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DESCRIPTION

Method and Apparatus for Transferring Fluid to a Container

The present invention relates a method and apparatus for transferring fluid to containers at a high pressure and has particular, but not exclusive, application to re-filling of aerosol canisters.

Aerosol canisters are well known and in very widespread use throughout the world. They have several advantages over similar storage and delivery systems, including ease of use and providing a continuous powerful spray that cannot be matched by other delivery systems of similar size. The latter feature is particularly important for products such as household insecticides, hairspray and so on.

However, aerosol canisters also have a number of disadvantages, not least in terms of consumer perception. Aerosol canisters are expensive to produce and this constitutes a high proportion of the total cost of providing a product with this delivery system. Aerosol canisters have also been attributed an environmentally unfriendly image due to the single use limitation amidst concerns about global waste production and the environmental consequences of waste incineration.

Re-fillable aerosol canisters have been proposed but they require complex apparatus to re-fill them. In order for a re-filling apparatus to be commercially viable the locations at which consumers may re-fill their canisters have to be convenient and widespread. The re-filling apparatus thus has to be provided at low cost and be operable by unskilled or only moderately skilled personnel.

It is an object of the present invention to ameliorate these disadvantages.

According to a first aspect of the present invention, there is provided an apparatus for transferring fluid to a container as set out in appended claim 1.

Known apparatus for filling such containers, for example aerosol canisters, is complex and expensive. These include metered filling systems typically comprising compressed air systems, high pressure lines, numerous valves, pressure regulators, bearings, seals, gaskets and so on. The precision required in the manufacture of such systems further adds to the cost. Once in operation, the systems require a high level of technical support and operation by skilled personnel.

The operating personnel have to program the known systems to fill aerosol canisters of a particular size, for example 200ml or 400ml. Were unskilled personnel to overlook such setting or make a mistake in the setting, the aerosol can being filled could burst with potentially disastrous consequences. Furthermore, were known systems used to re-fill aerosol canisters there is an added danger that the canister might not be empty when presented for re-filling. Even if the size of the canister to be filled were correctly programmed into the system, the risk of the canister bursting persists.

The fluid transferring apparatus in accordance with the present invention is self regulating with regard to pressure. Accordingly, not only is expensive metering equipment eliminated (making the apparatus simpler and cheaper to provide) but there is no danger of the apparatus being used to over-fill a container, even in the hands of unskilled personnel. As a consequence it is even possible for the consumer themselves to re-fill their own aerosol canisters.

The re-filling of the container may be attractively priced in comparison with the cost of disposable canisters and the cost of the container is effectively spread over the number of times that the container is emptied and re-filled. The consumer, therefore, may obtain the product more cheaply in the longer term.

The invention further provides a method of transferring fluid to a container as set out in appended claim 18.

Further preferred features of the present invention are set out in numbers 2 to 16 and 19 to 21 of the appended claims.

While described with reference to aerosol systems, the present invention is equally applicable to containers for pressurised gas.

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a main portion of a liquid filling apparatus in accordance with the present invention,

Figure 2 shows a main portion of a compressed gas filling apparatus in accordance with the present invention,

Figure 3 shows an enlarged view of one type of filling head provided on the apparatus in accordance with the present invention,

Figures 4(a) and 4(b) show the filling head of figure 3 in a state of connection to a container to be re-filled and a state of disconnection from a container respectively,

Figure 5 shows an enlarged view of a second type of filling head provided on the apparatus in accordance with the present invention,

Figures 6(a) and 6(b) show the filling head of figure 5 in a state of connection to a container to be re-filled and a state of disconnection from a container respectively,

Figure 7 shows an alternative embodiment of a re-filling apparatus in accordance with the invention which has a higher capacity for liquid or gas to be dispensed, and

Figure 8 shows an alternative apparatus in accordance with the invention.

In the figures the same reference numerals are used to identify corresponding features.

The apparatus shown in figure 1 comprises a reservoir or tank 12 containing a body of liquid 17. A fitting 7 is screwed onto the reservoir and a gasket 10 is provided between the two to ensure a gas-tight seal. Compressed air or other gas is fed to the interior of the container via an inlet pipe 9 and a valve 8. Also provided in the path of the inlet is

valve 11 which is a pressure release valve for manual intervention: i.e. to adjust, lower or "fine-tune" the internal pressure of the reservoir when the operator deems necessary. It will most commonly be used to manually release (completely) the internal compressed air/gas pressure of the pressurized container 12. After this is done, fitting 2 can then be safely opened to allow the liquid product to be filled into the reservoir or tank 12.

The source of the compressed gas is shown as a nitrogen cylinder 52 whose output is regulated to a desired pressure by a regulator 50. It is important to note that a pressure regulator 50 is responsible for regulating in-coming pressure to the reservoir, especially where the source of gas pressure is substantially higher than required pressure for tank 12. For example, the source of pressure may be one or more compressed nitrogen gas cylinders 52 but other gases such as nitrous oxide could be used. The typical pressure within a fully-charged standard nitrogen cylinder would be in excess of 3000 p.s.i. Therefore the pressure regulator 50 is provided to step-down the incoming pressure. Alternatively, the pressure can be generated by an air compressor at typically around 150 p.s.i. A built-in regulator would normally be already part of the air compressor (without built-in electric pump which would be automatically turned on once the pressure within the air receiver of the air compressor falls below a predetermined level). Such an arrangement is shown in Figure 2 describing a gas transferring apparatus but could be used here, as could a compressed gas cylinder in that embodiment.

The pressure within the container is measured and indicated by a manometer 1 and a critical pressure relief valve 3 is also provided for automatically relieving excess pressure from within the reservoir should the pressure encroach on the safe upper limit of the disclosed system. (Such excessively high pressure can foreseeably arise from any one of a number of reasons ranging from failure of the pressure regulator to human error). Should the pressure within the reservoir 12 exceed a safety limit, the valve 3 will open to release the pressure. The manometer 1 and the valve 3 are mounted on a lid or fitting 2 which is screwed to the fitting 7 by a screw-thread 6. The Manometer 1 and valve 3 are shown mounted on fitting 2 but may be fitted at any location on the

pressurized tank 12 so long as the opening to the manometer and valve occurs somewhere above the intended maximum level for the liquid product. O-ring seals 5 and 10 ensure that the connection between the fitting 2, the fitting 7 and the reservoir 12 are gas-tight and a handle 4 facilitates opening of the fitting or lid 2 for re-filling the reservoir and also provides a convenient means for carrying the apparatus.

The fitting 2 basically serves as a lid or cover to allow access into the reservoir/tank for refilling purposes. While our disclosed design for fitting 2 is that of a screw-on lid, other embodiments could include variations in mechanical locking systems for the containment of gas/compressed air. The criteria for the choice in any mechanical pressure locking system for the lid or cover should be based on reliability, practicality, (for repeated opening and closing) and safety. For example, should the lid/cover be accidentally opened while under pressure, safety is enhanced if the lid/cover is not violently forced out by pressure which could potentially injure the operator or bystanders.

The compressed air or gas 15 supplied to the interior of the reservoir exerts a force on the surface of the liquid 17 which is urged upwards through a tube 16. The tube 16 is connected to a valve 13 which is in turn connected to a tube 14 and to a filling head 20. The valve 13 is for preventing the outward flow of liquid product out of the reservoir or tank. The valve could be closed for any one of the following reasons: (a) the tube 14 or filling head 20 is leaking, (b) during transportation or (c) the filling head 20 is being changed for another type of filling head to fill an aerosol (empty) canister using a different type of valve (refer, for example, to Figures 5 and 6). The filling head may be hand-held (as shown) or may be mounted to the re-filling apparatus and will be described in greater detail below.

The operation of the re-filling apparatus is as follows. When a container such as an aerosol canister (not shown in Figure 1) is connected to the filling head 20 a pressure differential will exist between the canister (substantially at atmospheric pressure for a fully used aerosol canister) and the contents of the tank 12. There will consequently be

a flow of liquid 17 along the pipes 16 and 14 into the container. The pipe 16 is arranged with its inlet close to the bottom of the tank 12 so that liquid will still be forced along the pipe 16 by the pressure of the gas 15 when the tank is nearly empty. When the pressure of the liquid in the container equals that of the liquid in the tank 12, the container will be full and the re-filling procedure is complete. Due to inefficiencies in the transfer system, the pressure in the tank 12 will usually be slightly higher than that in the container being filled. Consequently, these two pressures are regarded as equal when no further significant flow of liquid occurs. The operator removes the container from the filling head and the apparatus is ready for re-use.

The apparatus may be incorporated into a vending machine for re-filling to be performed by the consumer themselves. The machine may be arranged to open valve 13 (figure 1) for a predetermined period of time in response to a consumer inserting money or tokens into the machine. The operator then removes the aerosol canister from the apparatus when the period of time has expired. A sight glass could be included in the pipe 14 containing a small turbine. The operator can see the turbine rotating when fluid is flowing and when the re-filling is complete the turbine will come to rest and the canister can be removed.

A typical tank or reservoir 12 will have a capacity of between 5kg and 30kg according to the requirements of the re-filling station. If the capacity of a dispensing container is 400g, the smallest reservoir will fill at least 12 dispensing containers. When the tank is empty or nearly so, it may be re-filled in situ or exchanged for a full tank depending on circumstances. The time at which this is required can conveniently be indicated by a liquid level indicator provided on or attached to the tank. Alternatively the tank can be weighed to determine the quantity of its contents.

The pressure required to be supplied via the pipe 9 by the compressor or the like will vary according to the pressure desired in the aerosol container but will typically be 120 to 140 pounds per square inch (p.s.i.) for an air or nitrogen-propelled canister. This pressure can be supplied and regulated using a variety of known techniques without

departing from the scope of the present invention. One way of preventing dishonest vendors from reducing this pressure to supply less product to the customer is to use fixed (non-adjustable) pressure regulators to set the pressure supplied by the compressed-gas cylinders (or air compressor and so on). Alternatively, a tamper-proof seal can be affixed to the pressure settings where a variable pressure regulator is provided. In addition, or as a further alternative, the customer themselves may weigh the re-filled aerosol canister after the re-filling/transferring process is complete. The correct weight could be marked on the canister itself, or, for example, marked on a chart provided on, or in the vicinity of, the re-filling apparatus.

Figure 2 shows a re-filling apparatus for compressed air or gas product. The features of the apparatus are identical with those shown in figure 1 and their description will not be repeated except for the source of gas. In this embodiment an air compressor with built-in pressure regulator is provided instead of a gas cylinder and pressure regulator. The pipe 16 need not be arranged at the bottom of the tank 12 in this embodiment since the compressed air or gas will naturally flow out of the tank along this pipe. The arrangement shown in Figure 2 is used for re-charging the propellant gas an aerosol canister. The re-charging of the propellant gas may be carried out either before or after the filling of the aerosol canister with liquid product. If carried out before the filling with liquid product, it is important to arrange that the pressure of gas in the reservoir 12 is lower than that in the liquid-containing reservoir 12 (Figure 1). This is to ensure that there will be sufficient pressure in the liquid-containing reservoir to force sufficient liquid into the aerosol canister. If the gas re-charging step is to be carried out after the filling with liquid product, then the pressure in the reservoir 12 (Figure 2) must be higher than that in the liquid-containing reservoir 12 (Figure 1). This is to ensure that sufficient propellant gas can be forced into the aerosol canister. The propellant gas is preferably an ozone-friendly gas such as compressed air or nitrogen although other propellant gases may be used.

The embodiment of the invention shown in Figure 2 provides a significant safety enhancement over prior art arrangements for re-charging propellant gas. Were an

unskilled operative to fill aerosol canisters with propellant gas directly from compressed gas cylinders, there is a significant risk of the aerosol canisters bursting during filling. Industrial compressed gas cylinders are typically pressurized to around 3000 p.s.i. Some not inconsiderable skill is required to ensure that the propellant gas is provided to the aerosol canister at the correct pressure of around 120 to 140 p.s.i. In particular, it is difficult for the unskilled operative to accurately measure the required pressure on a pressure gauge (or manometer) capable of reading up to 3000 p.s.i. By providing a separate reservoir at substantially the required pressure, the present invention significantly reduces these risks. In addition, the optional pressure release valve 3 provides an additional safety feature should the pressure in the reservoir 12 exceed a safe level.

Figure 3 shows one embodiment of the filling head 20 in greater detail. It should be appreciated that the construction of the filling head is determined by a requirement to couple to the container to be filled and the present invention is in no way restricted to a particular type or particular types of filling head. For example a male filling head may be provided for a canister having a female nozzle and vice versa. A first part 24 of the head 20 shown in Figure 3 is provided with a connection to a pipe 14 and the product may travel along a channel 22 within the part 24. The part 24 conveniently comprises a cylinder which may comfortably be held in the operator's hand. The part 24 is connected to a valve assembly 26 such that a channel 34 within the assembly 26 communicates with the channel 22. The channel 34 contains a piston 32 which is connected to a gas-tight coupler 28 via a hollow shaft 30. The hollow shaft 30 moves together with the piston 32 relative to the valve assembly. A seal 36 is provided between these two parts to prevent the escape of product. The operation of the filling head will be described with reference to figure 4.

Figure 4(a) shows a portion of the filling head 20 in the case where the valve is open to allow product to exit from the head. The gas-tight coupler 28 has been pushed towards the valve assembly 26 because the filling head has been pushed down onto an aerosol canister, shown in part at 38. This allows product to flow from the channel 34 around

the piston 32 into the hollow shaft 30 to pass from the filling head to the canister 38. This flow occurs while there is a pressure difference between the product in the tank 12 (figure 1) and that in the canister. The flow is indicated by small arrows on the figure.

Figure 4(b) shows a portion of the filling head after removal from an aerosol canister. The pressure within the channel 34 which results from the pressure in the tank 12 (figure 1) urges the piston 32 in the downwards direction as shown in the figure. A lower face of the piston abuts a part of the valve assembly and prevents the flow of any product. The filling head thus provided is simple to construct and reliable in operation. However, other arrangements may be used within a re-filling apparatus according to the invention.

Figure 5 shows a filling head 20 for use with an alternative container whose valve is offset from the centre of the filling head when fitted. This arrangement is particularly suited to filling containers with compressed gas. The head is identical to that shown in figure 3 with the exception that the coupler 28 now comprises a two-part coupler 28a, 28b. A product channel 29 includes a bend, for example a pair of right angled bends, within the portion 28a of the coupler. The threaded portion of the coupler part 28a is only an artifact of a particular construction method. The bend places the channel 29 off-centre at the point of connection between the parts 28a and 28b. The part 28b is arranged to co-operate with the container to be re-filled (Figure 6(a)) and the product passes into the container in an analogous manner to that described above. Other filling heads may be provided as appropriate to the container to be filled. They may be interchanged after closing the valve 13 (Figure 1) to isolate the filling head from the reservoir.

Figure 6(a) shows the filling head of figure 5 in the state it would occupy when pressed against a container to be filled. In the same manner as the head shown in figure 3, product may flow around the piston 32 and out of the head into an aerosol canister 38b. The aerosol canister 38b has a valve arrangement 39 for charging of the canister (indicated by an arrow). After removal of the head 20 from the canister, the valve 39 is

sealed closed by the internal pressure in the canister. Figure 6(b) shows the filling head in the unattached state where flow of the product is inhibited. The flow is inhibited in an analogous manner to that shown in Figure 4(b).

In order to provide a filling apparatus having a greater capacity for product without affecting the portability thereof, a number of re-filling apparatuses may be connected together as shown in figure 7. A source of compressed gas (not shown) is provided via inlet 9 as previously described to a first re-filling apparatus 40. The outlet of the apparatus 40 is connected to the compressed gas inlet of another apparatus 42 and the output of the apparatus 42 is connected to the compressed gas inlet of a further apparatus 44. The outlet of the apparatus 44 is connected to the filling head 20 as previously described. In operation, fluid product which flows from the reservoir of apparatus 44 to a container is replaced by fluid from the reservoir of apparatus 42 which is, in turn, replaced by fluid from the reservoir of apparatus 40. Once the reservoir of apparatus 40 is empty or nearly so, the compressed gas supplied via the pipe 9 is applied direct to the fluid in the reservoir of apparatus 42 and filling of the container may still be carried out. Once the reservoir of apparatus 42 is empty or nearly so, the gas pressure applied directly to the reservoir of apparatus 44 via the apparatus 40 and the apparatus 42 to allow filling of a container to occur. Using this cascaded arrangement, the apparatus has three times the capacity of a single apparatus without any increase in the size or weight of any individual element. Arrangements comprising two cascaded apparatuses or more than three are also possible.

A larger number of filling heads may be provided to a single (figure 1) or cascaded (figure 7) re-filling apparatus to permit two or more aerosol canisters to be filled simultaneously. These may conveniently be mounted to a frame to allow them to be applied by one operator to a plurality of aerosol canisters.

Figure 8 shows a variation on the arrangement shown in Figure 1 in which the filling head 20' is attached directly to the base of the reservoir 12 for dispensing liquid 17. The operation of the apparatus is as described with reference to Figures 1, except that the

filling head 20' need not be held by an operator. The same modification is, of course, applicable to the embodiment shown in Figure 2.

While the present invention has been described with reference to certain embodiments, the scope of the invention is to be defined only by the appended claims.

CLAIMS

CLAIMS:

1. Apparatus for transferring fluid to dispensing containers, the apparatus comprising a reservoir for containing a quantity of fluid sufficient to fill a plurality of dispensing containers;
means for maintaining the reservoir at a predetermined pressure greater than atmospheric pressure; and
means for temporarily connecting the reservoir to a dispensing container which means introduces substantially no pressure variation between the reservoir and the dispensing container.
2. Apparatus as claimed in Claim 1, wherein the reservoir has a capacity for containing a quantity of fluid sufficient to fill at least 12 dispensing containers.
3. Apparatus as claimed in Claim 1 or Claim 2, wherein the means for maintaining the reservoir at a predetermined pressure is arranged to maintain the predetermined pressure continuously.
4. Apparatus as claimed in Claim 1, Claim 2 or Claim 3, further comprising a critical pressure relief valve for releasing excess pressure from the reservoir in response to a pressure within the reservoir exceeding a predetermined threshold.
5. Apparatus as claimed in any one of the Claims 1, 2, 3 or 4, wherein the means for temporarily connecting the reservoir to a dispensing container comprises a filling head for engaging a fluid outlet of the dispensing container.
6. Apparatus as claimed in any one of the Claims 1, 2, 3, 4 or 5, wherein the means for temporarily connecting the reservoir to a dispensing container comprises a plurality of inter-changeable filling heads.



7. Apparatus as claimed in Claim 6, further comprising means for isolating the reservoir from the means for temporarily connecting the reservoir to a dispensing container.
8. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6 or 7, further comprising means for transferring a propellant gas to a dispensing container, the means for transferring a propellant gas comprising a source of propellant gas and a further reservoir for storing the propellant gas at a pressure greater than atmospheric pressure.
9. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7 or 8, further comprising means for indicating the pressure within the reservoir.
10. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7, 8 or 9, wherein the means for temporarily connecting the reservoir to a dispensing container are coupled to the reservoir at a lower surface thereof.
11. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, further comprising means for indicating substantially equal pressure between the reservoir and a dispensing container connected to the apparatus.
12. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11, further comprising means for measuring a quantity of fluid transferred to a dispensing container.
13. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12, further comprising means for releasing pressure in the reservoir for replacing or refilling the reservoir.
14. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 or 13, further comprising at least one further reservoir connected between the first-



mentioned reservoir and the means for temporarily connecting the reservoir to a dispensing container.

15. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 or 14, wherein the means for maintaining the reservoir at a predetermined pressure comprises pressure reducing means for connection between the reservoir and a compressed gas cylinder.

16. Apparatus as claimed in any one of the Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 or 14, wherein the means for maintaining the reservoir at a predetermined pressure comprises an air compressor and pressure-regulating means.

17. Apparatus as claimed in any one of the claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 or 16, comprising a plurality of means for temporarily connecting the reservoir to a dispensing container.

18. A method of transferring fluid to a dispensing container, the method comprising maintaining at a predetermined pressure greater than atmospheric pressure a reservoir for containing a quantity of fluid sufficient to fill a plurality of dispensing containers, and connecting the reservoir to a dispensing container without substantial pressure variation until flow of fluid between the reservoir and the dispensing container has substantially ceased.

19. A method of transferring fluid as claimed in Claim 18, the method further comprising gas-transference before the fluid transference, the gas transference comprising maintaining at a predetermined pressure greater than atmospheric pressure and lower than the predetermined pressure in the reservoir for containing fluid a further reservoir for containing a quantity of gas sufficient to charge a plurality of dispensing containers, and connecting the further reservoir to a dispensing container without substantial pressure variation until flow of gas between the further reservoir and the dispensing container has substantially ceased.



20. A method of transferring fluid as claimed in Claim 18, the method further comprising gas transference after the fluid transference, the gas transference comprising maintaining at a predetermined pressure greater than the predetermined pressure in the reservoir for containing fluid a further reservoir for containing a quantity of gas sufficient to charge a plurality of dispensing containers, and connecting the further reservoir to a dispensing container without substantial pressure variation until flow of gas between the further reservoir and the dispensing container has substantially ceased.

21. A method of transferring fluid to a dispensing container as claimed in any one of the Claims 18, 19 or 20, further comprising weighing the dispensing container after transferring fluid to ensure that the dispensing container contains a sufficient amount of fluid.