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(54) PISTON AND CYLINDER DEVICE

(71) We, JOHN POULTEN LIMITED, a British Company, of 77/93, Tanner Street, Barking, Essex, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a piston and cylinder device for filling and emptying containers such, for example, as pipettes.

Piston and cylinder devices for filling and emptying pipettes have already been proposed in which the piston is moved by means of a rack and pinion device to draw liquid into the pipette, the liquid being discharged by rotating the pinion in the opposite direction to that employed when filling the pipette.

The disadvantage of such devices is that the size of the device is altered during charging and discharging of the pipette, thus making one-handed operation of the device extremely difficult.

It is an object of the present invention to overcome or at least mitigate the above disadvantage.

The present invention provides a device for filling and emptying containers, comprising a cylinder, an opening in the cylinder for communication with a container, a piston movable in the cylinder, a first piston rod member attached to the piston, a second piston rod member in threaded engagement with the first piston rod member and arranged for manual rotation relative thereto and for manual axial movement relative to the cylinder, and stop means limiting movement of the second piston rod member relative to the cylinder in a direction away from the piston to a fixed position independent of the relative positions of the first and second piston rod members.

The first piston rod member is advantageously provided with guide means co-operating with a guide plate which is arranged to close one end of the cylinder to

prevent rotation of the first piston rod member relative to the cylinder. The other end of the cylinder is provided with an opening which is adapted for fluid-tight engagement with one end of the container.

A cover may be attached to the cylinder with the guide plate interposed between the cover and the cylinder, an actuator member which is secured to the second piston rod member projecting through an opening in the end of the cover remote from the cylinder. The piston is preferably resiliently biased for example by means of a helical spring into a rest position, in which a flange on the second piston rod member is in contact with the cover.

An aperture may be provided in the cylinder adjacent to the opening for engagement with said one end of the container by means of which the cylinder may be opened to the atmosphere during use of the device.

Preferably, the opening in the cylinder for fluid-tight engagement with said one end of the container is provided with resilient sealing means.

In order that the present invention be more readily understood embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings in which:—

Figure 1 is a side elevation, partly in section and partly broken away, of a piston and cylinder device;

Figure 2a is a sectional side view of a sealing member for use with the device of Fig. 1;

Figure 2b is an underneath view of the sealing member of Fig. 2a;

Figure 3 is a side view of a modified form of piston and cylinder device;

Figure 4a is a sectional side view of a modified form of sealing member for use with the device of Fig. 1 or Fig. 3;

Figure 4b is an underneath plan view of the sealing member of Fig. 4a, and

Figure 5 is a perspective view of part of the device of Fig. 3.

As shown in Fig. 1, a piston and cylinder device comprises a cylindrical body 1 which is connected to a generally cylindrical cover 2 by a threaded collar 3.

5 A piston 5 of an elastomeric substance, which is mounted on a support flange (not shown), is slidably received in the cylinder and is secured to a first piston rod member 6 which is generally cylindrical but which has two radially extending fins 8 which are disposed diametrically opposite one another. The piston rod member 6 projects through an aperture in a guide plate 9 interposed between, and maintained in position by, the body 1 and the cover 2. The shape of the aperture in the guide plate 9 corresponds to the cross-sectional shape of the piston rod member 6 so that the member 6 is constrained to move axially without being able to rotate about the axis of the body 1.

20 An axially extending threaded bore 11 is provided in the free end of the piston rod and receives a correspondingly externally threaded rod 12 which is attached to an actuator member in the form of a knurled control knob 13 which is provided at its lower end with a stop flange 14. The knob 13 projects through a hole in the top of the cover 2 and the flange 14, which is larger in diameter than the hole, is urged against the inner surface of the cover 2 by a helical spring 16 disposed between the guide plate 9 and the flange 14.

35 The body 1 is provided at its lower end with an orifice 20 which is normally closed by a screw threaded cap 32 and with an opening 21 by means of which the piston chamber is in communication with one end of a pipette or other graduated tube 31, which is shown in dotted lines in Fig. 1. The opening 21 is defined by a tubular extension 22, the free end of which is formed with an external screw thread for engagement with a collet 23 which together with elastomeric sealing member 24 seals the piston chamber 1 to the pipette.

45 The sealing member 24 is tubular and comprises a section 25, which is arranged to be received within the tubular extension 22, an annular shoulder 26 which is adapted to rest against the end of the tubular extension 22, and a further tubular section 28 of greater external diameter than the section 25 and which is arranged to be received in a frusto-conical portion 30 of the collet 23.

60 As will be seen from Fig. 2b, the section 28 is elliptically shaped externally and has a bore which is circular in cross-section such that the walls of the section 28 have two relatively thin portions which constrain the section 28 to form a pair of lips for receiving the end of the pipette when the collet 23 is screwed onto the extension 22.

65 An alternative but generally similar form

of elastomeric sealing member 24 is shown in Figs. 4a and 4b wherein the section 28 is cylindrical externally and has three relatively thin portions 29 to form three or more lips when the collet 23 is screwed on to the extension 22. The internal bore of the sealing device 24 is tapered to receive pipette ends of for example from 4 mm to 8.7 mm diameter.

In one method of use, the tubular end 31 of a pipette is pressed into the sealing member 24, and the collet 23 is tightened by rotating it relative to the body 1 so that the lips of the sealing member sealingly grip the end 31 of the pipette. The tip of the pipette is then dipped into a liquid to be drawn up into the pipette. The control knob 13 is then rotated to screw the rod 12 into the piston rod 6. Since the knob 13 is urged against the cover 2 by the spring 16, the piston 5 is moved upwardly to draw liquid into the pipette. Once the desired amount of liquid has been collected it can be discharged by depressing the knob 13 against the action of the spring 16 to discharge the liquid quickly when the pipette is of the 'fast flow' type. Alternatively, the knob 13 can be rotated in the opposite direction to that previously mentioned so as gradually to push the piston downwards. This allows the pipette/piston and cylinder combination to be used in the manner of a burette for titrations, i.e. where the liquid is discharged one drop at a time. By arranging for a suitable number of screw threads on the rod 12 and the piston rod member 6 it is easy to dispense accurately only one drop of liquid at a time.

Yet another method of discharging the liquid from the pipette is by partially unscrewing the cap 32 over the orifice 20 to allow air at atmospheric pressure to enter the cylinder so that the liquid in the pipette can flow freely out. This feature allows the device to be used with those pipettes which are calibrated on the basis that the liquid will not be forced out under pressure.

An alternative form of device for discharging liquid from the pipette comprises a spring clip 33 which has a pair of jaws 37 which snap onto the extension 22, a pair of lugs 36 on the extension 22 maintaining the clip against the under surface of the body 1. The clip 33 has a cap portion 35 which engages over the orifice 20 and seals the orifice, and an extension 34 adapted to be pressed downwardly by the operator to deform the clip and move the cap out of engagement with the orifice 20 so as to allow air into the piston chamber. The clip is preferably made from a hard, resilient plastics material such as nylon. The sealing surface of the cap 36 is preferably lined with a soft elastic material such as rubber.

It will be appreciated that if the pipette is filled by first depressing the knob 13, 130

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then dipping the pipette into the liquid to be sampled and subsequently releasing the knob so that the piston returns to its rest position under the action of the spring, then if the pipette is subsequently discharged by depressing the knob 13 or by opening the orifice 20 to atmosphere (as distinct from rotating the knob 13), the volume of liquid drawn into the pipette will remain approximately constant for each suction stroke of the piston 5. This means that a number of equal individual volumes of liquid can be drawn up into and discharged from the pipette quickly and accurately, and that only fine adjustment of the volume of liquid by rotating the knob 13 is required.

Since the uppermost position of the knob 13 is limited by the stop flange 14 it will be obvious that the height of the device is limited and hence the device can be designed so that it can be used one-handed with ease.

The device is preferably made from any suitable plastics or other material which can be sterilised by heating.

WHAT WE CLAIM IS:—

1. A device for filling and emptying containers, comprising a cylinder, an opening in the cylinder for communication with a container, a piston movable in the cylinder, a first piston rod member attached to the piston, a second piston rod member in threaded engagement with the first piston rod member and arranged for manual rotation relative thereto and for manual axial movement relative to the cylinder, and stop means limiting movement of the second piston rod member relative to the cylinder in a direction away from the piston to a fixed position independent of the relative positions of the first and second piston rod members.

2. A device according to any preceding claim, wherein the first piston rod member is provided with guide means cooperating with a guide plate fixed to and closing one end of the cylinder thereby to prevent rotation of the first piston rod member relative to the cylinder.

3. A device according to claim 2, wherein a cover is attached to the cylinder with the guide plate interposed between the cover and the cylinder, an actuator member which is secured to the second piston rod member projecting through an opening in the end of the cover remote from the cylinder.

4. A device according to claim 3, where-

in the piston is resiliently biased into a rest position, in which a flange on the second piston rod member is in contact with the cover, the flange and the portion of the cover contacted by the flange constituting said stop means.

5. A device according to any preceding claim, wherein the cylinder is formed with an aperture by means of which the cylinder can be opened to atmosphere and comprising means for closing the aperture.

6. A device according to any preceding claim, including means for sealing the end of a pipette to said opening, said means comprising a tubular elastomeric member adapted to embrace the end of the pipette and having a sealing part formed with at least two circumferentially spaced relatively thick wall portions which are separated by relatively thin wall portions, and means for deforming the sealing part into sealing engagement with the pipette.

7. A device according to claim 6, wherein the opening is the bore of a tubular extension on the end of the cylinder and the means for deforming the sealing part of the tubular elastomeric member is a housing in screw-threaded engagement with the extension so as to surround the sealing part, the housing being formed with a conical bore which bears against the sealing part and causes inwards deformation thereof when the housing is screwed onto the extension.

8. A device according to claim 5, wherein the means for closing the aperture comprises a cap seated over the aperture and resiliently biased into contact with the aperture by a spring member mounted on the cylinder, and an operating portion rigid with the cap and which can be engaged by an operator to urge the cap away from the aperture.

9. A device substantially as hereinbefore described with reference to, and as illustrated in, Figs. 1, 2a and 2b, or Figs. 1, 4a and 4b, or Figs. 2a, 2b, 3 and 5, or Figs. 3, 4a, 4b and 5 of the accompanying drawings.

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then dipping the pipette into the liquid to be sampled and subsequently releasing the knob so that the piston returns to its rest position under the action of the spring, then if the pipette is subsequently discharged by depressing the knob 13 or by opening the orifice 20 to atmosphere (as distinct from rotating the knob 13), the volume of liquid drawn into the pipette will remain approximately constant for each suction stroke of the piston 5. This means that a number of equal individual volumes of liquid can be drawn up into and discharged from the pipette quickly and accurately, and that only fine adjustment of the volume of liquid by rotating the knob 13 is required.

Since the uppermost position of the knob 13 is limited by the stop flange 14 it will be obvious that the height of the device is limited and hence the device can be designed so that it can be used one-handed with ease. The device is preferably made from any suitable plastics or other material which can be sterilised by heating.

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in the piston is resiliently biased into a rest position, in which a flange on the second piston rod member is in contact with the cover, the flange and the portion of the cover contacted by the flange constituting said stop means.

5. A device according to any preceding claim, wherein the cylinder is formed with an aperture by means of which the cylinder can be opened to atmosphere and comprising means for closing the aperture.

6. A device according to any preceding claim, including means for sealing the end of a pipette to said opening, said means comprising a tubular elastomeric member adapted to embrace the end of the pipette and having a sealing part formed with at least two circumferentially spaced relatively thick wall portions which are separated by relatively thin wall portions, and means for deforming the sealing part into sealing engagement with the pipette.

7. A device according to claim 6, wherein the opening is the bore of a tubular extension on the end of the cylinder and the means for deforming the sealing part of the tubular elastomeric member is a housing in screw-threaded engagement with the extension so as to surround the sealing part, the housing being formed with a conical bore which bears against the sealing part and causes inwards deformation thereof when the housing is screwed onto the extension.

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