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H. T. BONFIELD

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EMULSIFYING APPARATUS

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2 Sheets-Sheet 1

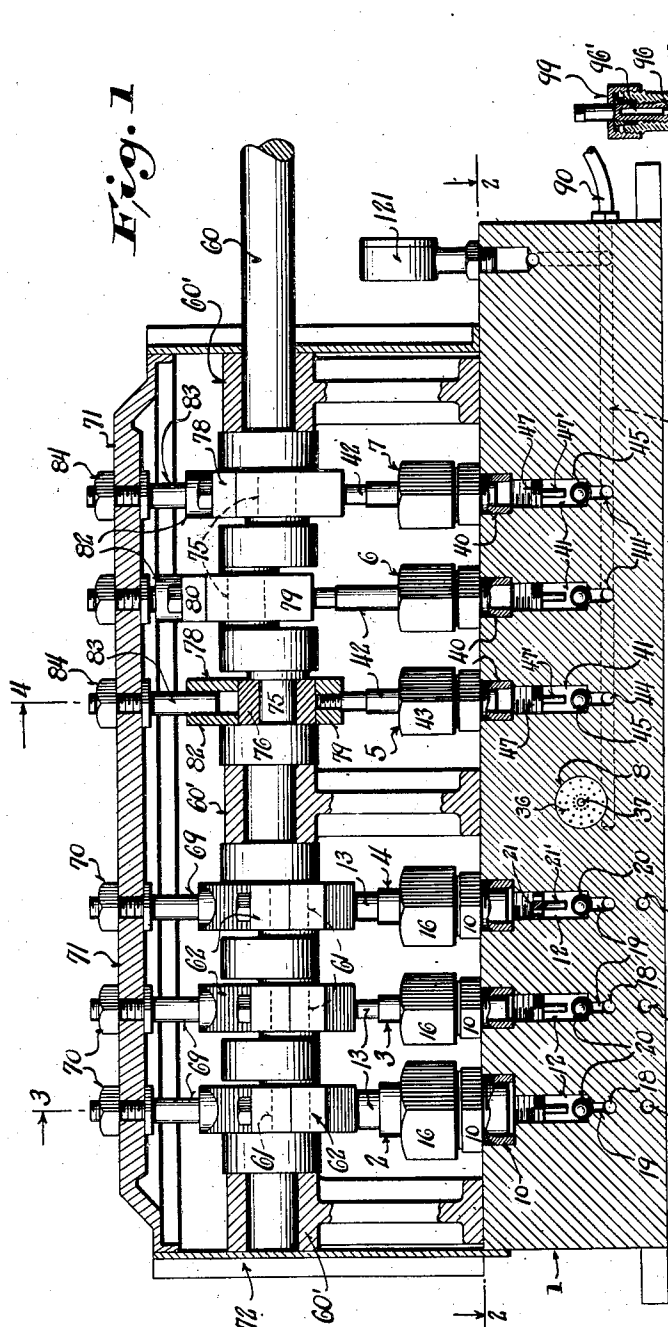


Fig. 1

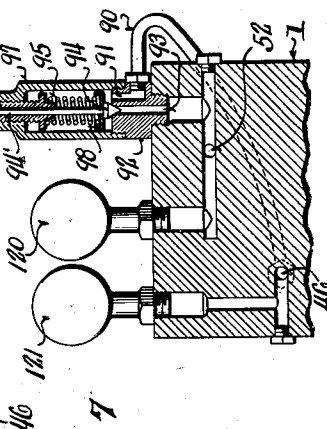


Fig. 7

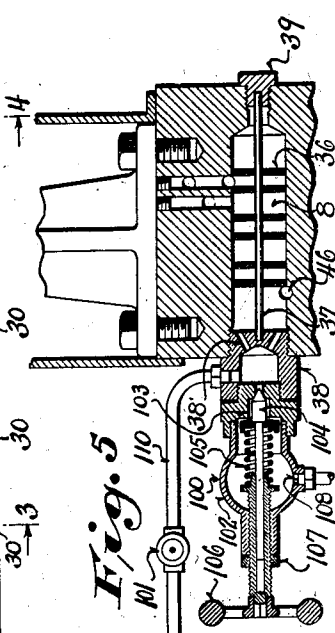


Fig. 5

Inventor
Haswell T. Bonfield

By
Bohning, Haden, Leach, McKinnon and Mitchell
Attorney

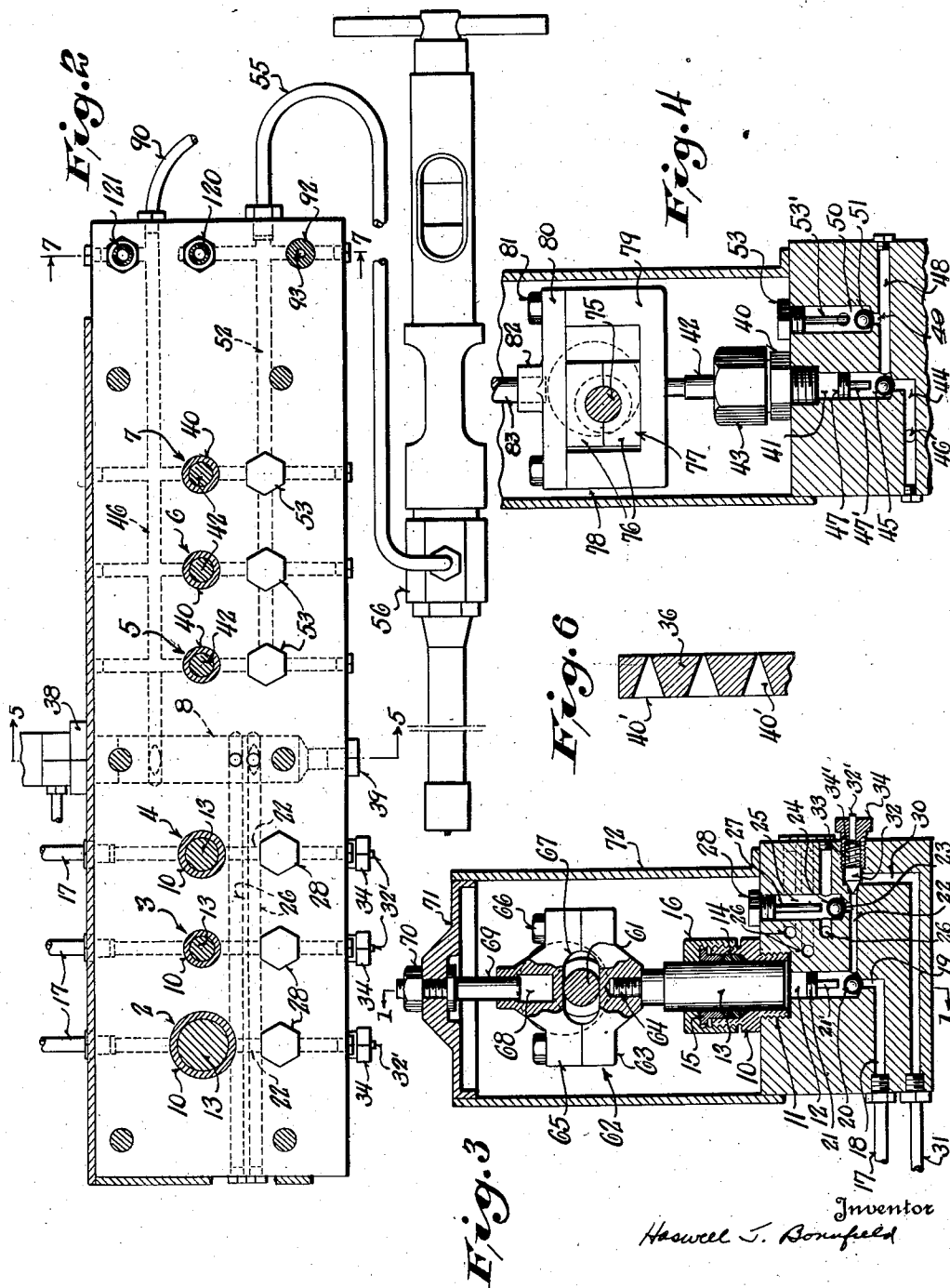
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Inventor
Haswell T. Bonfield

334
Bathum, Hurdwell, Lecher, McKinnon and Michael,
Attorneys

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EMULSIFYING APPARATUS

Haswell T. Bonfield, Reno, Nev., assignor to Universal Products Corporation, Reno, Nev., a corporation of Nevada

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3 Claims. (Cl. 99—2)

This invention relates to an emulsifying apparatus of the type which operates to form an emulsion by first mixing the several ingredients in proper proportion and partially emulsifying them under pressure and then effecting complete emulsification by subjecting the partially emulsified mixture to a higher pressure. The emulsion produced may be of a widely varied character in that a permanent or fixed emulsion may be formed or that the properties of the emulsion may be widely varied. The apparatus is also well adapted for preparing a liquid fuel for combustion as well as for other purposes.

In general, the object of the present invention is to simplify the construction of an apparatus of this character while rendering it more durable, enhancing its efficiency, and increasing the range and flexibility of its operation.

Another important object of the invention is to organize with the several units of the apparatus safety control devices operating to preclude the setting up of excessive pressures and the over-loading of the several instrumentalities of the apparatus thereby increasing the safety factor of the apparatus, precluding damage or injury thereto and reducing power consumption.

Still another salient feature of the invention resides in the provision of readily adjustable means for varying the proportion of the several ingredients of the emulsion and for protecting the low pressure pumps employed.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a view partly in side elevation and partly in vertical longitudinal section taken on line 1—1 of Figure 3 and showing an emulsifying apparatus embodying the present invention;

Figure 2 is a view in horizontal section taken on line 2—2 of Figure 1, parts being omitted for the sake of simplicity in illustration;

Figure 3 is a view in transverse vertical section taken on line 3—3 of Figure 1, parts being shown in elevation for the sake of illustration;

Figure 4 is a fragmentary view in transverse vertical section taken on line 4—4 of Figure 1, parts being shown in elevation for the sake of simplicity in illustration;

Figure 5 is a similar view taken on line 5—5 of Figure 2;

Figure 6 is a fragmentary detail view showing

one of the screens of the mixing chamber in cross section; and

Figure 7 is a view in transverse vertical section taken on line 7—7 of Figure 2 with parts shown in elevation for the sake of simplicity in illustration. 60

Referring to the drawings, it will be seen that, in general, the emulsifying apparatus includes a base 1 with which low pressure pumps, designated generally at 2, 3 and 4 and high pressure pumps, designated generally at 5, 6 and 7, are organized, the low pressure pumps 2, 3 and 4 serving to deliver, under pressure, measured quantities of the several ingredients of the mixture to a mixing chamber designated generally at 8. In the mixing chamber 8 the ingredients are mixed and partially emulsified and the high pressure pumps 5, 6 and 7 take the mixed and partially emulsified ingredients from the mixing chamber and by subjecting it to a much higher pressure operate to complete emulsification. For example, the pumps 2, 3 and 4 may operate to deliver air, water and oil, respectively, to the mixing chamber although, of course, the ingredients of the emulsion which are measured and delivered to the mixing chamber by the low pressure pumps 80 and associated instrumentalities, to be hereinafter more fully described, are varied in accordance with the emulsion to be produced.

Referring now to the structure of the apparatus shown, it will be seen that the base 1 consists of a solid block of metal, drop forged and then drilled and machined, as will be hereinafter described. At one end of this block 1 the low pressure pumps 2, 3 and 4 are arranged, these pumps being of similar construction and differing only in size. Each of the low pressure pumps includes a short, open ended cylinder 10, the lower end of which is threaded into an opening provided therefor in the block as indicated at 11 (see Figure 3) and communicates with an aligned passage 12 provided in the block. A piston or plunger 13 is fitted in the cylinder 10 and is designed to reciprocate therein. A fluid tight relation is established between each piston 13 and its cylinder 10 and this may be effected in any suitable way as by means of packing 14 provided in the internally recessed upper end of the cylinder and suitably compressed by a gland or follower 15 forced into operative engagement with the packing by means of a nut 16 threaded on the upper end of the cylinder. The inlet to each pump is supplied with the ingredients which the pump handles by means of a supply pipe 17 which is connected to the base block and communicates with a horizontal inlet passage 18, 110

the passage 18 communicating in turn with a vertical port 19 controlled by a ball check valve 20 and connecting at its upper end with the passage 12. Considering Figure 3, it will be obvious that

5 when the pump piston 13 moves upwardly fluid is drawn in through the passage 18, port 19 and passage 12, into the cylinder 10, the ball valve 20 being automatically lifted off of its seat by the suction induced by the upward movement of

10 the piston 13. The displacement of the valve 20 from its seat is limited by a stop pin 21' carried by a spider or apertured plug 21 threaded into the passage 12. Of course, each supply pipe 17 is connected with a tank or other suitable source

15 of supply. Each passage 12 also communicates, at a point just above the ball check valve 20, with a lateral discharge passage 22 and adjacent its outer end each discharge passage 22 communicates with a port 23 controlled by a ball check

20 valve 24 and connecting at its upper end with a vertical passage 25 which connects with a discharge duct 26 leading through the block to the mixing chamber 8 with which it has free communication. On the down stroke of the piston 13

25 the inlet valve 20 automatically closes and the discharge valve 24 automatically opens so that the fluid previously drawn into the cylinder 10 is displaced or forced out through the discharge passage 22, discharge port 23, vertical passage 25 and discharge duct 26 into the mixing chamber.

30 The displacement of the discharge valve 24 from its seat is limited by a stop pin 27 carried by a plug 28 which is threaded into and closes the upper end of the passage 25.

35 In operation, the low pressure pumps 2, 3 and 4 build up a certain amount of pressure in the mixing chamber 8, as, for example, a hundred pounds and, of course, this pressure in the mixing chamber exerts a back pressure on the discharge

40 valve 24 of each low pressure pump, which back pressure tends, of course, to close the discharge valves 24.

In order to provide a readily adjustable means for regulating the volume of fluid delivered by

45 each of the low pressure pumps to the mixing chamber and also to relieve the low pressure pumps of excessive pressures when such are built up in the mixing chamber or in the high pressure pumps, a by-pass 30 communicates with each discharge passage 22 on the pump side of the discharge valve 24 and this by-pass connects with

50 a return pipe 31 leading back to the source of supply. The communication of the by-pass 30 with the discharge passage 22 is controlled by a valve 32 biased to closed position by a coil spring 33,

55 the inner end of which engages the head of the valve and the outer end of which engages an internal shoulder 34' provided on an adjustable bushing or abutment 34 threadedly connected with the base plug and enclosing the spring. The

60 body of the bushing 34 is provided with an axial opening in which the stem 32' of the valve 32 is slidably fitted. By adjusting the bushing 34 the degree of compression of the spring 33 may be

65 varied and consequently the force with which the valve 32 is held against its seat is varied. The safety regulating valves 32 of the several low pressure pumps are independently and individually adjustable and their adjustment controls the

70 volume of fluid delivered by their respective pumps. For example, if the low pressure pumps are designed to maintain a hundred pounds pressure in the mixing chamber under normal conditions of operation of the high pressure pumps

75 and it is desired to reduce the proportion of air

in the mixture or emulsion, then the bushing 34 of the safety valve associated with the low pressure air pump 2 is backed off to reduce the compression of the associated spring 33 to a point where the associated valve 32 will partially open

80 when the pressure developed on the downstroke of the piston 13 of the air pump 2 reaches a hundred pounds whereby part of the air being discharged from the cylinder of the air pump 2 flows through the by-pass 30 back to the source of

85 supply. The pumps 3 and 4 may be similarly controlled. In the event excessive pressures should build up in the mixing chamber all of the discharge valves 24 will be held closed and the pistons 13 of the low pressure pumps on their

90 working strokes will merely force the fluid back to the several sources of supply through the several by-passes 30, all of the valves 32 automatically opening under such conditions.

The discharge ducts 26 lead into the mixing chamber as shown in Figure 5 and deliver the ingredients of the emulsion into the mixing chamber at points located in between mixing screens

95 36, these screens being soldered, welded, or otherwise suitably fixed on a supporting rod 37 extending axially through the mixing chamber and held in position by nuts 38 and 39 threadedly connected to the base block 1. Each screen is shaped to

100 snugly fit in the mixing chamber and has a multiplicity of openings 40' which converge from a large area at one side of the screen to a small orifice at the other. Adjacent screens are oppositely

105 arranged on their supporting rod 37 so that the ingredients, when passing through the screens, are thoroughly broken up and admixed. The combined action of the screens and the low pressure operates to partially emulsify the mixture.

The high pressure pumps 5, 6 and 7 are identical and are similar in construction to the low pressure pumps, each high pressure pump, as

110 shown in Figure 4, comprising a cylinder 40 threaded into the block 1 and communicating with a vertical passage 41. A piston 42 is fitted in each cylinder 40 and is maintained in fluid tight relation thereto in any suitable way as by

115 means of a stuffing box designated generally at 43 and similar in construction to the packing means employed for the low pressure pumps. The passage 41 of each high pressure pump communicates with an inlet passage 44 controlled

120 by an inlet ball check valve 45 and the several inlet passages 44 of the high pressure pumps are in open communication with an inlet manifold 46 which, in turn, communicates with the mixing chamber as shown in full lines in Figure 5

125 and in dotted lines in Figures 1 and 2. The displacement of each ball check valve 45 from its seat is limited by a stop pin 47' carried by a spider or apertured plug 47 threaded in the passage 41.

130 Above its ball check valve 45, each passage 41 communicates with a discharge passage 48, the latter communicating through a port 49 with a vertical passage 50 under the control of a discharge valve 51, preferably of the ball check valve type. The vertical passage 50 freely communicates with a discharge manifold 52. The displacement of the ball check valve 51 is limited by a

135 stop pin 53' carried by a plug 53 threaded into and closing the upper end of the passage 50. The discharge manifold 52 is connected with a pipe line 55 which leads to an atomizing nozzle 56

140 or to any other suitable point of use or storage. The atomizing nozzle 56 is shown as being of the type fully described and claimed in my copend-

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ing application executed under even date herewith, filed November 16th, 1929, Serial No. 409,352.

In operation it is proposed to operate the pistons 13 of the low pressure pumps 2, 3 and 4 in unison and the pistons 42 of the high pressure pumps in succession and for this purpose a crank shaft 60 is rotatably supported in bearings 60' secured to the base block 1 and has aligned crank pin 61 coacting with cross heads 62 connected to the pistons 13 of the low pressure pumps. Each cross head 62 is of two-part construction, that is, has the lower part 63 connected as at 64 with the piston 13 of its pump and also has an upper part 65 bolted to the lower part as at 66 (see Figure 3). The parts 63 and 65 define a cross slot 67 in which the associate crank pin 61 operates. For constraining the cross head 62 to vertical movement the upper part 65 has a guide opening 68 therein in which a fixed guide pin 69 is slidably fitted. The guide pin 69 may be secured to any stationary part but preferably is secured as at 70 to a heavy cover plate 71 bolted or otherwise removably secured to a casing 72 fastened rigidly to the base block 1. The crank shaft 60 also has crank pins 75, one for each of the high pressure pumps, the crank pin 75 being staggered 120°, one with respect to the other. Each crank pin 75 is fitted in the bearing opening provided therefor in the complementary sections 76 of a shuttle block designated generally at 77 (see Figure 4). The shuttle block 77 is fitted for transverse sliding movement in a cross head designated generally at 78 and made up of a U-shaped lower section 79 fastened to the piston of its associated high pressure pump and a top piece 80 secured by bolts 81 to the legs of the U-shaped lower part 79. The top piece 80 of each cross head has an integral guide collar 82 which slidably receives a guide pin 83 fastened as at 84 to the top 71 of the casing. The crank shaft 60 is driven in any suitable manner from a motor or any other appropriate source of power.

To preclude the setting up of excessive pressures by the high pressure pumps a safety valve controlled by-pass is provided between the discharge manifold 52 of the high pressure pumps and the intake manifold 46 thereof. In carrying out this purpose a by-pass pipe 90 is provided and, as shown in Figure 7, has one end connected to the intake manifold 46 and its other end connected to a discharge port 91 of a valve plug 92, the valve plug 92 being threaded into the base block and having an inlet port 93 in open communication with the high pressure discharge manifold 52. At the outer end of the passage 93 of the valve plug, a valve seat is provided and with this valve seat a safety valve 94 is normally engaged. The valve 94 is biased into engagement with its seat by a compression coil 95 encircling the stem 94' of the valve and having its compression varied by an adjustable abutment 96 threadedly connected to the outer end of a valve casing 97 attached to the plug 92 and bearing against the outer end of the spring 95. The inner end of the spring 95 engages a cup-shaped washer 98 which abuts the valve 94. The valve stem 94' is slidably fitted in an axial guide opening 96' formed in the adjustable abutment or bushing 96. A stuffing box 99 is provided for the outer end of the adjustable bushing to preclude escape of the fluid between the bushing and the casing 97. By adjusting the bushing 96 the valve may be set to remain closed until pressure exceeds any predetermined value, as, for instance, 3000 pounds. If the pressure exceeds 3000 pounds the valve 94 automatically

opens so that the discharge of the high pressure pumps is carried back to their intake manifolds and these pumps merely idle. Under such conditions the pressure rises in the mixing chamber and acts to close the discharge valves of the low pressure pumps. However, the low pressure pumps are not over-loaded because, under such conditions the valves 32 automatically open to permit the low pressure pumps also to idle.

As an additional safety feature and further for the purpose of facilitating starting, an automatic relief valve 100 and a manually operable relief valve 101 are associated with the mixing chamber. Thus, as shown in Figure 5, a valve casing 102 is threadedly connected with the nut 38 and at its inner end freely communicates through ports 38' with the interior of the mixing chamber. Interiorly the valve 100 is provided with a ported partition 103 formed with a valve seat with which a valve 104 coacts. The valve 104 is biased to engage its seat by means of a compression spring 105, the compression of which is adjusted by means of an adjustable abutment 106 which may be locked in position by a set nut 107. This valve 104 is set to hold a predetermined pressure and its adjustment is ordinarily not disturbed. If the pressure in the mixing chamber should exceed a safe or predetermined value the valve 104 automatically opens to permit the fluid to pass out through a discharge opening 108 to a suitable point of storage. In starting up the low pressure pumps it is sometimes desirable to relieve the pressure until the apparatus begins to function smoothly and for this purpose a relief pipe 110 is tapped into the inner end of the valve casing 102 so as to freely communicate with the interior of the mixing chamber. In this pipe 110 a manually operable relief valve 101 is incorporated. In starting up the relief valve 101 is partially open but after the low pressure pumps have begun to function smoothly this valve 101 is closed.

High and low pressure gauges designated at 120 and 121 respectively, are provided, these gauges being mounted on the base block 1 and, as shown in Figure 7, communicate respectively with the high pressure discharge manifold 52 and the intake manifold 46.

To facilitate production, the various ports and passages are drilled in the base block from the peripheral faces thereof and when desirable are suitably plugged, as shown.

It is to be understood that various changes may be made in the size, shape and arrangement of the various parts without departing from the spirit of the invention or the scope of the appended claims.

The invention claimed is:

1. An emulsifying apparatus including a mixing chamber, a plurality of low pressure pumps for delivering measured quantities of ingredients of the emulsion to the mixing chamber under pressure, each pump having a valve controlled inlet and a valve controlled discharge communicating with the mixing chamber beyond its valve, the discharge valves being adapted to seat under the influence of the pressure in the mixing chamber, a by-pass connecting the discharge of each pump at a point intermediate the pump and the discharge valve and communicating with a return line, a valve controlling the communication of each by-pass with its discharge passage, a spring engaged with each valve and a separate and independent adjustable abutment for each spring whereby the force which the spring exerts to close its valve may be varied

to determine the volume of fluid delivered by each pump to the mixing chamber.

2. In a mixing apparatus, a mixing chamber having an inlet and an outlet, pressure exerting means communicating with said inlet to deliver ingredients of a mixture separately to said chamber, pressure exerting means communicating with said outlet for withdrawing the mixture from said chamber, means for separately returning each ingredient to the source of supply and means responsive to pressure in said inlet for directing a

predetermined portion of each of said ingredients into said returning means.

3. In a mixing apparatus, means for subjecting a plurality of ingredients separately to varying pressures and deliver each ingredient to a mixing chamber, and individual pressure responsive means operative at intervals in said pressure subjecting operation to control the proportionate volume of the ingredients delivered to said chamber.

HASWELL T. BONFIELD.

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