Dec. 11, 1928.

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G. L. FISH

EMULSIFYING APPARATUS

Filed Nov. 25, 1925

Fig. 1.

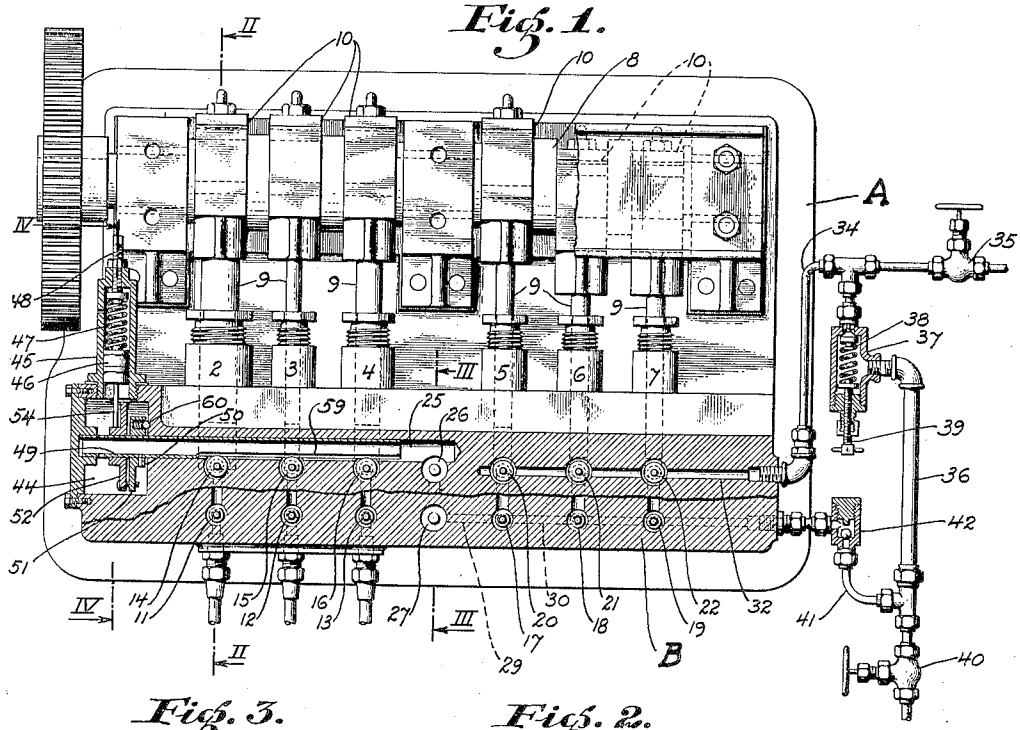


Fig. 3.

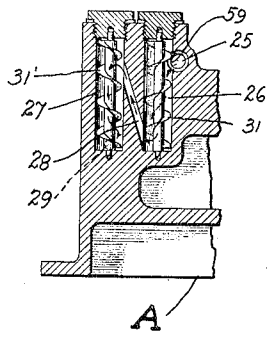


Fig. 2.

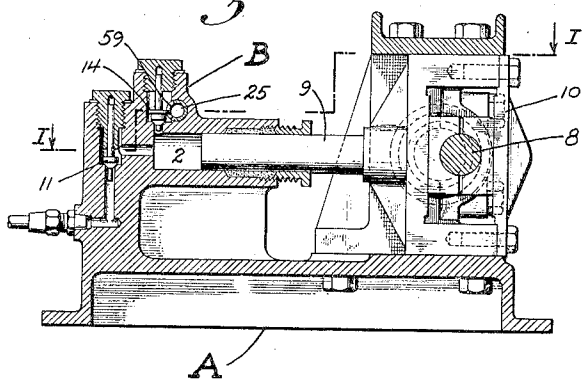
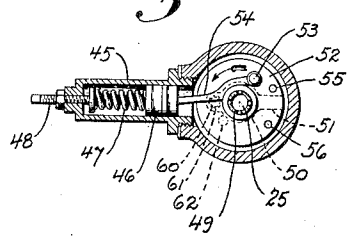


Fig. 4.



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EMULSIFYING APPARATUS.

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This invention relates to an apparatus for mixing and emulsifying fluids, liquids and the like, and particularly to a multi-cylinder pump whereby a mixing and emulsifying action is obtained.

The object of the present invention is to generally improve and simplify the construction and operation of an emulsifying apparatus, whereby fluids, liquids or the like, may be subjected to the following operations. First, measured; secondly, mixed and impregnated with an expansible fluid or gas; third, subjecting the impregnated mixture to high pressure; fourth, releasing the mixture into a chamber maintained under comparatively low pressure.

The apparatus employed for the purpose of forming the emulsion comprises a multi-cylinder pump consisting of a number of measuring cylinders and a number of compressing cylinders, a valve mechanism whereby the feed or delivery of fluids and liquids to the pump may be automatically regulated, a mixing device and a discharge valve, all of which will be more fully described having reference to the accompanying specifications and drawings in which:

Figure 1 is a plan view of the apparatus, said view being shown partially in section and the section being taken on line 1—1 of Fig. 2.

Figure 2 is a cross section of the apparatus taken on line 2—2 of Figure 1.

Figure 3 is a cross section taken on line 3—3 of Fig. 1, said view showing a portion of the mixing apparatus.

Figure 4 is a cross section taken on line 4—4 of Fig. 1.

Referring to the drawings in detail, particularly Figs. 1 and 2, A indicates the base member upon which is mounted a valve chest B, a plurality of cylinders 2, 3, 4, 5, 6 and 7, and a crank shaft 8. Each cylinder is provided with a piston or plunger such as indicated at 9 and reciprocable movement is transmitted from the crank shaft to the plungers in any suitable manner or as here shown through a Scotch crank or the like, such as indicated at 10. The cylinders 2, 3 and 4 will be hereinafter referred to as the measuring cylinders and the cylinders 5, 6 and 7 as the compressing cylinders. The cylinders 2, 3 and 4 are each provided with inlet valves indicated at 11, 12 and 13 and they are also provided with exhaust or discharge valves as indicated at 14, 15 and 16. The cylinders 5, 6 and 7 are similarly provided with inlet valves 17, 18 and 19 and also with discharge valves as indicated at 20, 21 and 22. The inlet and discharge valves employed in the measuring and compression cylinders are identical and are closely illustrated in Fig. 2. The plungers in the measuring cylinders operate in unison, while the plungers in the compressing cylinders operate in successive order, that is, the plungers in the measuring cylinders are driven directly from the crank shaft by crank pins which are set in alignment, while the plungers in the compressing cylinders are driven by cranks set 120° apart.

To illustrate one use of the apparatus, it will be supposed that it is desired to manufacture a cutting oil or emulsion such as is employed in machine shops. If that is the case, the oil to be emulsified will be delivered through a pipe which is connected with the inlet valve 13. Water will be delivered to the inlet valve 12 and air will enter through the inlet valve 11. The diameter of the plungers 2, 3 and 4 is preferably such that the combined volume of water and oil will be equal to a similar volume of air and it is for this reason that the air cylinder is larger in diameter, the exact proportions of water and oil being determined by the diameter of the cylinders 3 and 4. During the outward stroke of the plungers in the cylinders 2, 3 and 4, oil, water, and air will be admitted through the inlet valves 11, 12 and 13. During the return stroke of the plungers the air, oil and water will be discharged through the valves 14, 15 and 16 into a common passage generally indicated at 25. Communicating with one end of this passage is a pair of mixing chambers 26 and 27. The common passage 25 is in direct communication with the mixing chamber 26 and the oil, air and water delivered to the common passage 25 is thus discharged into the mixing chamber 26 where it passes in a downward direction as indicated by the arrow, Fig. 3. A passage 28 connects the lower end of the chamber 26 with the upper end of the chamber 27, and the flow of the liquid is thus reversed. The liquid flows in a downward direction in the chamber 27 and then discharges through a port 29 into a second common passage generally indicated at 30, which is in communication with the inlet valves 17, 18 and 19 of the high pressure or

compressing cylinders. The mixing chambers 26 and 27 are provided with spinners or agitators such as indicated at 31 and 32 and these insure a thorough mixing of the air, oil and water before the mixture enters the second common passage 30. The plungers in the compressing cylinders 5, 6 and 7 withdraw the mixture from the common passage 30 through the inlet valves 17, 18 and 19 and then place it under compression and discharge the mixture into a third common passage generally indicated at 32. The mixture is here subjected to a high compression, in some instances as high as 5000 lbs., and it is maintained under this pressure until released.

Before describing the release of the liquid or mixture after it has been subjected to a high compression, other parts of the apparatus will be described. First of all it will be noted that the third common passage 32 is connected with a discharge pipe 34 and that this is provided with a discharge valve 35. A by-pass pipe 36 is connected with the discharge pipe 34 and a check valve 37 is interposed between the two pipes. This check valve is normally held against its seat by a spring 38 and the spring is adjustable through an adjusting screw 39, so that the check valve will not open before the mixture reaches a predetermined pressure. When it does open, the mixture enters the pipe 36 from where it may be discharged through a valve 40 or returned to the second common passage indicated at 30 through means of a pipe 41 and a check valve 42 mounted thereon. The first common passage 25 referred to terminates at one end in a chamber 44. A cylinder 45 is mounted in alignment with this chamber and carries the piston 46. This piston is normally held in a depressed or lowered position by means of a spring 47 and any pressure desired may be imposed upon this spring by an adjusting screw 48. Extending into the first common passage and journaled therein is a tube or sleeve member 49. Secured on the tube is a hub member 50 and forming a part of the hub member is an arm 51. Turnably mounted on the sleeve, exterior of the hub member 50, is a disk 52. Formed on the outer face of the disk is a crank pin 53 and a connecting rod 54 forms a connection between the crank pin and the piston 46. Formed on the opposite face of the disk 52 are a pair of pins 55 and 56. These pins are adapted to engage opposite sides of the arm 51 when rotary movement is transmitted to the disk and as the arm and the hub member 50 are secured to the sleeve member 49, it is obvious that rotary movement will be transmitted thereto. The sleeve member serves only one function, to wit, that of retaining the discharge valves 14, 15 and 16 in an elevated position with relation to their seats under certain conditions. For instance, if air, oil or water is being continuously delivered to the cylinders 2, 3 and 4 and is discharged thereby into the passage 25 and then passed through the mixing chambers 26 and 27 into the second common passage 30 and finally admitted to the high pressure cylinders 5, 6, and 7 and then discharged into the high pressure passage 32, it is obvious that an excessive pressure would finally build up in this passage and in the discharge pipe 34 unless it was permitted to continuously discharge through the valve 35. Under normal conditions the mixture will discharge through the valve 35 or the valve 40, but it sometimes happens in actual operation that both valves are closed and it is accordingly necessary to permit recirculation of the mixture. This is accomplished by so regulating the pressure of the spring 38 that the liquid under high pressure delivered to the discharge pipe will by-pass through the check valve 37 and enter the pipes 36 and 41. The liquid is thus returned to the second common passage 30 and is recirculated through the high pressure cylinders and the high pressure passage 32. Liquid or fluid is at the same time entering through the inlet valves 11, 12 and 13 and as such is being delivered into the common passage 25. It will here build up a pressure substantially equal to the pressure exerted on the circulating liquid in the passages 30 and 32 and the pressure thus built up will be exerted on the lower side of the piston 46 as this is in direct communication with the passage 25 through the intermediate chamber 44. The moment the pressure overcomes the pressure of the spring 47, piston 46 moves upwardly and through the connecting rod 54 and crank pin 53, transmits a rotary movement to the disk 52. The pin 56 will thus be brought into engagement with the arm 51 and will swing the same in unison with the disk and as the arm and the hub portion thereof is secured to the sleeve or tube 49, rotary movement is transmitted thereto, this rotary movement as previously stated, being utilized to lift the discharges 14, 15 and 16 up from their seats, so as to maintain the same in an elevated position.

By referring to Figs. 1 and 2, it will be noted that the sleeve or tube 49 has one side cut away as indicated at 60. If the tube is rotated in the direction of the arrow (see Fig. 2) it will be obvious that one edge of the tube will engage the lower sides of the discharge valves and as such will raise the same to an elevated position and will retain the valves in an elevated position until the pressure in the passage 25 is reduced. The mixture contained in the passage 25 is thus merely circulated through the pumps 2, 3 and 4 and neither air nor water will enter through the inlet valves 11, 12 and 13 as they are held on their seats by the pressure imposed on their upper surfaces. In other words, an automatic control has been provided which prevents building up of excess pressures in the emulsi-

fying apparatus, or which automatically regulates the feed or delivery of liquids or fluids when the apparatus is in operation. The hub member 51 is provided with a spring-actuated latch in the form of a ball such as indicated at 60. This ball engages either one or another of a pair of recesses such as shown at 61 and 62, or in other words, holds the arm 51 and the sleeve 49 in one position or another; that is, either where the valves are held at elevated position, or in a position where the valves are free to function.

By generally reviewing the unit as illustrated and described, it will be noted that means are provided for measuring two or more liquids and fluids, the means employed being the cylinders 2, 3 and 4. Means are also employed for the purpose of mixing the liquids and for impregnating the liquids with a fluid, the means employed being the common passage 25 into which the liquids and fluids are discharged and mixed, and the mixing chambers 26 and 27. Means are then employed for placing the impregnated mixture under high pressure, this being accomplished by the use of the high pressure pumps 5, 6 and 7 and means are employed for maintaining the pressure until the mixture or emulsion formed is liberated by either of the valves 35 or 40. Means are also employed to permit recirculation of the mixture to wit, the by-pass pipes 36 and 41 and means are employed for rendering the discharge valves 14, 15 and 16 inoperative or operative as the case may be, so as to automatically regulate the feed or delivery of fluids or liquids to the measuring cylinders, this means being the piston 46 and the sleeve or tube 49 actuated thereby. The apparatus employed performs the following operations. First, that of measuring the liquids so as to obtain predetermined proportions in the mixture; secondly, that of forming a mixture of the ingredients and impregnating the same with air or some other expansible medium; third, that of subjecting the impregnated mixture to high pressure and fourth, instantly lowering the pressure to produce final disruption and homogenous mixing of the liquids. For instance, if it is desired to manufacture a cutting oil as previously stated, air is admitted to the cylinder 2, water to the cylinder 3, and oil to the cylinder 4. These cylinders discharge the respective liquids and fluids in predetermined proportions into the first or main duct 25 where they are mixed to a certain extent, the mixing action being more thoroughly completed after the liquids and fluids have passed through the mixing chambers 26 and 27. The mixing and emulsifying action however further improves as the mixture passes through the valves of the high pressure pumps from where the mixture is discharged into the high pressure duct 32. That is, the ingredients are mechanically and thoroughly mixed by the action of the several pumps and valves and by the spinners in the mixing chambers 26 and 27 and finally placed under a high pressure in the duct 32 and the discharge pipe 34 and the mixture is of course also impregnated with the air or other expansible medium employed and this air is compressed to the same pressure as that maintained in the high pressure duct and discharge pipes. When the machine is in operation and it is desired to obtain the cutting mixture, it is only necessary to open the valve 40. The air under high pressure with which the mixture or emulsion is impregnated expands with almost explosive rapidity when it discharges from the valve and as such causes a minute disruption or pulverizing action and final mixing of the ingredients employed. The emulsion in reality leaves the valve as a finely divided vapor, but as this vapor is discharged into a tank or container it condenses on the walls thereof and as such runs down and collects as a liquid or an emulsion within the container. By enlarging the pipe 36 and adjusting the tension of the spring 38 so that the check valve 37 does not open except under a predetermined pressure, the expansion takes place the moment the liquid passes beyond the check valve. It therefore leaves the check valve in the form of a vapor which is condensed within the chamber of the check valve and the discharge pipe 36 and if the valve 40 is left completely opened, an emulsion will discharge therefrom as the condensation required has taken place within the check valve casing and the discharge pipe. In some instances it is desirable to burn the vapor; in that instance it is not desirable to condense the same; valve 35 would then be opened and the mixture in the vapor form would be directed into the fire box of a furnace or whatever the case might be. Actual practice has shown that predetermined proportions of air, oil and water form a vapor which is ideal for combustion. In fact, many uses have been found for this device and it should by no means be limited to the production of an emulsion, as a product in a vaporous state is also desirable.

Having thus described my invention, what I claim is:

1. An apparatus for emulsifying liquids and the like, comprising means for measuring the liquids to be emulsified, means for mixing and impregnating the liquids with an expansible fluid, means for subjecting the impregnated mixture to high pressure, a discharge through which the mixture is liberated and expanded, and means whereby a predetermined pressure on the impregnated mixture regulates delivery of the fluid and liquids to the apparatus.

2. An apparatus for mixing and emulsifying liquids and the like, embodying means for mixing and emulsifying in predetermined

proportions a plurality of liquids, means for impregnating the emulsion with an expansible fluid, means for subjecting the emulsion when impregnated with said fluid to high pressure, a valve through which the impregnated liquid under high pressure is released and instantly expanded, and means actuated by the impregnated liquid when under high pressure whereby delivery of the fluid and liquids to the apparatus is regulated.

3. An apparatus for mixing and emulsifying liquids and the like, comprising a pump having a plurality of cylinders, means for delivering liquids to be emulsified in predetermined proportions to certain of said cylinders, means for mixing and impregnating the liquids with an expansible fluid, means for transferring the impregnated liquid to another cylinder and for placing said impregnated liquid under high pressure, means for releasing the impregnated liquid under high pressure through an expansion valve when the pressure is instantly lowered, and means actuated by the impregnated liquid under pressure before release for automatically regulating delivery of fluid and liquids through the pumping cylinders.

4. An apparatus for mixing and emulsifying liquids and the like, comprising a pump arranged in two units and a unit consisting of a plurality of cylinders, means for delivering liquids to be emulsified in predetermined proportions to the individual cylinders of one unit, means for combining, mixing and emulsifying the liquids after they have discharged from said cylinders, means for transferring the emulsion to the second set of cylinders and for subjecting the emulsion to high pressure, means for releasing the emulsion under high pressure through an expansion valve when the pressure is instantly lowered, and means whereby the emulsion under pressure before release automatically regulates delivery of the liquids to the first named pumping cylinders.

5. An apparatus for mixing and emulsifying liquids and the like, comprising a pump arranged in two units and each unit embodying a plurality of cylinders, an inlet and a discharge valve cooperating with each cylinder, means for delivering fluids to be emulsified in predetermined proportions to the individual cylinders of one unit, means for combining, mixing and emulsifying the fluids after discharge from said cylinders, means for transferring the emulsion to the cylinders of a second unit and applying a high pressure to the emulsion upon discharge therefrom, means whereby the valves in the first named pumping unit are rendered inoperative when a predetermined pressure is imposed upon the emulsion, so as to prevent further delivery of fluids to the cylinders, and an expansion valve through which the emulsion under pressure may be released and instantly expanded.

6. An apparatus for mixing and emulsifying liquids and the like, comprising a pump arranged in two units and each unit embodying a plurality of cylinders, an inlet and a discharge valve cooperating with each cylinder, means for delivering fluids to be emulsified in predetermined proportions to the individual cylinders of one unit, means for combining, mixing and emulsifying the fluids after discharge from said cylinders, means for transferring the emulsion to the cylinders of a second unit and applying a high pressure to the emulsion upon discharge therefrom, means whereby the valves in the first named pumping unit are rendered inoperative when a predetermined pressure is imposed upon the emulsion, so as to prevent further delivery of fluids to the cylinders, said means rendering the valves operative the moment a predetermined pressure is lowered, and an expansion valve through which the emulsion under pressure is released and instantly expanded.

7. An apparatus for mixing and emulsifying liquids and the like, comprising a pump arranged in two units and each unit embodying a plurality of cylinders, an inlet and discharge valve cooperating with each cylinder, means for delivering fluids to be emulsified to the individual cylinders of one unit, means for combining, mixing and emulsifying the fluids after discharge from said cylinders, means for transferring the emulsion to the cylinders of a second unit and applying high pressure to the emulsion upon discharge therefrom, means providing for recirculation of the emulsified liquid through the cylinders of the second-named unit, means providing for recirculation of the emulsified liquid in the cylinders of the first-named unit, means for discharging the emulsified liquid under high pressure from the cylinders of the second-named unit and means whereby recirculation of the emulsified liquid in the first-named unit is automatically prevented when the emulsified liquid under high pressure is discharging from the cylinders of the second-named unit.

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