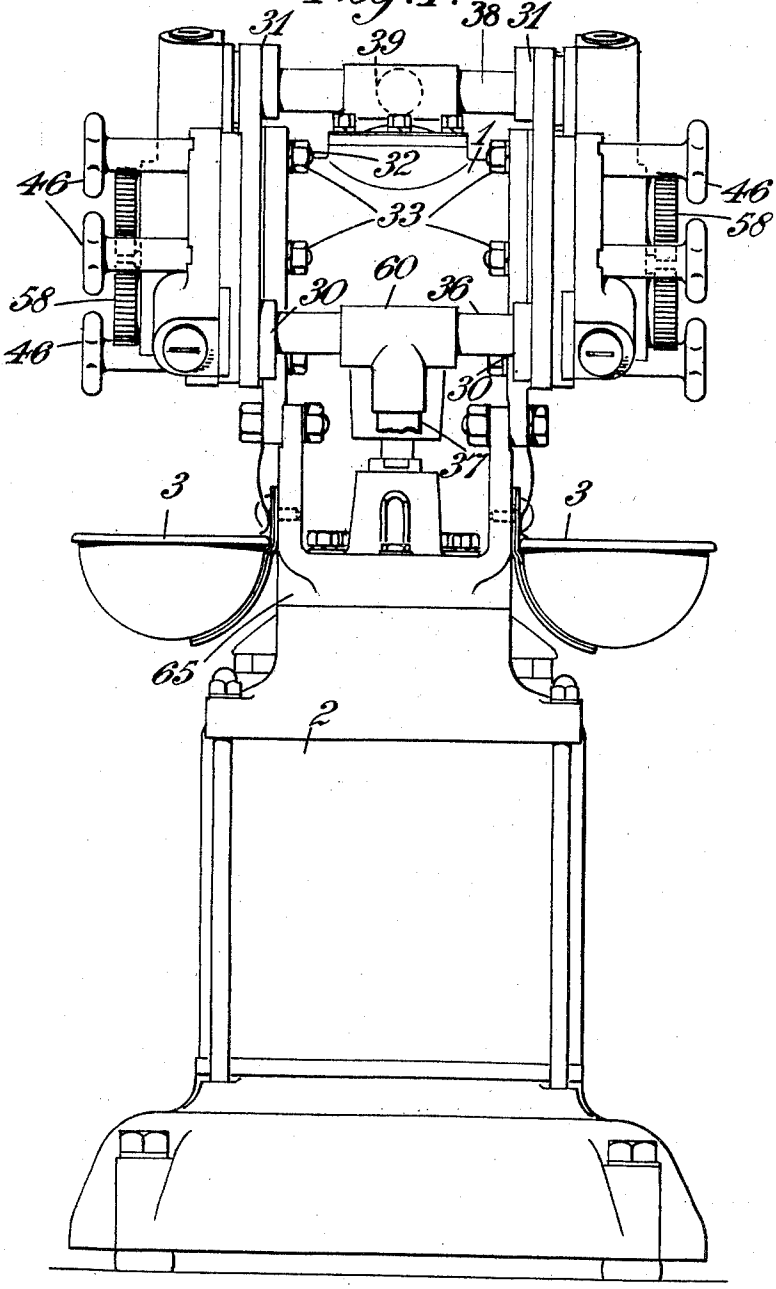
Feb. 20, 1951 J. E. N. YATES ET AL 2,542,786

DIAPHRAGM PUMP

Filed March 28, 1947 6 Sheets-Sheet 1

Fig. 1.



Inventors: J. E. N. Yates, A. L. B. Dawson and J. C. Meredew

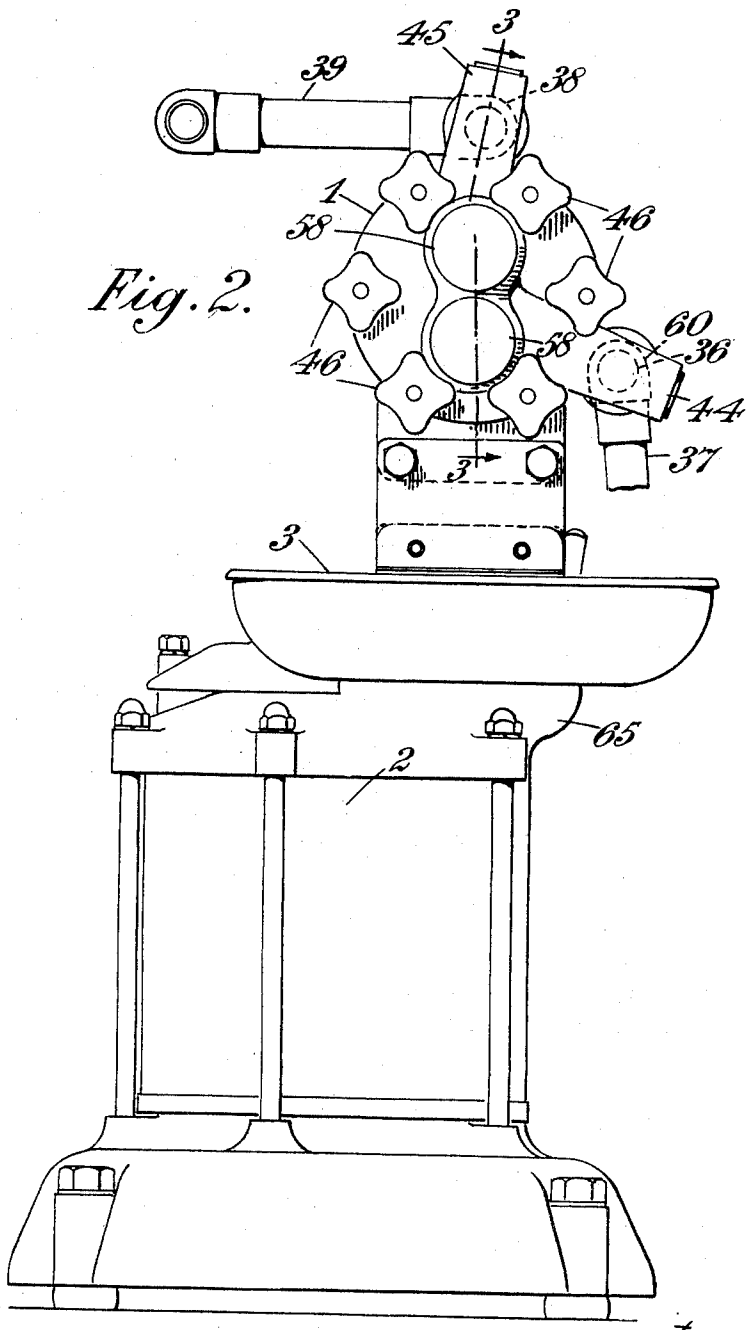
Watson, Cole, Grindle & Watson Attys.

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DIAPHRAGM PUMP

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Fig. 2.



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DIAPHRAGM PUMP

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Fig. 3.

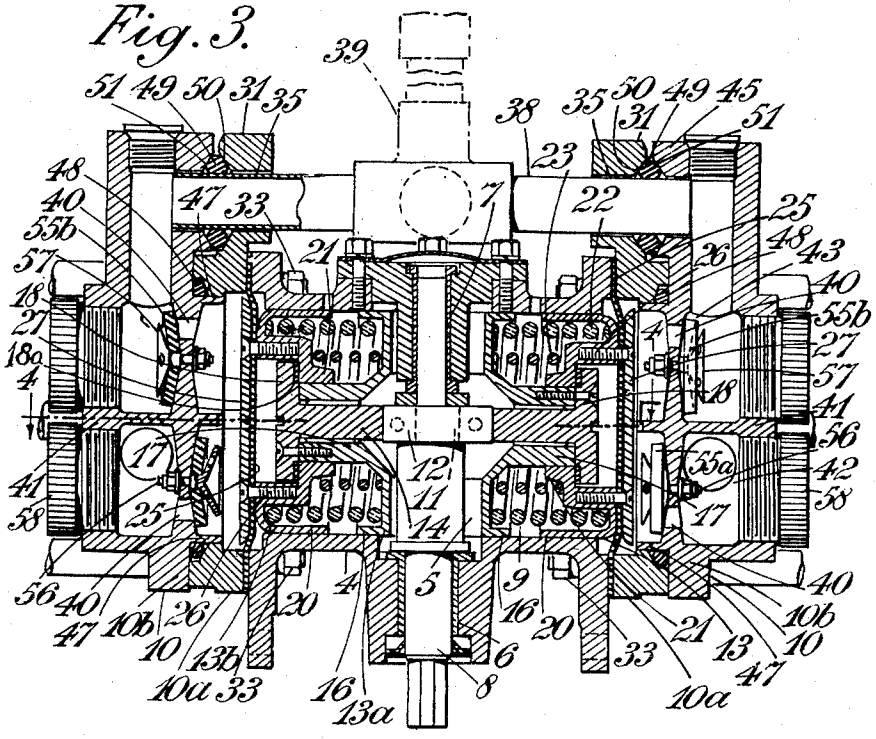
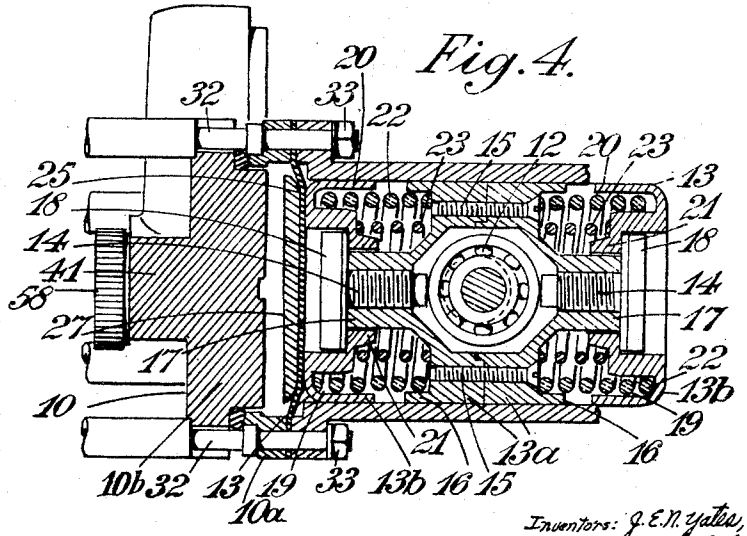


Fig. 4.



Inventors: J. E. N. Yates, A. L. B. Dawson and G. C. Meredew

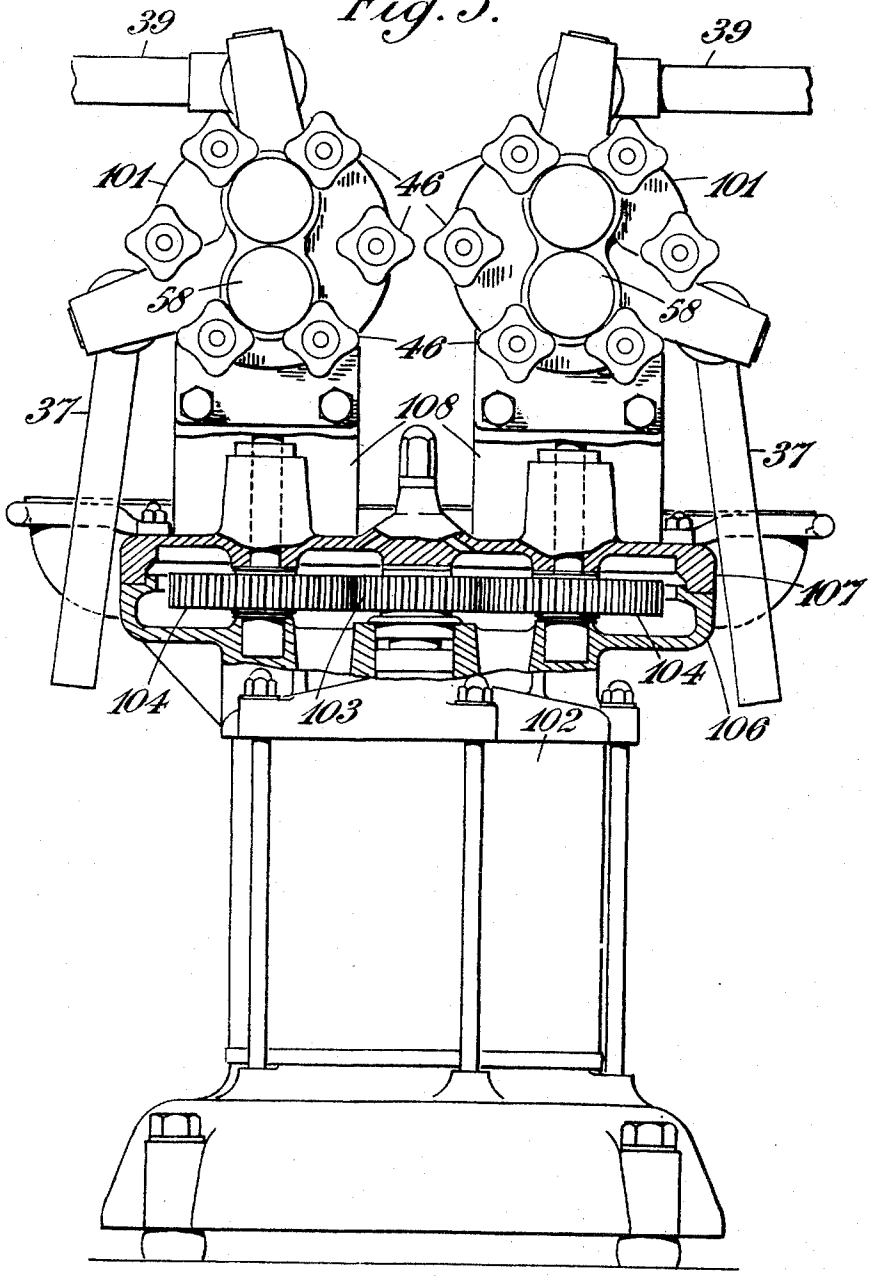
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DIAPHRAGM PUMP

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Fig. 5.



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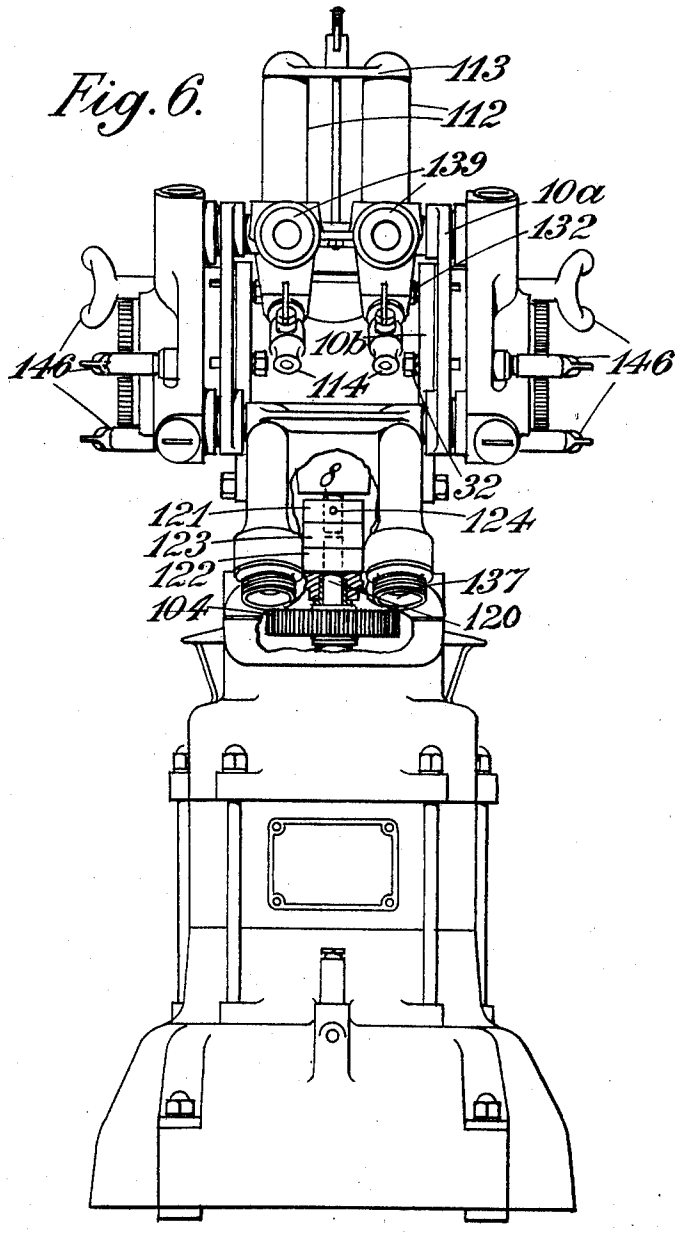
Watson, Cole, Grindle & Watson
Attys.

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DIAPHRAGM PUMP

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Fig. 6.



Inventors: J. E. N. Yates and L. B. Dawson and G. E. Meredew

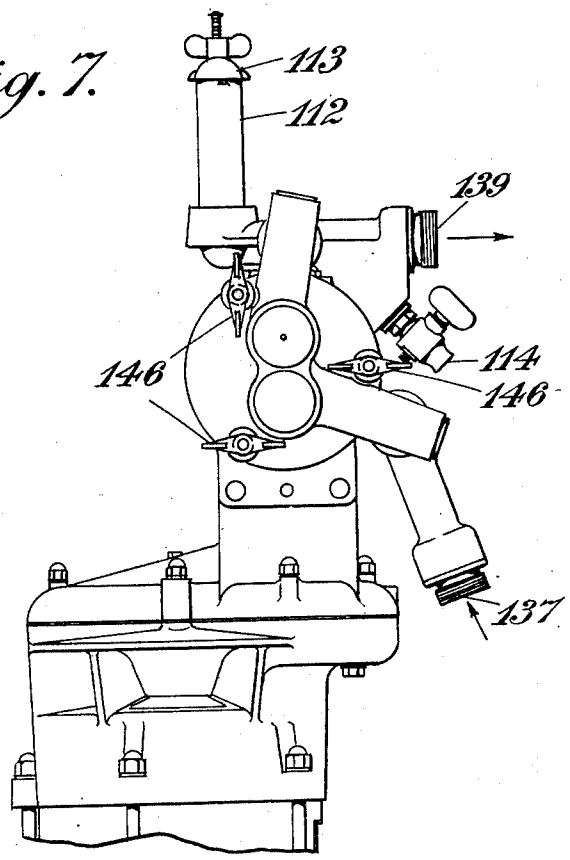
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DIAPHRAGM PUMP

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Fig. 7.



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Patented Feb. 20, 1951

2,542,786

UNITED STATES PATENT OFFICE

2,542,786

DIAPHRAGM PUMP

John Ernest Neville Yates, Edgbaston, Birmingham, and Arthur Lionel Brown Dawson and George Charles Meredew, London, England, assignors to Self-Priming Pump & Engineering Co. Limited, London, England, a British company, and Gaskell & Chambers Limited, Birmingham, England, a British company

Application March 28, 1947, Serial No. 760,674
In Great Britain March 29, 1946

1 Claim. (Cl. 103—150)

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This invention consists in a new or improved diaphragm pump and is particularly, but not exclusively, concerned with the provision of a pump suitable for use with beverages such as beer and milk or other liquids which require a high degree of cleanliness in the pump and freedom from contamination by lubricants.

The invention provides a diaphragm pump comprising a casing in which are formed two opposed pump chambers provided with automatic inlet and outlet valves, two opposed pistons arranged for reciprocation in guides formed in the casing and appropriated to the two pump chambers respectively, two flexible pump diaphragms arranged for reciprocatory pumping operation by the two pistons respectively and each forming a wall or part of a wall of the pump chamber to which the associated operating piston is appropriated, and an operating eccentric or crank common to the two pistons and arranged on rotation to reciprocate the two pistons and their respective diaphragms in out of phase relationship. In one construction according to the invention, the two pistons are integral with one another or are connected together and reciprocate as a unit.

In the preferred form of the pump according to the invention, there is a resilient link in the operative connections between each diaphragm and the eccentric or crank whereby when a predetermined pressure is reached in the pump chamber the displacement of the crank or eccentric is absorbed in the resilient link and the pumping stroke of the diaphragm is reduced or eliminated. Conveniently, each piston is divided in its length and a compression spring tending to separate the two parts of the piston forms the resilient link.

According to a preferred feature of the pump the valves are of the type comprising a rigid perforated seating and a flexible disc overlying the perforations and secured at its centre to the seating by means which permit the outer portions of the disc to lift off the seating under fluid pressure to allow fluid to flow through the perforations. Transparent inspection windows covering the valves may be provided and the windows may be arranged for ready removal to provide access to the valves for cleaning.

A specific form of pump and some modified

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arrangements thereof embodying the above and other features of the invention will now be described, by way of example, and with reference to the accompanying drawings in which:

Figure 1 is an elevation showing the pump and driving motor

Figure 2 is a side view of the pump and motor shown in Figure 1

Figure 3 is a section through the pump on the line 3—3 in Figure 2.

Figure 4 is a part section on the line 4—4 in Figure 3

Figure 5 is a view similar to Figure 2 of a modified construction

Figure 6 is a view similar to Figure 1 but showing a further modified construction and

Figure 7 is a side view of part of the construction shown in Figure 6.

The pump shown in Figures 1–4 is intended for dispensing beer through one or more servicing points at which measuring devices are provided and is arranged to be driven by an electric motor. The pump 1 and motor 2 are constructed as a unit and when in the operative position the pump is mounted above the motor with the axis of the pump and motor shafts extending vertically as shown in Figures 1 and 2. There are two drip-trays 3 between the pump and the motor arranged to collect drips from the pump during cleaning and prevent them seeping into the motor. The pump casing consists of a casting 4 having a vertical passage 5 provided with suitable bearings 6, 7 for the pumpshaft 8 and a horizontal cylindrical passage 9 which constitute cylinders for the pistons 13. Attached to the pump casing at each end of the horizontal throughway 9 there are units 10 constituting the pump chambers and valve chests. The pump shaft 8 has an eccentric 11 at a position centrally in the bore of the horizontal passage 9 and there is a ball bearing 12 surrounding the eccentric.

The pistons 13 are positioned in the cylinders one to each side of the pump shaft and each piston has a follower 14 continuously engaging the periphery of the ball bearing 12 on the eccentric. Each piston is divided into two parts 13*a*, 13*b* in its length and the two inner parts 13*a* are connected together by screws 15 (Figure 4) to form a unit surrounding the pump shaft. Each inner 13*a* part has an upstanding periph-

eral flange 16 bearing against the cylinder wall and an upstanding central boss 17 within which the associated follower 14 is screwed. The follower has an enlarged head 18 of greater diameter than the boss 17. The portion 13b of each piston, herein referred to as the "piston body," is of annular form and of substantially channel cross-section, the mouth of the channel 19 facing towards the inner portion of the piston. One arm of the channel section, the outer arm 20 constitutes a cylindrical skirt bearing against the wall of the cylinder. The inner arm 21 surrounds and has a bearing on the upstanding central boss 17 of the inner portion of the piston. There are two compression springs 22, 23 extending between the two portions of the piston and retained within the outer flanged portions 16 and 20 thereof. These springs tend to separate the two portions of the piston and the movement of separation is limited by engagement of the enlarged head 18 of the follower with the piston body. A rubber buffer ring 18a is interposed between the head 18 and the piston body to reduce the shock of the re-engagement between these two parts when, as later described, the parts separate to reduce the effective stroke of the pump. Attached to each piston body there is a flexible diaphragm 25 the diaphragm being held in position by screws 26 passing through a piston head 27. The piston head 27 is in the form of a metal disc and there may be a sheet metal cover (not shown) sprung over the disc to prevent an accumulation of dirt in the screw heads, and to present a clean smooth surface for wiping. The outer periphery of each of the diaphragms 25 is clamped against the end of the pump casing by one of the pump chamber units 10 previously referred to.

Each pump chamber unit 10 is in two parts 10a, 10b. The part 10a is in the form of an annular ring with two radial extensions 30, 31 about 120° apart (Figure 1). The ring portion constitutes an extension of the cylinder of the pump and forms part of the pump chamber. This part of the unit is attached to the pump casing by clamping bolts 32 and nuts 33 which bolts are also employed, as later described, independently to secure the other part 10b of the unit. The ring portion serves to clamp the associated diaphragm 25 against the end of the pump cylinder. Each lateral extension 30, 31 has a machined passage 35 extending parallel to the axis of the pump cylinder and one of these passages fits over one end of the cross-piece 36 of a T-shape supply line 37 (Figure 1) common to both pump cylinders and the other passage fits over one end of the cross-piece 38 of a T-shape discharge pipe 39 common to the two cylinders (Figure 3).

The part 10b of the pump chamber unit constitutes the cylinder head and has similar inlet and outlet valve ports in the head, each port consisting of a ring of holes 40 machined in the head. On the outside of the head there is an upstanding hollow boss 41 machined internally, providing two separated cylindrical chambers 42, 43 coaxiel with the two rings of valve holes. The head has two radial extensions 44, 45 corresponding to the extensions 30, 31 on the ring 10a as described above and providing passage connecting the inlet and outlet valve ports with the supply and discharge pipes 37 and 39 through the chambers 42 and 43 respectively. The head is secured to the pump casing by means of the clamping bolts 32 described above which are extended to pass through the head and provided with finger nuts 46 on their outer ends. The head has a spigot 47 fitting into the ring portion of the other part 10a and a sealing ring 48 located between the two parts serves to prevent leakage of fluid from the joint. Sealing rings 49 are also provided around the cross-pieces of the inlet and discharge pipes where they pass through the aforesaid passage and these rings are clamped between recessed faces 50, 51 on the two parts of the unit, the faces being tapered to clamp the rings against the cross-pieces of the pipes. In this way, leakage of fluid along the outside of the pipes is prevented while at the same time a limited freedom of adjusting movement of the pipes during the erection of the apparatus is permitted.

The valves each consist of a flexible disc 55a, 55b of non-fabric synthetic material suitable for use with beer covering the ports 40 in the cylinder head and each disc is retained in position by a central bolt 56 passing through the head and secured by a lock nut. The bolt has an enlargement 57 of conical form which serves to limit the flexing movement of the valve disc 55. The inlet valve disc 55a is located on the inside of the head, and the outlet valve disc 55b is located on the outside of the head. For ease of manufacture the heads appropriate to the two cylinders of the pump may be made interchangeable and for this purpose, both sides of each of the valve ports may be machined to serve as valve seats. Access to the valves may be obtained through suitable apertures in the boss on the cylinder head, these apertures being closed in use by means of caps 58 which may be constructed of transparent material or include transparent windows.

In the construction described above, the inlet and outlet valves lie within the circumference of the cylinder heads and it will be appreciated that by removal of the heads ready access may be obtained to the valves, the faces of the pump diaphragms and to the cross-pieces of the inlet and discharge pipes for cleaning purposes.

In addition to the clamping bolts 32 described above for securing the two parts of the pump chamber unit together and for securing the parts to the pump casing, further clamping devices may be provided if considered necessary for securing the lateral extensions of the two parts together. These members may consist of bolts pivotally secured to the head and engaging in forked lugs provided on the other part at the ends of the extensions.

If desired, a connection may be made to the inlet side of the pump (e. g. at the intersection 60 of the cross-piece and upright portions of the inlet T-piece) for the purpose of facilitating the priming of the pump. The connection may be provided with a valve or cock and when it is desired to prime the pump, the cock is opened and connection made with a small supply of the fluid which is drawn into the inlet system of the pump and is found in practice to prime this part of the system. This arrangement may be used with or without a foot-valve.

A connection may also be made to the inlet side of the pump for the recovery of waste fluid. Thus when the pump is to be used for beer, any beer spilt at the dispensing head is collected and fed into the inlet of the pump through the aforesaid connection and is re-circulated.

As already stated the pump is mounted vertically upon an electric driving motor and it is driven by the motor operating through a reduction gear within the casing 65 provided by the motor end cap. If desired the pump may be di-

rectly coupled to the motor, i. e. without a reduction gear. With a view to standardising the castings required to enable the pump to be driven directly or at a reduced speed, as may be necessary to obtain the required pump out-put, the motor end cap is provided with a suitable boss for the reception of a spindle supporting a driven gear and the pump base is arranged for attachment to the motor end cover in either of two positions corresponding respectively to a direct drive and to an indirect drive through a gear supported on the boss aforesaid.

In the operation of the pump so long as beer is being delivered the two diaphragms complete their full stroke at each revolution of the pump shaft. When the delivery cock is closed and pressure built up in the delivery system the resistance to movement of the diaphragms causes the springs in the pistons to collapse reducing or eliminating the effective stroke of the diaphragms without causing undue strain upon the driving mechanism. The pump therefore has the advantage that it may be run continuously and is capable of maintaining a constant substantially non-pulsating pressure in the supply line so that beer may be withdrawn at any time and there is little or no agitation of the beer while the pump is idling. It is a further advantage of the pump that by reason of its robust construction and the provision of cylindrical pistons and co-operating cylinders it may be run continuously without attention. The pump may be incorporated in an existing beer delivery system if desired and the whole system may be sealed against ingress of air.

The pump may be arranged for remote control by an electric switch which may embody a pilot light and a thermal overload, and the pump may be situated at any convenient position from which it can supply several spaced delivery points.

The use of flexible pumping diaphragms and valves ensures that the pump will make the minimum of noise when running. In order further to reduce the noise, the pump and motor unit may be enclosed in a sound-proof box.

The materials used in the construction of the pump are chosen with regard to the particular fluid to be pumped, and the fluid chambers are machined internally throughout. The materials may, for example, be stainless steel, anodically treated aluminum or nickel plated brass.

Figure 5 of the drawings shows a modified arrangement of pump and motor unit in which two pumps **101** as described above are driven by a single motor **102**. Each pump is constructed as described above and the two pumps have independent suction pipes **37** and delivery pipes **39**. The pumps may therefore be employed to deliver different beers or they may be used independently to deliver the same beer. On the other hand, if desired in any particular installation, the two pumps may be connected to a common suction line or a common delivery line or both. The pumps are driven from the motor through reduction gearing. The motor shaft has a gear **103** which engages with gears **104** on the two pump shafts, respectively, all these gears being located in a casing **105**. The casing **105** is constituted in part by the motor end cover **106** and in part by a separate casting **107** having upstanding brackets **108** to which the pumps are attached.

Figures 6 and 7 show an alternative construction in which a single pump is employed. In this construction the pump has independent suction and delivery pipes **137** and **139** for the

two cylinders. The pump may therefore be employed to deliver two different beers, or by connecting the suction pipes to a common source both cylinders may be arranged to deliver the same beer. In order to reduce pulsation from the two independent cylinders air bottles **112** are provided in the delivery pipes adjacent to the pump outlets. These bottles are held by a clamp **113** common to the two bottles. The drip trays are omitted in this example and drain cocks **114** are provided in the pump outlets to enable the outlet pipes to be drained into a suitable receiver before the pump is dismantled for cleaning or other purposes. The six finger nuts **46** employed in the previous constructions are, in this example, replaced by three wing nuts **146**. It is however to be noted that six bolts **32** and **132** are employed to clamp the parts **10***a* and **10***b* together.

Figure 6 is partly broken away to show a flexible coupling between the pump shaft **8** and the driving spindle **120** of the gear **104**. This coupling comprises a flange **121** pinned to the shaft **8**, a flange **122** pinned to the spindle **120** and a flexible rubber driving member **123** bonded to the two flanges. If it should be desired to remove the pump (e. g. for repair or interchange) the upper pin **124** is knocked out enabling the shaft **8** to be withdrawn from the coupling.

If desired the construction shown in Figures 6 and 7 may be modified by the addition of a second pump in the manner shown in Figure 5. This second pump may be a duplicate of that shown and have independent suction and delivery pipes in which case the combined pump unit may be employed to pump four different types of beer. Alternatively the two pumps may each have suction and delivery connections common to the two cylinders in which case the air bottles may be omitted and the unit may be used to pump two different beers.

It is to be understood that the combined resistance to compression required of the springs **22** and **23** will vary according to the pressure at which the pump is required to operate. Conveniently, sets of interchangeable springs of different compression resistances are prepared for use in different pump installations.

As an alternative of the arrangements described in the above specific examples the motor and pump or pumps may be arranged horizontally. It is preferred to employ a standard synchronous motor for driving the pump.

We claim:

A diaphragm pump comprising a casing, two opposed pump chambers formed in said casing, automatic inlet and outlet valves in the two said chambers, suction and delivery means connected to the two said chambers through the said inlet and said outlet valves respectively, a piston divided in its length into three parts to comprise an inner part and two outer parts, a piston guide formed in said casing, each of the three parts of said piston being supported in and guided for reciprocation in said guide, an operating eccentric connected with and arranged on rotation to reciprocate the inner part of said piston, an enlarged head portion provided on each end of the said inner part of the piston and arranged to engage and move inwardly each of the outer parts thereof, respectively, on alternate strokes, spring means mounted between the inner part of the piston and the outer parts thereof, for moving the last named parts outwardly, respectively, on the intervening strokes of the said inner part, whereby the outer parts are moved inwardly solely by

the action of the said head portions and outwardly solely by the action of the said spring means, two flexible pump diaphragms each forming a part of the walls of one of the said pump chambers, and respectively connected with and arranged for reciprocatory pumping operation with the two said outer parts of the piston.

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GEORGE CHARLES MEREDEW.

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