

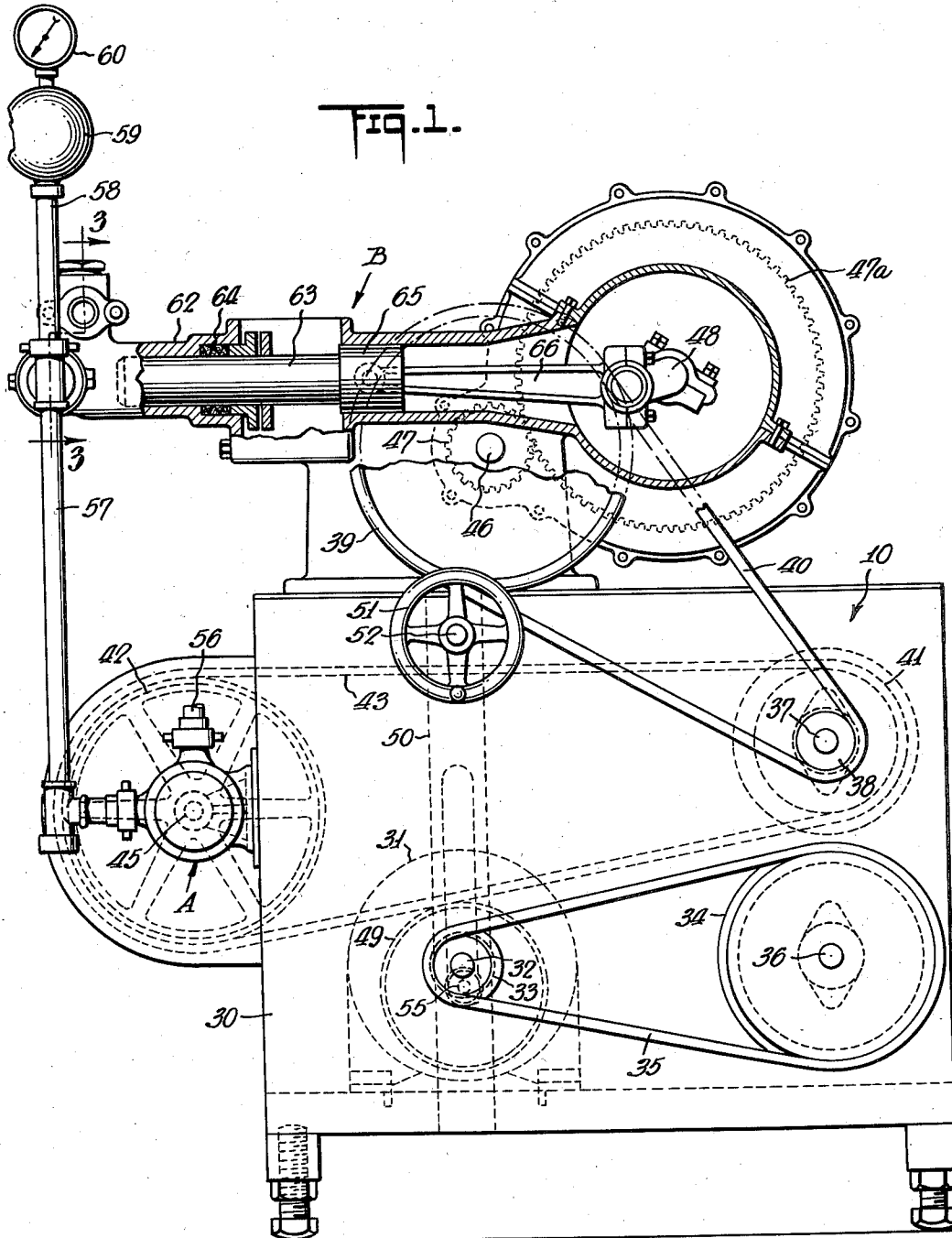
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2,013,017

PUMPING MECHANISM

Original Filed March 31, 1932 4 Sheets-Sheet 1



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FIG. 3.

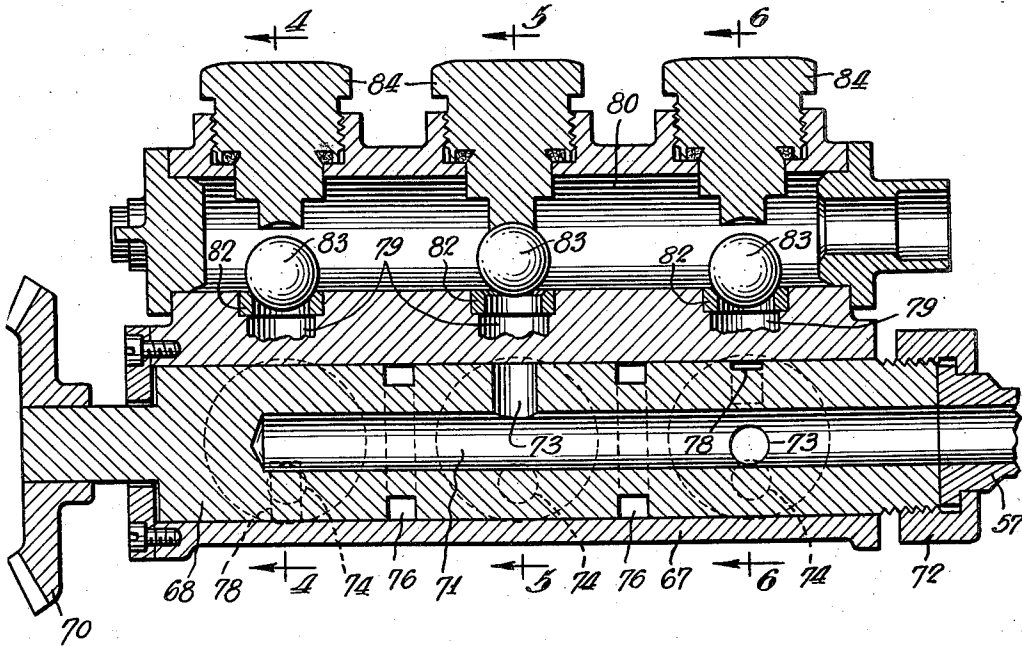
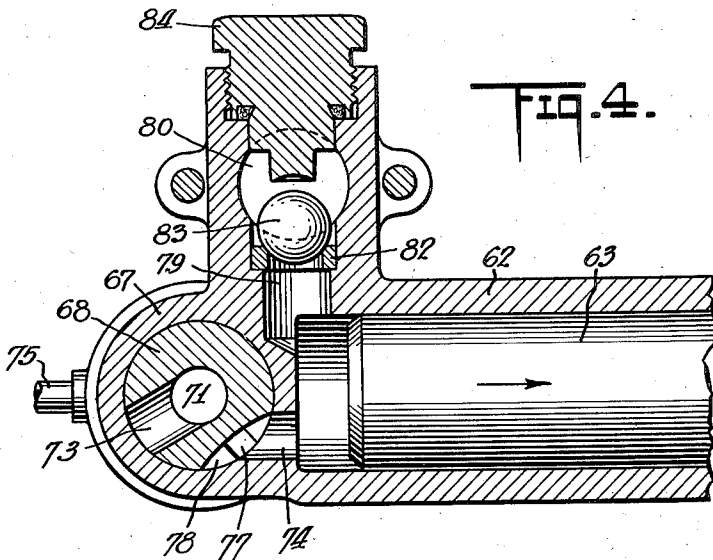


FIG. 4.



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PUMPING MECHANISM

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602,157. Divided and this application Janu-
ary 5, 1935, Serial No. 459

16 Claims. (Cl. 103—5)

This invention relates to pumping mechanism primarily intended and adapted for forcing two fluids in predetermined relative amounts to an apparatus for continuously processing the same.

As an example of such fluids, the pumping mechanism may be employed for forcing an ice cream mix and air or other gas directly or indirectly to the apparatus for continuously freezing the mixture to form ice cream.

In continuous ice cream freezers, such for instance as those of the type disclosed and claimed in my prior Patent 1,783,864, issued Dec. 2, 1930, the air and gas are delivered together under pressure to one end of the freezing tube, and by reason of this initial pressure the material as it freezes is advanced through and from the freezing chamber. The ice cream delivered from the freezer may be continuously delivered as a plastic rod or bar, progressively enwrapped or encased by paper or other analogous material, further hardened, and cut into successive sections. In order that all of the steps of the process be properly timed to insure the feed of the ice cream and the wrapping material at the proper relative speeds, it is important that slippage be prevented as far as possible. It is also essential that the mix be delivered under sufficiently high and sufficiently definite and positive pressure that a uniform product will be delivered from the freezer at comparatively high speed.

One object of the present invention is to provide a pumping mechanism whereby the mix and gas may be delivered in accurately predetermined relative proportions, at the desired high speed and at a rate which may be accurately controlled in respect to the delivery of the wrapping or encasing material for the frozen product.

A further object of the invention is to provide a pumping mechanism of the multiple piston type having a single rotary inlet valve for the separate successive admissions of the liquid and the gas to the separate cylinders in succession.

A further object of the invention is to provide a pumping mechanism adapted for the delivery of liquid and gas and having the outlet valve so designed and positioned as to insure the complete discharge of the gas at each stroke, and the sealing of the outlet valve by means of the liquid.

A further object is to provide a pumping mechanism of the piston type in which a single rotary inlet valve is self-balancing against the pressures of the gas and/or liquid when the materials are introduced under pressure, and which will coact with the pistons of the pump to admit measured

quantities of the gas and the liquid to the pumping chamber.

As another feature of the invention the pumping mechanism includes a pair of pumps arranged in succession, one pump serving to deliver liquid under pressure to the second pump and in such measured quantities as to only partially fill the pump chamber for each stroke, and whereby the pump chamber may receive gas during the remainder of the stroke.

A further object is to provide a pumping mechanism in which the two pumps are capable of adjustment to vary the relative speeds and consequently the relative proportions of the liquid and gas delivered to the second of the pumps in accordance with the percentage of overrun desired, the nature of the material being treated, the effectiveness and temperature of the refrigerating medium to be subsequently employed, and various other factors.

A further object of the invention is to provide a pump which will receive liquid under pressure and also receive gas which may be at atmospheric pressure and deliver the two under such pressure that the gas may be caused to become substantially completely dissolved in the liquid prior to the subjecting of the two to the action of a temperature changing medium.

The present application is a division of my co-pending application Serial No. 602,157, filed Mar. 31, 1932, and the pumping mechanism herein claimed may be used as a part of the system or combination of units disclosed in said application or in application Serial No. 1,314, filed January 11, 1935 or for carrying out the processes disclosed and claimed, in either of said applications, or may be used for delivering the mix and gas directly to any freezer or other processing apparatus of the continuous type.

The invention may be more fully understood from the following description in connection with the accompanying drawings wherein:—

Fig. 1 is an elevation, partly in section, showing my improved pumping mechanism,

Fig. 2 is a front elevation of the parts shown in Fig. 1,

Fig. 3 is a vertical, longitudinal section through the pump valves, said section being taken on the line 3—3 of Fig. 1,

Figs. 4, 5, and 6 are transverse sections on the lines 4—4, 5—5, and 6—6 respectively of Fig. 3, and

Fig. 7 is a perspective view of the inlet valve for the pump.

The two pumps A and B, one for the mix and

the other for the gas and mix, may be mounted on the same base and driven from the same source of power if desired, but with suitable means for varying and controlling their actual and relative speeds in accordance with the speed of the source of power, the effectiveness of the temperature changing medium to be employed in the freezing unit (not shown) through which mix and gas are to be subsequently passed, the desired hardness of the delivered product, the percentage of overrun desired, the nature and type of material being treated, and other factors.

In Figs. 1 and 2 the pump A is shown as mounted upon the side of a casing 10 for the motor and gearing, and the pump B is shown as mounted on top of said casing. The pump A is preferably of the positive acting rotary type, involving the use of intermeshing gears, the pump illustrated being of a type commonly known in the trade as a Viking pump. As the details thereof form no portion of the present invention they have not been illustrated. The pump B is of the multiple plunger reciprocating type and will be described more in detail hereinafter.

The two pumps A and B are driven from a suitable source of power, such for instance as an electric motor 31. The motor shaft 32 is provided with a sprocket or pulley 33 which drives a larger sprocket wheel or pulley 34 through a chain or belt 35. The sprocket wheel or pulley 34 is on a shaft 36 and power is transmitted by means of a variable speed power transmitter of any suitable type from this shaft to a parallel shaft 37 which drives both of the pumps. For instance the shafts 36 and 37 may be provided with pairs of opposed relatively adjustable cone pulleys whereby the spreading apart of the pulleys of one pair and the pressing together of the pulleys of the other pair will vary the speed ratio of the driving and driven shafts. One type of such transmission is commonly known as a Reeves drive.

I have not illustrated the details of this drive or the pulley adjusting means, but have merely indicated in dotted lines the casing 44 thereof. The shaft 37 on one end thereof may have a sprocket wheel or pulley 38 for driving the pump B through a sprocket wheel or pulley 39 and a chain or belt 40. The same shaft, at its other end, may drive the pump A through a pulley 41, a belt 43 and a pulley 42. The pulley 42 may be on the shaft 45 of the pump A, while the sprocket wheel or pulley 39 may be on a shaft 46 which has a pinion 47 meshing with a gear 47a on the crank shaft 48 of the pump B. Thus, both of the pumps A and B are driven from the shaft 37 and the speed of this shaft may be varied in respect to the speed of the motor 31 or other prime mover.

Means are provided for varying the relative speeds of the two pumps. For instance, the pulley 41 may comprise a pair of cone pulleys shown in dotted lines in Fig. 2, of the type used in a Reeves drive. They are adapted to be forced together by means of a compression spring, whereby upon spreading these cones apart or allowing them to come closer together, the effective driving radius is varied. To alter this effective driving radius of the pulley 41, there is provided an idler 49 engaging the belt 43 and mounted on a slide 50, which may be moved vertically to raise or lower the idler 49, thereby forcing the cone pulleys 41 apart against the compression of the spring, or allowing them to come closer together.

Any suitable means may be employed for operating this slide, but I have illustrated a hand wheel 51 on a shaft 52 and driving a vertical shaft 53 through a pair of beveled pinions 54. The lower end of the shaft 53 may be threaded into a bearing block 55 supporting the shaft of the idler 49.

The mechanism for driving the two pumps at variable speeds and for varying the relative speeds as desired, may be varied within wide limits, and therefore it will be understood that the details of the specific mechanism and the particular arrangement of the parts above described constitutes no essential part of the invention, and are illustrated merely as an example of suitable mechanism which may be employed.

The pump A receives the cold mix through a pipe 56 from mixing tanks, a homogenizer, or other suitable equipment commonly used in the manufacture of ice cream or other material to be processed, and which has not been illustrated. The mix is delivered by the pump A through the pipe 57 to the inlet of the pump B. This mix is preferably delivered under no pressure if the product is to have a high overrun and under only a slight pressure if it is to have a low overrun. The pipe 57 may have an extension 58 with a pressure chamber 59 to compensate for the continuous delivery from the pump A and the intermittent admission of the pumped mix to the cylinders of the pump B, and may have a pressure gauge 60 to indicate the pressure.

The pump B, as previously stated, is of the multiple plunger reciprocating type, and serves to pump both gas and the mix, and deliver them under pressure. The three cylinders 62 may be cast in the same block, which may be integral with the casings for the inlet and outlet valves. Within these cylinders are the plungers or pistons 63 which slide through stuffing boxes 64 and have enlarged heads 65 sliding in cylinders 65a forming part of the housing for the crank shaft 48. The plunger heads are driven by connecting rods 66 journaled on the separate cranks of the crank shaft 48. These cranks are preferably set at angles of 120° apart to effect a more nearly uniform operation of the pump B and to distribute the load on the source of power as well as effecting a continuous delivery of gas and mix from the pump. Although I have shown the pump provided with three cylinders and pistons, it will of course be evident that there is nothing particularly important about this number, and that any desired number may be employed.

The cylinder block may have detachably secured thereto or cast integral therewith a valve casing 67 for a rotary cylindrical suction valve 68. (See Figs. 3 to 7 inclusive.) This valve is driven from the shaft 46 or the crank shaft 48 in any suitable manner, for instance by means of a shaft having a beveled gear within a gear casing 69 and meshing with a gear 70 on one end of the shaft of the valve 68.

The valve 68 has a central bore 71 registering at one end with a passage which may be the pipe 57 connected to the valve casing by a union 72, or in any suitable manner. The valve 68 has separate radial ports 73 from the bore, disposed at angles of 120° apart, and so positioned that they intermittently and successively communicate with corresponding ports 74 leading into the separate cylinders 62 and permit entrance therefrom to the pipe 57.

The valve 68 also serves to control the admission of gas to each cylinder of the pump B in ad-

vance of the entrance of the mix thereto. In the manufacture of ice cream it is the usual practice to use air as the gas for giving the desired overrun, but it will be evident that any other inert gas, such for instance as carbon dioxide, nitrogen, helium or the like, may be used.

The valve casing 67 is provided with two or more ports 75 in the side thereof which may open directly to the atmosphere or may be connected by pipes to any source of other gas. The valve 68 is provided with a pair of annular grooves 76 which are in registry with the ports 75, so that the gas may enter these grooves and flow circumferentially of the valve. These grooves communicate with longitudinally extending grooves or channels 77 in the periphery of the valve, and each of these last mentioned grooves terminates in an elongated port 78 extending along a portion of the periphery of the valve, and in the same transverse plane as the radial ports 73 from the central bore 71.

Each port 78 is disposed a short distance in advance of the corresponding port 73, in the direction of rotation of the valve, so that the gas and the mix may be delivered separately and in succession to each cylinder. The relative positions of the ports and passages of the valve in respect to the drive for the pistons may be substantially as shown in Figs. 4, 5, and 6. As the piston first starts to move toward the right on the suction stroke, the port 78 comes into registry with the port 74, as shown in Fig. 6. Almost instantly after the port 78 passes beyond the port 74, and the piston has reached a predetermined position in the suction stroke, the passage 73 will come into registry with the ports 74 as shown, and during the balance of the suction stroke, no further gas will be admitted to the cylinder, but the mix will enter due in part to the movement of the piston, and in part to the pressure on the mix in the pipe 57 and bore 71, due to the action of the mix pump A. When the piston reaches the end of the suction stroke the valve 68 will have moved to such position as to close the port 74, and during the return stroke of the piston as shown in Fig. 7, the gas and mix are ejected through a port 79 under the desired pressure.

It will be evident that by proportioning the width of the ports 73, 74, and 78, the relative proportions of gas and mix entering the cylinder may be varied at will. In order to produce an ice cream having 100% overrun, the gas and mix may be admitted in approximately equal quantities. This may require a slightly larger volume of gas to provide for the amount of gas which is still dissolved in the mix even after final freezing of the aerated cream as more fully explained in the parent application above identified.

This does not mean that the passage 73 comes into registry with the port 74 when the piston is back one-half of its stroke. The gas being sucked in may enter at slightly below atmospheric pressure, whereas the mix is forced in and may act to very considerably compress the air in the cylinder even before the piston reaches the end of its intake or suction stroke. Furthermore, the gas may be delivered to the inlets 75 under pressure, and if so, the position and/or size of the ports 73 and 78 may be correspondingly varied.

The several cylinders communicate with a discharging passage 80 which is connected at one end to a delivery pipe 81. The passage 80 may be formed directly in the cylinder block or cylinder head, and communicates with the several

cylinders through the discharge ports 79. Each of these ports may have a valve seat 82 engaged by a ball check valve 83, and the upper side of the valve casing may have removable blocks or caps 84 whereby the valves and valve seats may be removed, and whereby the limit of movement of the ball valves away from their respective seats may be controlled. During the discharge stroke of each piston the gas will tend to flow out first as the discharge ports 79 are on the upper side of the cylinder. The mix will be discharged last, and therefore a liquid seal will be left around the ball valve. The intake ports 74 of the cylinder are preferably closely adjacent to the lower sides of the cylinders so that these ports will remain filled with liquid during the discharge stroke and aid in sealing the rotary valve 68; also this positioning of the intake ports prevents any trapping of air in the ports and also serves to avoid any undue turbulence or mixing of the gas and liquid in the cylinder. To prevent the intermixing (and foaming) of the mix within the pump cylinders, the pump is preferably geared down to operate slowly.

Independently of any variation in port sizes or arrangements it will be apparent that the relative amounts of gas and mix taken in on each stroke of the piston may be readily varied by speeding up or slowing down pump A (by turning hand wheel 51) or by varying the pressure of the entering gas when this gas is supplied from pressure containers instead of sucked in directly from the atmosphere.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, one of said valve ports being in constant communication with a source of liquid, the other of said ports being in constant communication with a source of gas.

2. A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, means establishing communication between one valve port and a source of liquid and means establishing communication between the other valve port and a source of gas.

3. A piston type pump including a piston and a cylinder having an inlet and an outlet port, and a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, one valve port when in registration with the cylinder port serving to deliver a liquid and the other valve port serving to deliver air.

4. A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, one of said valve ports being in constant communication with

a source of liquid, the other of said ports being in constant communication with a source of gas, said gas port opening during the first part of the intake stroke of the piston and said liquid port opening after the gas port has been closed.

5 A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, one valve port communicating with a source of liquid and the other valve port communicating with a source of gas, said gas port opening during the first part of the intake stroke of the piston and said liquid port opening after the gas port has been closed.

6. A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, one valve port communicating with a source of liquid and the other valve port communicating with a source of air, said air port opening during the first part of the intake stroke of the piston and said liquid port opening after the air port has been closed.

7. A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, a second pump for advancing liquid to one of said valve ports, the other of said ports being in constant communication with a source of gas.

8. A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, a second pump for continuously advancing liquid to one of said valve ports, the other of said ports being in constant communication with a source of gas and a pressure chamber communicating with the line through which liquid flows from the second pump to the valve, whereby the second pump may run continuously although the valve permits discharge only intermittently into the cylinder of the first pump.

9. Pumping mechanism of the character described including a plurality of parallel cylinders, a plurality of reciprocating pistons working in said cylinders, means for operating said pistons so that at all times at least one of said pistons is travelling on its expelling stroke and another of said pistons is travelling on its intake stroke, inlet and outlet ports in each cylinder, a rotary inlet valve controlling the admission of fluid to all of said cylinders, said inlet valve having ports in communication with a source of liquid and being operable as it continuously revolves to effect successive registration of a gas inlet port and a liquid inlet port with the inlet port of each cylinder during the suction stroke of the piston in said cylinder, and to present a portion to seal the inlet port of the cylinder upon the expelling stroke of the piston.

10. Pumping mechanism of the character described including a plurality of parallel cylinders,

a plurality of reciprocating pistons working in said cylinders, means for operating said pistons so that at all times at least one of said pistons is travelling on its expelling stroke and another of said pistons is travelling on its intake stroke, inlet and outlet ports in each cylinder, a rotary plug type inlet valve extending transversely of the axes of and controlling the admission of fluid to all of said cylinders, said inlet valve having a central longitudinal bore therein communicating with a source of liquid, radial ports in the valve communicating with the central bore, other ports in the valve communicating with a source of gas, said valve as it continuously revolves being operable to effect successive registration of a gas inlet port and a liquid inlet port with the inlet port of each cylinder during the suction stroke of the piston in said cylinder, and to present a portion to seal the inlet port of the cylinder upon the expelling stroke of the piston.

11. Pumping mechanism of the character described including a plurality of parallel cylinders, pistons working in said cylinders, inlet and outlet ports in each cylinder, a rotary plug type inlet valve controlling the admission of fluid to all of said cylinders, a casing for the valve having gas inlet ports therein, circumferential grooves in the valve registering with said ports, longitudinally extending grooves in the surface of the valve communicating with the peripheral grooves and intermittently with the inlet ports of the cylinders.

12. Pumping mechanism of the character described including a plurality of parallel cylinders, pistons working in said cylinders, inlet and outlet ports in each cylinder, a rotary plug type inlet valve controlling the admission of fluid to all of said cylinders, a casing for the valve having gas inlet ports therein, circumferential grooves in the valve registering with said ports, longitudinally extending grooves in the surface of the valve communicating with the peripheral grooves and intermittently with the inlet ports of the cylinder, said valve having a central longitudinal bore therein for the admission of liquid and radial bores communicating with said central bore and communicating intermittently with the inlet ports of the cylinders.

13. Pumping mechanism of the character described including a plurality of parallel cylinders, pistons working in said cylinders, inlet and outlet ports in each cylinder, a rotary plug type inlet valve controlling the admission of fluid to all of said cylinders, a cylindrical casing for the valve having a gas inlet port therein, annular peripheral grooves in the valve constantly communicating with said ports, longitudinal grooves in the surface of the valve communicating with said annular grooves and relatively short peripherally disposed grooves in the surface of the valve communicating with said longitudinal grooves and adapted to register with the inlet ports of the cylinders.

14. A piston type pump including a piston and a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, a second pump for advancing liquid to one of said valve ports, the other of said ports being in constant communication with a source of gas and means for varying the relative speeds of the two pumps.

15. A piston type pump including a piston and

5 a cylinder having an inlet and an outlet port, a continuously moving inlet valve having a pair of ports therein successively registering with the inlet port during the intake stroke of the piston and including a portion to seal said inlet port on the expelling stroke of the piston, a second pump for advancing liquid to one of said valve ports, the other of said ports being in constant communication with a source of gas, said second pump permitting limited slip.

0 16. A pump including a plurality of substantially parallel cylinders, separate pistons in said cylinders, means connecting said pistons for ef-

fecting successive delivery operations, a transverse header above said cylinders having a separate valve control communication with each cylinder at the upper side of the latter, a transverse valve chamber having a series of ports corresponding to each cylinder, said series including an outlet port leading to the cylinder, a gas inlet port and a liquid inlet port, and a valve member in said valve chamber and having a passage to admit first gas and then liquid in succession to 10 each cylinder and to said cylinders in succession.

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