working area.

In another form of apparatus the surface of each material component, while in the containers in which they are delivered, are subjected to fluid pressure which forces the materials out of their containers through suitable hoses to the metering device.

A primary object of the invention is the provision of a metering pump assembly which includes a metering pump for each container of material component with the pumps being inserted, as through the open top of each container, into the material component in the container, and which pumps are so operatively interconnected and so accurate in their delivery, that they will pump the component from

the containers in accurate relative proportions directly to the mixer thereby eliminating the necessity of emptying the components from their containers into reservoirs from which they are pumped to the metering device, or employing the relatively massive "pumps" described above, or the necessity of subjecting the surface of the components to fluid pressure to force them from their containers to a metering device.

Another object of the invention is the provision of a metering pump assembly adapted to be bodily placed atop the containers of component material and having a metering pump for each container which extends into the containers, and with the pumps so interconnected as to insure their simultaneous pumping of components from the containers and with the interconnection such that the delivery from the pumps may be varied relative to each other to vary the relative proportions of the components pumped from the respective containers.

A further object of the invention is the provision of equipment for pumping and metering material directly from containers in which the material is delivered and which comprises a metering pump assembly adapted to be supported directly on the containers of material component to be mixed and which assembly has a plurality of metering pumps disposed in fixed relation with one pump extended into each container, with the assembly having lid means as a part thereof adapted to close the upper end of the container into which each pump extends.

Other objects, advantages, and meritorious features will more fully appear from the specification, claims, and accompanying drawings, wherein:

FIG. 1 is a schematic illustration of a metering, mixing, and dispensing system embodying the invention;

FIG. 2 is a fragmentary elevation of the connection between two metering pumps comprising a portion of the invention;

FIG. 3 is a top view of the apparatus shown in FIG. 2;

FIG. 4 is a cross sectional view taken on the line 4—4 of FIG. 2;

FIG. 5 is a fragmentary elevation, partially in section, of one of the metering pumps and motor for operating the same;

FIG. 6 is a fragmentary elevation of another pump forming a part of the metering pump assembly;

FIG. 7 is a fragmentary elevation in section through one of the metering pumps;

FIG. 8 is a schematic illustration similar to FIG. 1 showing a modification of the system embodying the invention;

FIG. 9 is a fragmentary elevation in section through one of the metering pumps of the system shown in FIG. 8; and

FIG. 10 is a fragmentary elevation partially in section showing the mechanism for adjusting the stroke of the pumps of FIG. 8.

FIG. 1 schematically illustrates a system embodying the invention. Such system comprises a metering pump assembly **20** and a mixing and dispensing assembly **22** connected together by suitable control lines and component delivery lines. The metering pump assembly is adapted to communicate with component to be metered and mixed which is delivered to the consumer in separate containers or drums **24** and **26**. For convenience, these drums may be mounted on a wheeled dolly or the like **28**. Each drum upon delivery to the consumer contains a supply of the component to be metered and delivered to the mixing and dispensing assembly **22**, the latter being schematically shown as a flow or spray gun adapted to be hand-held by an operator. A gun suitable for use in connection with the metering pump assembly is disclosed in the U.S. patent application of Trumbull et al.,

Serial No. 50,428, filed August 18, 1960, now Patent No. 3,053,457, dated Sept. 11, 1962.

The material in the drums 24 and 26 is delivered to the gun through separate hoses 30 and 32 and admitted in the gun through valve controlled ports to a mixing chamber. The gun may include a motor driving a mixing rotor in the mixing chamber, the opening and closing of the valved ports and the starting and stopping of the motor being controlled by a trigger 34 on the gun. The trigger also serves to start and stop the metering pump assembly as hereinafter described.

In the illustrated embodiment of the invention shown in FIGS. 1–7, the metering pump assembly is air operated, the air being delivered to the assembly by a line 36 from a source of compressed air, not shown. It passes through an air filter 38, through a T connection 40, a pressure regulator 42, a lubricator 44, a pilot operated air control valve 46 and from thence to an air motor 48 which has a reciprocating part 50 connected to the pumps to operate them. Air motor 48 is of conventional double-acting design having internal manifolding and valve controlled porting such that when piston 52 is at the top of its stroke air from line 36 is admitted to the motor at the upper side of the piston to force it to the bottom of its stroke, and at the bottom, air is admitted below the piston from line 36 to return the piston upwardly. As the showing of the air motor in FIG. 1 is merely schematic, the internal manifolding and porting has not been shown in detail, and it is considered obvious that air entering the motor through the single line 36 may be directed to either side of the piston 52 in a sequential operation to shift the piston between opposite ends of its stroke.

Starting and stopping of motor 48 is controlled by valve 46, which is remotely operated by squeezing or releasing the spring-loaded trigger 34 of the gun 22. Connected to the trigger as shown in the above-identified co-pending application is an air valve serving, upon squeezing of the trigger, to pressurize pilot hose 54 by air delivered to the gun through hose 56', and vent hose 54 to the atmosphere upon release of the trigger. Valve 46, which is a conventional air operated valve, is connected to hose 54. When hose 54 is pressurized by squeezing trigger 34, valve 46 opens to allow air to pass from the lubricator 44 through the valve to the motor 48, and upon release of trigger 34 and consequent venting of hose 54 to the atmosphere, the reduced pressure in hose 54 causes closure of valve 46 thereby preventing the delivery of air to motor 48 which stops operation.

The metering pump assembly comprises means forming a pump-supporting platform 56 having a lid 58 and 60 for each drum. A pair of metering pumps 62 and 64, one for each drum, are mounted on platform 56 with a suction end in the material in the drum. Means 66 connected to the motor 48 and the pumps operate the pumps synchronously, with the entire assembly removably resting upon and supported by the drums 24 and 26. The motor 48 may also be, and preferably is, supported by means 56. If desired the metering pump assembly may be held down against the drums by tie rods, as for example, tie rods 68 and 70 pivotably connected at their lower ends to dolly 28 and provided with wing nuts 72 and 74 at their upper ends for engaging the lid 60 at suitable bifurcated ears at the rim of the lid and tensioning the lid downwardly. Similar hold-down means may be provided for the other lid.

Platform 56 is of U-shape in cross section as shown in FIGS. 5 and 6 and the pumps extend therethrough and are secured by bolts and nuts 76 rigidly to the platform. Each pump includes a hollow elongate cylinder 78, as shown in FIG. 7, composed of an upper or pumping cylinder portion 82, and a lower or suction cylinder portion 84, which portions are coaxially aligned and threadedly connected at their meeting ends. The connection is effected at a check valve 86 which permits upward flow but prevents downward flow. The check valve comprises a cylindrical block 88 having an annular flange 90 on opposite sides of which the block is externally threaded at 92 and 94 to threadedly engage complementary internal threads on the upper and lower cylinder portions 82 and 84. Block 88 is provided with annular undercuts at opposite sides of flange 90 to receive O-ring or the like seals 96 and 98 to prevent escape of material. The block is axially bored and threaded to provide a tapering port 98 and an internal thread 100 into which is threaded the valve seat defining member 102, having an internal valve seat shoulder 104 having a ball receiving seat 106 against which a ball valve 108 is adapted to seat. Member 102 includes two ball valve guides 109 and 110 having opposed cylindrical surfaces which hold the ball 108 in coaxial alignment with the valve seat 106. A stop pin 112 extends between the guides to limit upward movement of the ball. An annular gasket 114 beneath the seat 104 and bearing against the block 88 serves to seal against the escape of material through the threads 100.

Lower cylinder portion 84 may be provided in a variety of lengths to accommodate the depth of the containers with which the pump is to be used. Upper cylinder portion and the piston assembly hereinafter described may be of a standard size. Therefore the pump may be utilized with any size material container by fitting the proper length lower cylinder portion 84 and the proper diameter lid.

Lower cylinder portion 84 is provided with a material inlet at its lower end. Such inlet is so constructed that once the pump has been filled with material the pump may be removed from an exhausted container and placed in a fresh container without danger of air entering the pump through the inlet. For this purpose the lower cylinder portion is internally threaded at 116 to receive the externally threaded upper end of inlet port member 118 which forms a part of lower cylinder portion 84; an O-ring 120 or the like preventing material leakage through the threaded connection. Port member 118 has a bar 122 therethrough and a pair of diametrically opposed side opening apertures, one of which is shown at 124 in FIG. 7. An internally threaded cup 126 is threaded at 128 on the lower end of the lower cylinder portion 84, specifically upon port member 118 as shown, and is provided with an enlarged counterbore 130. The rim 132 of the cup is disposed above the upper edge 134 of each side opening apertures to form a hydrostatic material trap preventing entrance of air into the pump when the pump, full of material, is lifted from the container of material and held in a substantially vertical position. The exclusion of air from the inlet end of the pump is an important feature of this assembly as it allows the assembly to be removed from one container which is nearly empty and placed in a full container without the necessity of purging the assembly, hoses, and gun 22 of air.

The upper cylinder portion 82 includes means for mounting the pump on the pump-supporting platform 56, for providing a discharge port for the pump, and for sealing the piston rod against the escape of material along the rod. Such means comprises a mounting block 136 threadedly connected as at 138 to the upper end of cylinder portion 82. The block has an internal bore comprising a lower or material pumping bore portion 140 and an upper material sealing portion 142 separated by an internal annular shoulder 144 upon which is seated a sealing ring 146 which encircles the piston rod 148 and is squeezed against the rod and the bar portion 142 to seal against the escape of material by a castle-packing nut or the like 150 threaded into the upper end of block 136. Castle nut 150 is internally bored at 152 substantially oversize the outside diameter of piston rod 148 to provide a material trapping well. Through a side opening aperture 154 at the lower end of nut 150, the well communicates with a drain 156 formed in the block 136.

The nut **150** is provided with an annular relief **158** with which opening **154** cooperates to establish communication between such opening and the drain **156**. The drain empties into the container over which the pump is disposed so that material leaking past seal **146** is caught in the well and drained back to the container.

Block **136** is provided with a pair of vertically spaced apart semi-circular flanges **160** and **162**, each being provided with a plurality of vertical bolt holes **164** and **166**. Flange **160** is adapted to underlie pump-supporting platform **56** and be secured thereto as shown in FIG. 6 by the nuts and bolts **76**. Flange **162** is adapted to overlie the lid, as shown in FIG. 2, and is secured to the lid as by bolts **168**. Therefore, flanges **160** and **162** serve to connect the pump, the pump-supporting plate, and the lids in fixed relation.

Block **136** is provided with a threaded discharge port **170** opening outwardly of the block and communicating with the lower bore portion **140**. Secured to the lower end of the piston rod **148** is a piston assembly **172**. The piston rod **148** includes an upper portion **174** formed of a solid rod and a lower hollow portion **176** secured to the upper portion in any suitable fashion as by a threaded connection **180**. The piston assembly **172** includes a plug member **182** having a threaded upper end threadedly engaged at **184** with the lower end of the hollow interior of piston rod portion **176**. An O-ring seal or the like **186** seals against the leakage of material through the threads **184**. Plug **182** is axially bored and threaded as at **188** to provide a check ball chamber within which is disposed a check ball **190** tensioned downwardly by a coil spring **192**, the upper end of which is seated in a relief **194** formed in the upper end of the check ball chamber. A pair of threadedly connected members **196** and **198** form the valve seat defining means which cooperates with the check ball **190**. Member **196** is shaped as shown in FIG. 7 and externally threaded to engage with threads **188** of the plug member **182**. Member **198** is provided with a tapered port **200** which opens upwardly into a valve seat defining recess within which is disposed a valve seat **202**. The seat may be formed of any suitable material, one of the synthetics being satisfactory. The ball **190** may be formed of steel. Member **196** extends slightly over the upper edge of the seat **202** to hold it in place. Plug **182** is provided with a plurality of side opening apertures **204** which establish fluid communication between the lower bore **140** and the valve chamber in the plug.

Member **198** is provided with a radial head or flange **206** which cooperates with the lower end of plug **182** to trap therebetween a pair of annular seals **208** and **210** which are held in spaced relation by spacers **212** and **214**. Seals **208** and **210** serve to wipe the inner cylindrical surface **216** of the upper cylinder portion **82** of the pump in sealing contact therewith to effect the pumping action upon reciprocation of the piston rod.

Assuming that the upper and lower cylinder portions **82** and **84** are full of component to be pumped, upon downward movement of the piston rod check valve **108** will prevent flow of the component from the upper to the lower cylinder portion while check valve **190** will open against the tension of spring **192** allowing the component to flow upwardly through the piston and into the upper cylinder portion **82** above the piston. When the piston reaches the bottom of its stroke and reverses direction of movement, valve **108** will rise allowing component in the lower cylinder portion **84** to pass upwardly into the upper cylinder portion **82** beneath the piston, while check valve **190** will be forced closed by spring **192** and the component above the piston will be forced out of upper cylinder portion **82** through the discharge port **170**. This action will repeat upon each stroke of the piston. It will be noted that the pumping action is not dependent upon the length of lower cylinder portion **84** and therefore the length of portion **84** may be varied to accommodate the particular container within which the pump is to be disposed. The bottom **218** of the cup **126** should be disposed, when the pump is in the container, at substantially the bottom of the container so that the pump will remove, substantially all of the material component in the container.

The lids **58** and **60** are each provided with an upstanding vertically bored boss **220** through which extends a component level indicating rod **222** having a suitable stop such as a ball, **224**, at the upper end. To the lower end of each rod **222** is secured a float **226**. As component in each container is used up by the pump, the rod will fall and when the ball **224** closely approaches the boss **220** the operator will be aware that the material component is nearly exhausted. Before the pump has removed material component from the container to a level equal to the position of the rim **132** of the cup, the operator should stop the pump assembly and replace the container with a fresh container of component material. Should he allow the material in a container to drop below the rim **132** of the cup there is danger of sucking air.

The hoses **130** and **132** shown in FIG. 1 are connected in the discharge ports **170** of each pump. In order to provide for a recirculation of material in the event it is desired to operate the pumps continually rather than on demand when the operator squeezes or releases trigger **134**, or for any other reason, the hoses **130** and **132** may be provided with T's **230** and **232** each having a line **234** extending through the lids **58** and **60** back into the containers. Lines **234** may be provided with pressure relief valves **236** to allow material to flow back into the containers when the pressure of the material exceeds a determined value. This recirculation of material through the lines **234** may be desirable where the gun **32** is adjusted to dispense material at a rate less than the capacity of the pumps. The pressure relief valves in this event will serve to prevent an undue build up in component pressure within the hoses **30** and **32**.

The means **66** for synchronizing operation of the pumps and for varying the relative proportional amounts of component dispensed by the pumps comprises a pair of lever arms **240** and **242** pivotally connected together intermediate opposite ends, with one end of each connected to one of the piston rods and the other end pivotally connected to the pump-supporting means. More specifically, and as shown in FIGS. 2, 3 and 4, the arms are pivotally connected intermediate their opposite ends by a pair of pivot blocks **244** and **246** which are adjustable along the arms and which are pivotally connected together by a bolt and nut assembly **248**. Each block, as shown in FIG. 4, is generally J-shaped. The head of the J shape is formed by a plate **250** bolted as at **252** to the body of the J shape securing between the body and the head the lever arm associated with the block. When bolts **252** are tightened they rigidly secure the pivot blocks to the arms against movement along the arms and also serve to lock the pivotal connection of the arms at a fixed position relative to the arms. Upon loosening of the bolts the blocks may be adjusted along the arms to vary the relative proportional amounts metered by the pumps. Arm **242** may be provided with a scale **254** by reference to which the operator may be aided in adjustment of the relative proportional setting of the pump assembly.

As shown in FIG. 2, arm **240** at the right hand end is connected to a vertically fixed pivot and arm **242** at the left hand end is similarly connected to a vertically fixed pivot. The vertically fixed pivots at the right hand end of arm **240** and the left hand end of arm **242**, respectively, shown at **256** and **258**, are vertically fixed relative to each other and to the pump-supporting plate **56**. As shown in FIG. 6 an upstanding bracket **260** having an integral lower semi-circular flange **262** bolted as by bolts **264** to the pump-supporting plate **56**, upstands from the plate parallel and in proximity to the piston rod **148** of pump **62**. A link **266** is pivotally connected by a bolt or

the like 268 to the upper end of the bracket 260. The right hand end of arm 240 is pivotally connected to the bolt or the like 270 to the link 266. Bolt 270 is coaxial with the aforementioned vertically fixed pivot 256. It will be noted that the upper end of piston rod 148 has the portion 174 cut away as at 272 to clear the link 266 and the lever arm 240. To the upper end of piston rod 148 of the pump 62 is pivotally connected as by a bolt or the like 274 a link 276 which is, in turn, pivotally connected, as by bolt 278, to the right hand end of arm 242.

At the other end of plate 56 is a bracket 280 having at the lower end an integral semi-circular flange 282 which is secured to plate 56 by bolts or the like 284. The bracket is disposed adjacent the upper end of piston rod 148 of the pump 64. The bracket has a laterally extending boss 286 through which extends a bolt or the like 288 upon which is pivotally connected the downwardly extending ear-like end 290 of arm 242. The vertically fixed pivot 258 is coaxial with bolt 288. Bolt 288 establishes the vertically fixed pivot for the left hand end of arm 242. The left hand end of arm 240 is provided with a downwardly extending ear portion 292 which is pivotally connected to the upper end of piston rod 148 of pump 64 by a bolt or the like 294. The upper end portion of piston rod 148 of pump 64 is cut away as at 296 so as to not interfere with the pivotal connection of arm 242 to the bracket 280. Such upper piston rod portion is also cut away as at 298 and thereabove is provided with a head portion 300 to which the reciprocating part or piston rod 50 of the motor 48 is connected.

The upper end of bracket 280 is provided with a semi-circular integral flange 302 to which the motor 48 is secured by bolts 304. In order to rigidify the motor 48 and assist in its support on the pump mounting plate 56 a tie rod 306 extends between the motor and the plate being secured at its upper end to the motor in any convenient fashion as by being threaded thereinto, and connected at the lower end in any convenient fashion to the plate as by an internal thread cooperating with one of the bolts 76.

From a study of FIG. 2 it will become apparent that as the point of pivotal connection 248 between the lever arms is shifted to the left that the pump 62 will pump a proportionately greater amount of material than will pump 64, and vice versa, as the pivot point is moved to the right, and that this is so regardless of the fixed or uniform stroke of the motor 48. The aforementioned construction of the pumps is such that each will accurately meter a quantity of component material dependent upon the length of stroke of the pistons and that because the pumps are of a positive displacement type the quantity of component delivered will be directly related to the length of stroke of the pistons.

If desired the component in the containers may be heated in any suitable fashion to reduce the viscosity to a point that the components may be pumped. Also, if desired, the lids 58 and 60 may be internally provided with a gasket to seat upon the rim R of the containers so that the containers may be pressurized to assist in filling the pumps with the components to be metered. In the event the containers are to be pressurized, suitable sealing means will be provided around the level indicating rods 222 as well as suitable gaskets between the flanges 262 to seal against the escape of fluid pressure where the pumps extend through the lids.

It is apparent that the pump assembly may be bodily removed from the containers upon which it rests. It is also apparent that the necessity of providing a separate metering device is eliminated as the pumps 62 and 64 not only pump the components from the containers but simultaneously meter them according to the position of the pivot 248 of the arms 240 and 242.

Referring now to FIGS. 8–10, FIG. 8 shows a system similar to that shown in FIG. 1. As many of the parts shown in FIG. 8 are identical to that hereinabove described, they are indicated by the same numerals, and will not be redescribed. The system of FIGS. 8–10 is designed to deliver measured quanta or "shots" of material, as distinguished from a continuous flow.

In the embodiment of the invention shown in FIGS. 8–10, the air is supplied through the lubricator and regulator to the fourway air valve 320, which is pilot operated, and thence to an air motor 322 which has a reciprocable part 324 connected to the pumps. The synchronizing means 66 is identical to that previously described. Air motor 322 is of conventional design, with air supply through line 326 to force piston 328 downwardly, and alternately through line 330 to return the piston to the top of its stroke. Component materials are supplied through lines 332 and 334 from the containers 24 and 26 to a mixer-dispenser 336. Air motor 322 is controlled by air valve 320. A suitable control (not shown) on mixer 336 serves to pressurize pilot line 338 by air delivered to the mixer through hose 340. When line 338 is pressurized, valve 320 opens, allowing pressure air to be supplied to air motor 322. The control on the mixer may be selectively set to operate valve 320 through only one cycle of motor operation, or may be set to continuously recycle motor 322 to deliver successive quanta of components to mixer 336.

Platform 56 supports the pumps 342 and 344 which extend into the containers 24 and 26. Each pump has a hollow elongate cylinder 346, as shown in FIG. 9, comprising an upper or pumping cylinder portion 348 and a lower or suction cylinder portion 350, which are coaxially aligned and connected at their meeting ends. The connection is effected at a check valve, and as can be seen from FIGS. 7 and 9, the suction cylinder 350 is identical to the suction cylinder 84 hereinabove described. Hence no additional description is necessary, and like components are indicated by like numerals.

The upper cylinder portion 348 is similar to portion 82 of the pump shown in FIG. 7, except that in the pump of FIG. 9 the check valve has been eliminated. The piston rod 148 has an upper portion 174 formed of solid rod and the lower hollow portion 176 secured thereto as by the threaded connection 180. The piston assembly 352 includes a plug member 354 threadedly engaged as at 356 with the lower end of piston rod portion 176, and an O-ring seal 358 seals against leakage of material about threads 356. Member 354 is axially bored as at 360 and has a plurality of side opening apertures 362 which establish communication between bore 360 and an outlet chamber 365. Plug 354 has an undercut portion 366, having a threaded length 368 at the lower end thereof. Ring-like member 370 is slipped over portion 366 and secured in place against shoulder 372 by nut 374 threadedly engaged on threaded length 368. The remaining portions of the pump shown in FIG. 9 are the same as those of the pump of FIG. 7 and have been indicated by like numerals.

The pump shown in FIG. 9 is provided with check valve means 376 threaded into the discharge port 170. Valve 376 consists of a tubular member 378 having a material passageway 380 therethrough and a portion 382 defining a check ball chamber within which is disposed a check ball 384 tensioned against the portion 382 by a spring 386, the other end of which bears against a shoulder portion 388.

The pump shown in FIG. 9 may be characterized as a single-action displacement pump. Assuming that cylinder portions 348 and 350 are full of material to be pumped, upon downward movement of the piston rod check valve 108 will prevent flow of component from the upper to the lower chamber, while check valve 376 will open against the pressure of component being forced through port 170 by the displacement of piston rod 176 into upper cylinder portion 348. The amount of component forced out of the pump will be equal to the volume displaced by the shifting of piston rod 176 into the

chamber. When the piston reaches the bottom of its stroke and reverses direction, valve **108** will rise and allow component to flow from cylinder portion **350** to cylinder portion **348**, while check valve **376** will be closed, and no material allowed to flow through the outlet. Thus the pump of FIG. 9 will deliver a measured amount of component upon the downstroke of the piston and will prevent material flow on the upstroke of the piston.

The hoses **332** and **334** are connected to the members **380** of each pump as shown in FIG. 8, and deliver component to the mixer-dispener **336**, which is provided with a suitable dispensing nozzle **390**. The mixer-dispenser will deposit quanta of mixture into molds or the like **392** passing beneath the mixer on a conveyor **394**.

The air motor **328** is provided with mechanism **396** for varying the stroke of the air motor piston rod **324**. The piston rod **174** of pump **344** is connected to piston rod **324**, and hence the stroke of pumps **342** and **344** can be varied by adjusting the stroke of air motor **328**. The synchronizing means **66** of course determines the relative amounts of component delivered by each pump **342** and **344** as hereinabove described.

Referring to FIG. 10, air motor **328** is of conventional design and comprises a cylindrical body **396** closed at each end by end plates **398** and **400** secured as by tie rods **402** and nuts **404**. Piston **406** is threadedly engaged on piston rod **324** as at **408**, and is provided with sealing means **410** to prevent air by-passing the piston. Air line **326** from valve **320** is coupled to the end plate **398** by the threaded aperture **412**. End plate **400** has a slant passageway **414** communicating with threaded aperture **416**, into which air line **330** is threaded. Packing **418** is held in place within packing nut **420** by coil spring **422**, and the nut is threadedly engaged in plate **400**.

End plate **398** is provided with a boss portion **424** having external threads **426**. Internally threaded hollow cylinder **428** is threadedly engaged upon boss **424**. A rod **430** having a threaded upper end portion **432** and a smooth lower end portion **434** extends through a bore **436** in boss **424**, and is threadedly engaged with an internally threaded portion **438** at the upper end of cylinder **428**. O-ring seals **440** are provided in bore **436** to prevent the escape of air along rod **430**. Secured to the upper end of rod **430** as by a set screw **442** is a wheel **444** having a suitable handle **446** thereon. The lower end of rod **430** bears against the top of piston **406**. As wheel **444** is turned, rod **430** is shifted moving piston **406**. The extent that rod **430** projects into the air motor determines the upper limit of the air motor piston, and hence the stroke of piston rod **324**. This in turn regulates the stroke of the pumps **342** and **344**, and determines the quantity of component delivered to mixer-dispenser **336** during each cycle of the pumps.

A hollow sleeve **448** encircles cylinder **428** and is secured to rod **430** as by a nut **450** to shift with the rod. Cylinder **428** has a mark etched thereon which is visible through a slot **452** in sleeve **448**. As rod **430** is positioned by turning wheel **444**, the mark on the cylinder may be aligned with a calibration on sleeve **448**, and the desired stroke of air motor **348** determined.

Under normal conditions, air valve **320** supplies air through line **330** to passageway **414**, holding piston **406** at the top of its stroke against rod **430**. Upon the actuation of the control (not shown) on mixer-dispenser **336**, pilot line **338** is pressurized, shifting valve **320**, and supplying pressure air through line **326** to the top of air cylinder **406**. This shifts the piston down, carrying with it piston rod **324** and, through mechanism **66** (see FIG. 8), the pistons of pumps **342** and **344**. As the pump pistons are shifted downwardly, the components are fed through lines **332** and **334** to the mixer-dispenser **336**, causing an amount of mixture to be dispensed as determined by the setting of the mechanism **396**.

What is claimed is:

1. Apparatus for pumping separate flowing materials in determined relative proportions directly from a plurality of containers each holding one of the materials comprising, in combination: a plurality of pumps, one for each container, each pump extending vertically downwardly into the container and terminating adjacent the bottom of the container and being of positive displacement piston type having a cylinder with a piston therein, a piston rod connected to the piston and extending upwardly out of the cylinder and beyond the upper end of the container, a check valve in the cylinder below the piston allowing flow upwardly of the cylinder but blocking flow downwardly therethrough, a discharge port opening through a wall of the cylinder adjacent the upper end thereof, a check valve in the piston allowing flow from below to above the piston but preventing reverse flow, a pair of lever arms pivotally connected together intermediate opposite ends, one end of each arm connected to one of the piston rods, means connected to the other ends of the arms pivotally securing them in fixed vertical relation, and motor means having a reciprocating part connected to one of the piston rods to reciprocate the same.

2. The invention as defined in claim 1 characterized in that the point of pivotal connection of the lever arms is adjustable longitudinally of the arms to vary the relative displacement of the piston rods.

3. Apparatus for pumping separate flowing materials in determined relative proportions directly from a plurality of containers each holding one of the materials comprising, in combination: means extending between the containers and across the top thereof and removably resting on the containers providing a pump support, a pump for each container mounted on the support, each pump comprising a vertically extending cylinder disposed substantially entirely within the container and having an inlet at the lower end and a check valve allowing material entry into but preventing material discharge from the lower end of the cylinder, a discharge port through the cylinder, a piston in the cylinder having a piston rod extending upwardly out of the cylinder and beyond said pump support, synchronizing means comprising a pair of lever arms pivotally connected together intermediate opposite ends and with one end of each connected to one of the piston rods, the other end of each lever arm connected to the pump support, motor means on the pump support connected to one of said arms remote from the arm connection with the pump support and operable to swing the arm to reciprocate the pump pistons.

4. Apparatus for pumping separate flowing materials in determined relative proportions directly from a plurality of containers each holding one of the materials comprising, in combination: a positive displacement piston pump for each container extending downwardly into the container and having an inlet port at its lower end, a check valve preventing flow from the pump through the inlet port back into the container, an outlet port for each pump, each pump having a piston rod extending upwardly therefrom, means extending between and connected to each pump holding the pumps in fixed spaced apart relation, a pair of lever arms for synchronizing movement of said pistons, said arms pivotally connected together intermediate opposite ends, one end of each arm connected to one of the piston rods, the opposite end of each arm pivotally connected to said means, and a motor mounted on said means and having a reciprocating part operatingly connected to one of the piston rods.

5. The invention as defined in claim **4** characterized in that said arms are pivotally connected together intermediate opposite ends by means adjustable along the arms to vary the point of pivotal connection to vary the relative proportions of material pumped by each pump.

6. In apparatus for the purpose described, a pump comprising: an elongate hollow cylinder having upper and lower coaxially arranged cylinder portions remov-

ably connected together at one end, means connecting said upper and lower cylinder portions together comprising a check valve assembly allowing fluid flow from the lower cylinder portion to the upper cylinder portion but preventing reverse flow, a piston in the upper cylinder portion, a port opening into the upper cylinder portion, the lower end of said lower cylinder portion having a fluid entrance, a cup-shaped member received over the lower end of the lower cylinder portion and having a continuous side wall encircling said lower end and extending upwardly from such lower end above the fluid entrance to form a hydrostatic fluid trap.

7. In a positive displacement type pump having a cylinder adapted to be positioned vertically with a piston reciprocable within the cylinder, said cylinder having a fluid inlet at the lower end to be submerged in the fluid to be pumped, means at the lower end of the cylinder forming a fluid-holding cup whose rim is disposed vertically above the upper edge of said fluid inlet providing, when said cup is full of fluid, a hydrostatic fluid seal against air entry through the inlet when the inlet is raised from the fluid to be pumped.

8. Apparatus for simultaneously pumping discrete quanta of separate flowing materials in determined relative proportions directly from a plurality of containers each holding one of the materials comprising, in combination: a plurality of pumps, one for each container, each pump extending vertically downwardly into the container and terminating adjacent the bottom of the container and being of a single acting positive displacement type having a cylinder with a displacement plunger therein, said plunger having a portion extending upwardly out of the cylinder and beyond the upper end of the container, a check valve in the cylinder below the plunger allowing flow upwardly of the cylinder but blocking flow downwardly therethrough, a discharge port opening through a wall of the cylinder adjacent the upper end thereof, a check valve communicating with said discharge port permitting material discharge during the downward stroke of said plunger but preventing discharge during the upward stroke of the plunger, a pair of lever arms pivotally connected together intermediate opposite ends, one end of each arm connected to one of the plungers, means connected to the other ends of the arms pivotally securing them in fixed vertical relation, motor means having a reciprocating part connected to one of said plungers to reciprocate the same, and control means coupled to the motor means operable to determine the distance of movement of such reciprocating part.

9. Apparatus for pumping simultaneously dicrete quanta of a plurality of flowing materials comprising a container for each material, a single action positive displacement pump mounted on and extending into each container and having a reciprocable plunger therein, means for reciprocating the plungers including a motor having a reciprocating part connected to one of said plungers and a pair of pivotally connected lever arms operatively coupled to each plunger and to said reciprocating part with the pivotal connection between said lever arms being adjustable to vary the relative proportions of material pumped by each pump, and control mechanism coupled with said means and operable to determine the distance of movement of such reciprocating part to vary the volume of materials pumped during each cycle of operation of said pumps.

10. The invention as defined in claim 9 characterized in that said control mechanism comprises an adjustable rod connected to said motor and having a portion extending into interfering relation with said reciprocating part of the motor to determine the length of stroke of said part.

References Cited by the Examiner

UNITED STATES PATENTS

620,701	3/99	Cushing	222—137
679,504	7/07	Heard	222—137 X
1,051,171	1/13	Stevenson	103—6
1,072,718	9/13	Heindl	103—47
1,160,510	11/15	Holder	91—49
1,964,028	6/34	Boynton et al.	222—57 X
2,905,361	9/59	Noall	222—137 X
2,946,488	7/60	Kraft	222—334 X

RAPHAEL M. LUPO, *Primary Examiner.*

LAVERNE D. GEIGER, *Examiner.*