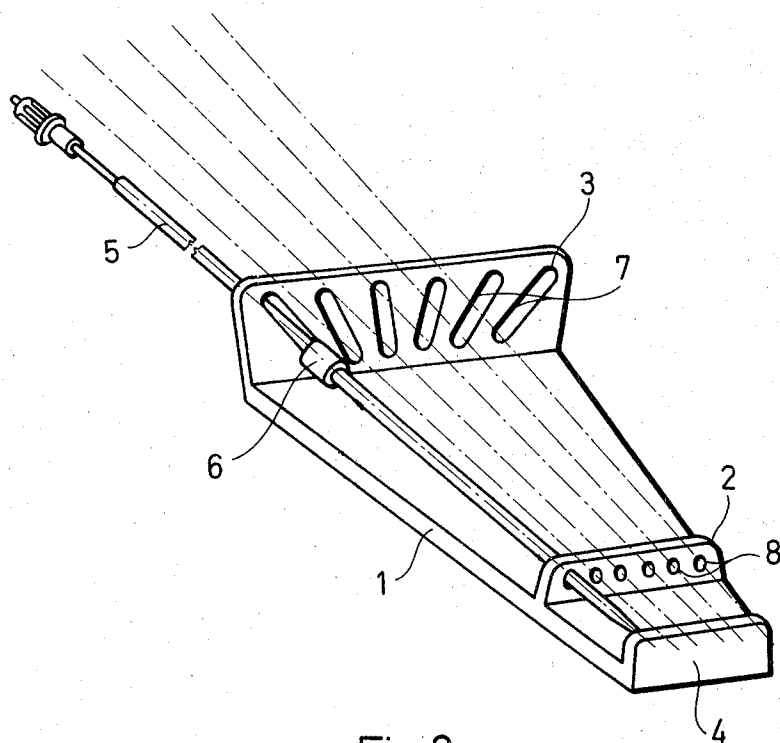
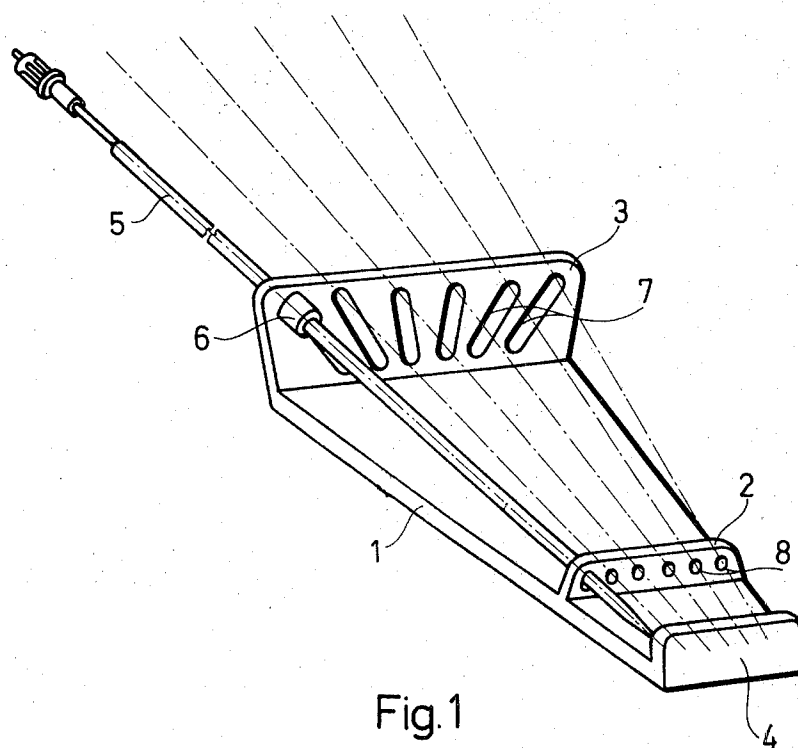


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DEVICE FOR USE WITH A LIQUID TRANSFER
APPLIANCE IN CHEMICAL ANALYSIS
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**DEVICE FOR USE WITH A LIQUID TRANSFER
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43,202/73****Int. Cl. G01n 1/12****U.S. Cl. 23—259****5 Claims****ABSTRACT OF THE DISCLOSURE**

A device for facilitating the titration of liquids with the aid of capillary cage-type liquid transfer appliances, comprises a base plate with three unequally spaced up-standing flanges. The middle flange has bores for the capillary cage stems. The flange nearer the middle flange is an abutment for the stem ends. The third flange has slots diverging from the base plate. Thus the middle flange serves as a pivot for the stems, and the slots guide the pivoting of the stems so that the transverse stem spacing may be increased for charging the cages with liquid and decreased when the cages are rotated for mixing.

This invention relates to device for use with a liquid transfer appliance in chemical analysis.

Several analytical methods are known in laboratory use for quantitative determination of chemical components in liquids, these methods comprising preparation of a series of dilutions and determination of the highest dilution degree still showing a visible reaction with some other reagent e.g. decolouration, formation of a precipitate, etc.

The quantity i.e. concentration of the component in the starting solution is then calculated from this limit of possible dilution. This method—called titration—is used mainly for quantitative determination of chemicals for which no more exact analytical method is known.

From British Pats. Nos. 984,284 and 1,135,847 liquid transfer appliances in the form of capillary cages have become known which enable the carrying out of a so-called micro-titration process wherein a small, predetermined quantity of a complex liquid chemical substance is analysed by preparing dilutions to determine the concentration of a given component.

This process has become widespread in use for the reason that it is simple, very quick, requires very small quantities of the substance being analysed and of the reagents and the results are accurate and reproducible. The process is carried out by using these capillary cages both during the mixing and the dilution.

The process is carried out by using a plastics sheet or plate, called hereinafter the dilution plate, which has rows of depressions therein, arranged in a predetermined array, usually six depressions in each row. The diluent is fed to the depressions in predetermined quantities by means of drip tube or pipette. Then, six capillary cages are simultaneously dipped into and filled with the substance to be analysed, and then simultaneously placed in the first row of the series of depressions and rotated. In this way the substance is mixed with the diluent, or in other words, is diluted to a known value. Thereafter all six cages are lifted out from the first row of depressions and are transferred to the second row, rotated, transferred to the third row and so on. Following this a suitable reagent is introduced into each depression and the results of the analysis are given by a change of colour or precipitation in the relevant depression.

For a long time the operations involving six or more capillary cages simultaneously were done manually which

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required great manual dexterity. This is because the cages had to be placed individually into the depressions at each change of row without permitting the cages to come into contact with anything so as to prevent loss of liquid or contamination. It should also be mentioned that the cages are easily damageable and damage would cause the cage to take up a quantity of liquid other than the predetermined one and so the analysis would give an incorrect result.

The mixing and the dilution in the depressions are carried out by rotation involving twirling movements.

Devices have been marketed for rotating the so-called short-stemmed cages. Their principle of operation is that the cages are fixed in cartridges arranged in a row at a spacing appropriate to the spacing of the depressions of the dilution plate and by holding the device in one hand the cages are rotated by the fingers *via* a transmission involving a rack-and-pinion or gears.

These devices have, however, the following disadvantages. Compared with the tasks for which they are destined, their construction is complex and the devices thus involve the whole unit of cages, and such devices become expensive. Furthermore owing to the rigid mounting of the cartridges the smallest deformation of the cage stems would cause the cages to "strike," i.e. malfunction. For these reasons the known cage rotating devices and the short-stemmed cages have been slow in finding widespread acceptance, as a consequence of which at present one cannot remove liquid satisfactorily in micro-analysing processes from the bottom of a test tube.

It represents a further problem with the known devices that due to the rigid mounting the rotating device must be held in such a way that the cages are perpendicular to the dilution plate. If this is not so, certain ones of the cages may rise up and give imperfect mixing or even no mixing at all. The removal of the liquids from a vessel highlights a further shortcoming of the above-mentioned cages rotating devices. This is because the capillary cages fixed in the rotating devices at a spacing appropriate to the spacing of the depressions in the dilution plate (generally 9 to 10 mm.) are very close to each other and frequently cannot be used at all because the average laboratory vessel cannot be introduced between the cages. As a consequence, during the removal of the liquid the cages must first be lifted out, then put back again and this process not only increases the operational time but may also endanger the sterility of the process.

Thus, it can be stated that although the micro-titration process using capillary cages is widely used, its further spread is fundamentally hindered by the dependence on manual dexterity in carrying out the operations with them and this is inconsistent with the general aim of eliminating subjectivity in laboratory work.

It is an aim of the invention to provide a simple and inexpensive device which facilitates and greatly simplifies the manual rotation of the cages, renders the process performable by anybody and obviates the defects of the hitherto known cage-rotating devices. A further aim of the invention is to permit the heads of the cages to be kept at a mutual spacing appropriate to the spacing of the bores in the dilution plate.

A further aim of the invention is to provide a device which does not unconditionally require that the cages should be held rigidly during mixing, so that the cages are easily insertable into the depressions and removed therefrom, and which can serve as a stand for the cages when they are not in use.

According to the invention, there is provided a device for supporting and controlling the rotary movements of liquid transfer appliances for use in chemical analysis, each said appliance being of the type having an elongated

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stem carrying a capillary cage for holding a predetermined quantity of the liquid, the device comprising a support body for simultaneously supporting a plurality of said stems, a first member on said body for engaging the ends of the stems remote from the capillary cages, a second member on said body for providing a fulcrum-like support for each stem at a predetermined spacing of the stems transversely of their lengths, whereby the stems are permitted to move pivotally about the supports, and a third member on said body, the second member being nearer to the first member than to the third member, and means provided on the third member to guide, in use, the pivotal movement of the stems such that the transverse spacing of the stems in the region of the third member may be varied.

Preferably, the support body is a base plate, each said member is a flange secured perpendicularly thereto, there being a plurality of bores in the second flange for pivotally supporting the stems, a plurality of slots is formed in the third member so as to diverge in a fan-like manner outwardly from the base plate to constitute the means for guiding the pivotal movement of the stems, the distribution of the slots being equal to or greater than the distribution of the bores.

The invention is described, by way of example only, with reference to the accompanying drawing, wherein:

FIG. 1 shows in perspective, the capillary rotating cage device according to the invention, in its state ready for receiving liquid, and

FIG. 2 shows, in perspective, the device in the state when it is ready to be twirled.

For the sake of the simplicity only one capillary cage is shown in the drawing.

The illustrated exemplary embodiment of the device is a one-piece, unitary member made e.g. by injection moulding from a plastics material. The device has a substantially trapezoidal base plate 1 with three upstanding ribs or flanges 1, 2 and 3, described below. When introducing the cages into the device they are first passed through a plurality, e.g. six slots 7 in an upstanding guiding flange 3 at the wider end of the base plate 1. The flange 3 is perpendicular to the base plate 1 and the slots are arranged in a fan-like manner, i.e. they radiate or diverge from the base plate 1. Abutment rings 6, made expediently from a resilient plastics material, are threaded on the cage stems 5. The end of each cage stem 5 (the left-hand end, as viewed) carries a capillary cage as described e.g. in British Pat. No. 1,135,847 or U.S. Pat. No. 3,466,153. The cage stems 5 are pushed all the way to an abutment flange 4 via a plurality of bores 8 through a supporting flange 2. The flanges 2, 3 and 4 are substantially parallel, and flange 2 is nearer to flange 4 than to flange 3. The number of bores 8 is the same as that of the slots 7, of course but the minimum spacing of the slots 7 is greater than, or equal to, that of the bores 8. The abutment rings 6 are displaceable along the cage stems but nevertheless provide sufficient friction to prevent the cages from slipping out.

The bores 8 on the supporting flange 2 are so formed that when the cages are depressed at their ends they can rise up fully in the slots 7 and can tilt about the bores 8 in the manner of a two-armed lever.

When being charged with liquid to be investigated it is necessary for the cage heads to become more separated from each other. To this end, the operator, i.e. the laboratory technician supports the cage rotating device on the palm of his hand and at the same time pushes the cage stems in the region between the supporting flange 2 and the abutment flange 4, whereby the cages rise up in a fan-like manner in the slots 7 formed in the guiding flange 3

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and separate from each other. In this way a test tube can be introduced between the cage heads and liquid can be introduced into each cage.

Thereafter the technician transfers his fingers to the region of the cage stems between the supporting flange 2 and the guiding flange 3 whereupon the cage heads return to the original mutual spacing determined by the bores of the dilution plate and the rotation of the cage heads may be commenced. The rotation is carried out by the technician performing alternating rubbing movements at right angles to the axis of the cage stems as a consequence of which the cages turn e.g. three or four times in one angular direction and then in the other angular direction. During rotation the cage heads lie against the bottoms of the bores in the dilution plate while the ends of the cage stems are supported on the abutment flange 4.

The rings 6 are so located that the cage stems have a few millimeters of longitudinal play. This ensures that the cage heads do not rise up from the bottom of the bores even when the device is tilted. When the device is not in use it can serve as a cage support by being laid on its back.

We claim as our invention:

1. A device for supporting and controlling the rotary movements of liquid transfer appliances for use in chemical analysis, each said appliance being of the type having an elongated stem carrying a capillary cage for holding a predetermined quantity of the liquid, the device comprising a support body for simultaneously supporting a plurality of said stems, a first member on said body for engaging the ends of the stems remote from the capillary cages, a second member on said body for providing a fulcrum-like support for each stem at a predetermined spacing of the stems transversely of their lengths, whereby the stems are permitted to move pivotally about the supports, and a third member on said body, the second member being nearer to the first member than to the third member, and means provided on the third member to guide, in use, the pivotal movement of the stems such that the transverse spacing of the stems in the region of the third member may be varied.

2. A device according to claim 1 wherein the support body is a base plate, each said member is a flange secured perpendicularly thereof, there being a plurality of bores in the second flange for pivotally supporting the stems, a plurality of slots is formed in the third member so as to diverge in a fan-like manner outwardly from the base plate to constitute the means for guiding the pivotal movement of the stems, the distribution of the slots being equal to or greater than the distribution of the bores.

3. A device according to claim 2 wherein the flanges are mutually parallel.

4. A device according to claim 1 wherein the device is a one-piece unitary member.

5. A device according to claim 1 wherein abutment rings are associated with the device for arrangement on the stems of the cages.

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