March 27, 1928. 1,664,127

K. S. MILLS

APPARATUS FOR INTERMITTENTLY INTRODUCING SUBSTANCES INTO SOLUTIONS AND WITHDRAWING THEM THEREFROM AND FOR ANALOGOUS PURPOSES

Filed Sept. 24, 1926 2 Sheets-Sheet 1

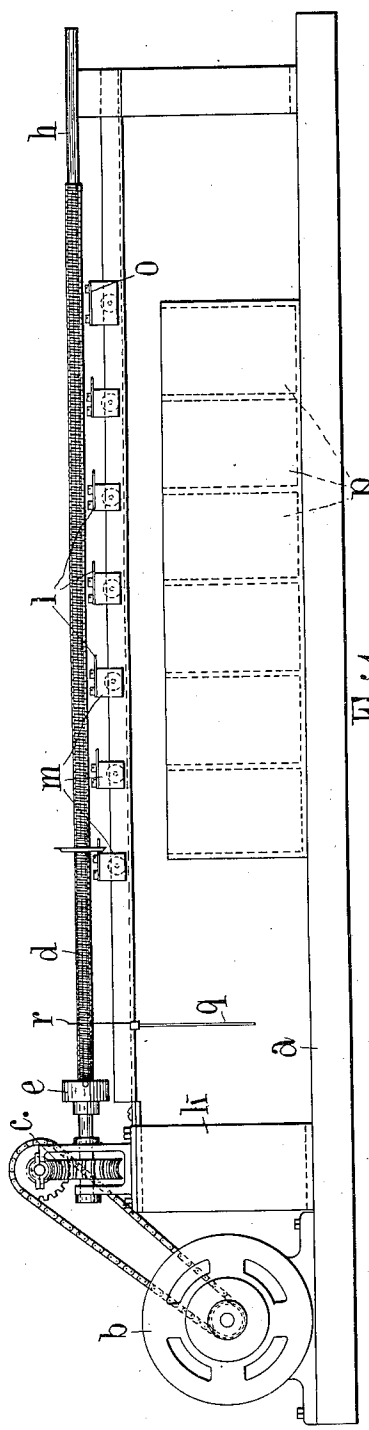


Fig. 1.

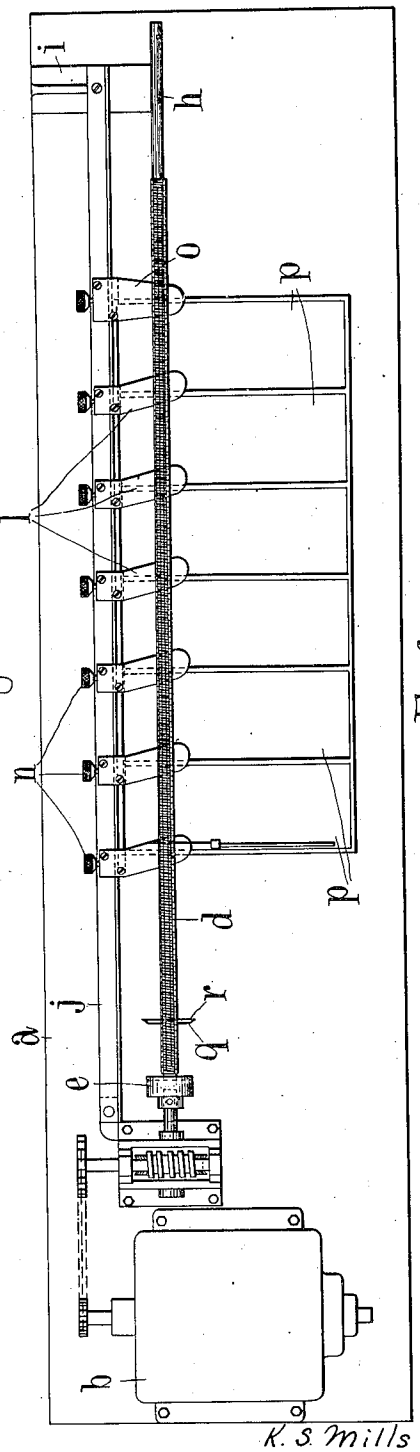


Fig. 2.

K. S. Mills
inventor
By: Marks & Clark
Attys.

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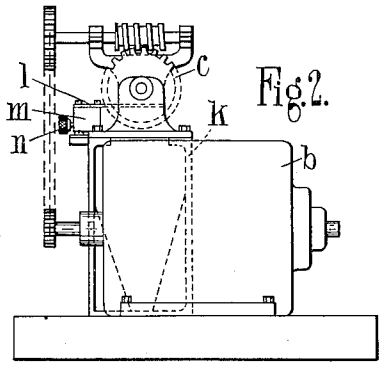


Fig. 2.

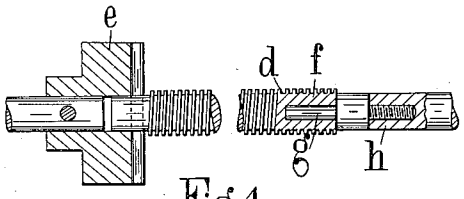


Fig. 4.

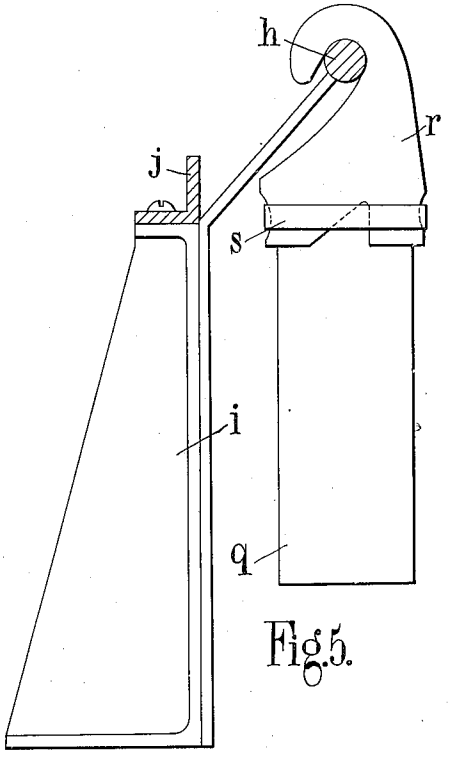


Fig. 5.

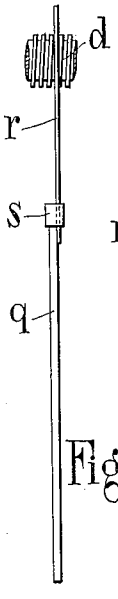


Fig. 6.

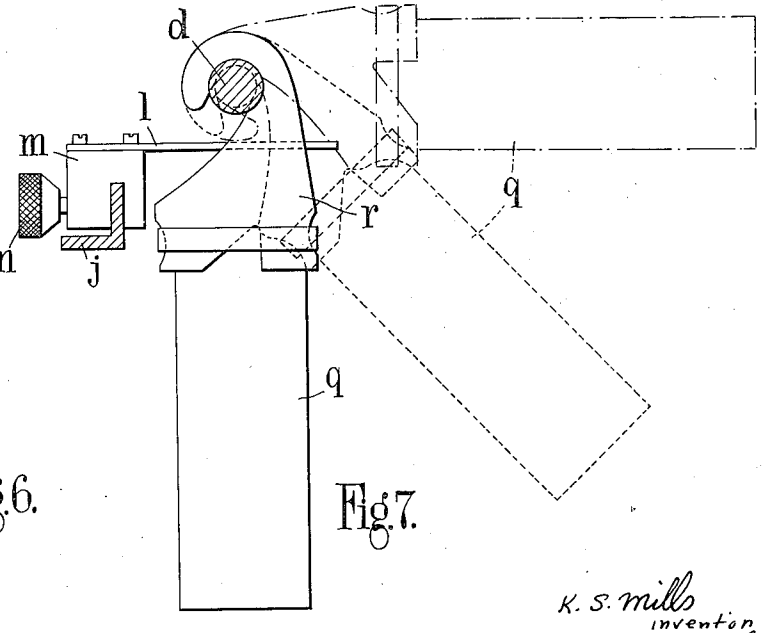


Fig. 7.

K. S. Mills
Inventor
By: Marks & Clerk
Attys.

Patented Mar. 27, 1928. 1,664,127

UNITED STATES PATENT OFFICE.

KEITH SINCLAIR MILLS, OF BEACONSFIELD, ENGLAND.

APPARATUS FOR INTERMITTENTLY INTRODUCING SUBSTANCES INTO SOLUTIONS AND WITHDRAWING THEM THEREFROM AND FOR ANALOGOUS PURPOSES.

Application filed September 24, 1926, Serial No. 137,604, and in Great Britain September 24, 1925.

This invention relates to the introduction of solid substances into a number of solutions in order and particularly to such examples of this general class as the introduction of microscope slides into staining solutions or the introduction of photographic plates into developing and other solutions.

In making experiments on the staining of bacteria on microscope slides I have found first that a considerable amount of time is taken in routine work, such as the staining of a slide, washing after staining, submission to a second colouring solution, further washing, treatment with appropriate agents and the like.

Further I have found that irregular results sometimes arise which are thought to be due to certain causes whereas often they can be traced to irregularities of the time of immersion in the staining and like solutions which must necessarily occur with the usual process of hand manipulation so that there is a possibility of obtaining misleading results in matters which may be of importance although they are frequently of necessity routine matters.

Further by the hand process a considerable amount of stain is wasted owing to the excess used beyond actual staining requirements.

The object of the present invention is mainly to provide an apparatus enabling the staining of microscope slides to be carried into effect without the disadvantages referred to above but the invention is not limited to the use of this apparatus for that particular purpose.

The invention in brief consists in a rotating carrier on which may be mounted slides or the like to be stained or otherwise treated, these slides or the like being so moved on the rotation of the carrier as to be immersed in turn into a series of suitable receptacles containing stains or the like and to be lifted therefrom, for example by ramps, lift plates or inclined surfaces.

The invention also consists in an apparatus comprising a rotatable screwed rod in proximity to a fixed bar or the like, the former adapted to carry a series of slides or the like and to cause them to travel along the length of the rod and the latter carrying ramps, lift plates or inclined surfaces for lifting the slides from time to time so that they can be immersed into and withdrawn from a series of tanks disposed below the slide-carrying rod.

Referring to the accompanying drawings, which illustrate a slide-staining machine according to one form of the present invention:—

Figure 1 is a front elevation,

Figure 2 an end elevation, viewed from the left of Figure 1, and

Figure 3 is a plan view.

Figure 4 is a detail drawn to an enlarged scale, showing the bearings of a screwed rod which acts as the slide carrier.

Figure 5 is a sectional elevation, taken through the line 5—5 of Figure 3, looking in the direction of the arrows, a slide in its carrier being illustrated, and this view being drawn to an enlarged scale.

Figure 6 is an elevation taken at right angles to Figure 5, and showing a slide carrier and slide-carrying screwed rod drawn to the same scale as Figure 5.

Figure 7 is a section on the line 6—6 of Figure 3, looking in the direction of the arrows, and showing in full, dotted and chain lines respectively slides in different positions, which they may take as they move along the slide-carrying rod and are lifted by the ramps or lift plates.

In the form illustrated by way of example, on a base *a* there is mounted an electric motor *b* and speed reduction mechanism *c* for driving a threaded metal rod *d* which acts as a carrier for microscope slides or the like.

The rod *d* is connected with the speed reduction mechanism *c* in any suitable way, for example by a chuck *e*.

At the other end of the rod *d* there is a concentric steel bushed hole *f* into which there enters a brass pin *g*, screwed into a cylindrical rod *h* of external diameter equal to the depth of the bottom of the threads of the rod *d*.

This rod *h* is suitably attached to a support *i* secured to the base *a*, the supporting arrangement being such that a slide carrier when on the rod *h* may be moved along the same without interference by the support.

A nickel bar *j* runs parallel to the threaded rod *d*, and is supported at one end of a support *k* on which the reduction gear *c* is mounted and at the other end by the support *i* referred to above.

To this rod there are attached at intervals ramps, lift plates or inclined surfaces, as

shown more particularly in Figures 3 and 7. These comprise a plate *l*, a block *m* slotted to fit over the bar *j*, and a fixing screw *n*.

The plates *l* are suitably shaped to permit the necessary lifting and release of slide carriers, referred to below, to be effected, the end plate of the last member of the series denoted by *o* being shaped somewhat differently from the remainder.

Beneath the threaded rod *d* there are placed a number of removable glass or like troughs or tanks *p* suitably located.

For the immersion of microscope slides into these tanks, slides *q* are carried in light brass plates or stampings *r* to which they are attached by rubber bands *s*, the stampings being suitably shaped to ride in the thread of the rod *d* and subsequently on the rod *h*.

In operation, the troughs or tanks *p* are filled to an appropriate height with the solutions or stains or the like to be used.

The rod *d* is rotated at a constant speed by the electric motor *b*.

Films of bacteria or the like being fixed on the microscope slides *q* in the usual manner, the slides are attached to their respective carrier plates *r* and the latter hung on the threaded rod *d* at a position in advance of the first trough, the opening or part by which the slide carrier is placed on the screwed rod *d* pointing away from the rod.

The slide *q* hangs from this carrier *r* in a vertical position beneath the rod *d* and the rotation of the rod *d* imparts a horizontal motion thereto in a direction from left to right of the apparatus shown.

When a carrier approaches the first ramp the foremost edge of the plate *l* of the ramp, which is suitably shaped for that purpose, co-operates with the edge of the carrier *r* and as the rotation of the rod *d* is continued the carrier *r* and slide attached thereto are forced upwards through an appropriate angle, for example an angle of 90°, thus clearing the edge of the trough *p*, as indicated in Figure 7.

The carrier *r* and slide *q* continue to move forward as permitted by the ramp or lift plate *l* until, owing to the shape of the lift plate *l*, the carrier is permitted to drop back to the vertical position, which it does preferably rapidly, that is to say, the shape of the far edge of the lift plate *l* is such as to permit this.

On reaching the end of the trough *p* the carrier *r* is acted on by the next lift plate of the series. The process continues until the last lift plate *o* is reached, when a similar action takes place with the exception that this lift plate is so shaped as to permit the carrier and slide to return to the vertical position gently, thus preventing any violent swinging of the carrier on the screwed rod.

This motion in the case of the earlier lift plates of the series is permissible, owing to the damping action of the fluid in the trough.

On leaving the last lift plate *o* the carrier *r* moves forward clear of the troughs, until it reaches the smooth rod *h* and remains there until required.

As each successive carrier reaches the plain rod *h* it forces the carriers already on this rod farther away from the screwed rod *d* so that an accumulation of carriers takes place at this end of the apparatus and these can be removed at leisure.

A machine of the character described is very convenient for carrying out, for example, Jensen's modification of Gram's stain, the solutions in the troughs being as follows:—

Methyl violet 6B. .5 per cent in distilled water.

Triple strength Gram's iodine.

Filtered commercial methylated spirit.

Running water for washing slides.

Neutral red, ½ gram to 500 c. c. distilled water.

Running water for washing slides.

The speed of the electric motor may be adjusted by a sliding resistance so that the carriers move horizontally at a rate of 4 inches per minute, this speed conveniently enabling the correct immersion time of ½-minute in each bath to be given.

Any staining process of this nature may be carried out by means of this machine, the only necessary alterations being the speed of the electric motor, different sets of troughs and suitable ramps or lift plates for such troughs.

The apparatus may be applied to processes other than straining processes, for example the development of photographic plates and matters associated therewith and in this connection it is to be noted that reference to the staining of slides or like references in the specification or claims are to be construed broadly to include all similar or analogous processes unless the context clearly requires the contrary construction.

The form of the invention described is given by way of example only and modifications may be made as desired.

In place of the slide carrier described in detail, other forms may be used, for instance, a carrier consisting of three parts, namely a sheet brass stamping to which is loosely riveted a small brass stamping so as to allow movement between the two stampings, these two with the assistance of a small spring forming the grip for an ordinary microscope slide.

The slide is attached to or removed from the carrier by the pressure of the fingers which causes jaws to move apart against the action of the spring.

The apparatus may be contained in a suitable casing which may have an easily re-

movable inspection cover to facilitate oiling the matter and reduction gear.

In place of the nickel bar shown for supporting the lift plates *m* a square metal rod or the like may be used.

If desired, a small nick may be formed in the lift plates for the purpose of slightly shaking the slide after removal from the trough with a view to dislodge adhering drops of liquid.

It is preferred in operation that a space of about ½ inch should be left between slide carriers when placed on the rod *d*, before their progress along the length of troughs.

As different stains require different times of immersion the times given in the specification above are by way of example only. In some cases the time required for immersion in different baths of the same series of operations is different, for which reason the baths may be made of different length.

In place of an electric motor a spring motor or any other form of constant speed motor may be employed.

In cases where the invention is applied to the development, fixing, washing and like operations of photographic plates, special carriers may be used, particularly from the aspect of taking plates of different sizes, which is found useful, for instance, in connection with X-ray work.

The carrier in this case may be made to hold the plates across one of the diagonals and one of the supports may be adjustable in position to accommodate different plates as indicated.

Such carriers may be made of celluloid or of any other material unaffected by the solutions which come into question.

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

1. Apparatus for intermittently introducing articles into solutions and withdrawing them therefrom including a rotatable screw-threaded element extending along the length of the apparatus, a stationary element extending along the length of the apparatus and disposed substantially parallel to the aforesaid screw-threaded element and a plurality of lifting pieces carried by said stationary element.

2. Apparatus for intermittently introducing articles into solutions and withdrawing them therefrom including a rotatable screw-threaded rod extending along the length of the apparatus, a stationary bar disposed substantially parallel to the aforesaid screw-threaded rod and a plurality of lifting pieces carried by said stationary bar.

3. Apparatus for intermittently introducing articles into solutions and withdrawing them therefrom including a screw-threaded rod extending along the length of the apparatus, means for rotating said screw-threaded rod, a stationary rod disposed substantially parallel to the aforesaid screw-threaded rod and a plurality of lift plates carried by said stationary rod.

4. Apparatus for intermittently introducing articles into solutions and withdrawing them therefrom including a screw-threaded rod extending along the length of the apparatus, means for rotating said screw-threaded rod at a constant speed, a stationary bar disposed substantially parallel to the aforesaid screw-threaded rod, a plurality of lift plates and means for affixing them to said stationary bar in any desired position.

5. Apparatus for intermittently introducing microscope slides into solutions and withdrawing them therefrom including a rotatable screw-threaded rod extending along the length of the apparatus, the screw thread being cut deeper than a standard thread, a plurality of microscope slide carriers on said screw-threaded rod, a stationary support disposed substantially parallel to the aforesaid screw-threaded rod and a plurality of lifting pieces carried by said stationary support.

6. Apparatus comprising a screw-threaded rod, a bar parallel thereto, means for rotating said screw-threaded rod, inclined planes detachably mounted on said bar pendant fittings for said screw-threaded rod adapted to contact with said inclined planes and a series of vessels disposed beneath said pendant fittings.

7. Apparatus as claimed in claim 1 in which there is provided at the end of the screw-threaded rod a non-rotating part which is uncovered and of diameter substantially equal to the diameter of the rod at the bottom of the threads.

8. Apparatus as claimed in claim 1 in which a substantial length of threaded rod is provided in front of the first lifting piece.

9. Apparatus as claimed in claim 1 in which the screw-threaded rod is supported only at the ends that is, is unsupported at the middle.

10. A method for intermittently introducing substances into solutions and withdrawing them therefrom which comprises traversing the aforesaid substances in a predetermined direction and intermittently causing them also to travel in a direction substantially at right angles to the previous direction whilst maintaining motion in the previous direction.

In testimony whereof I have signed my name to this specification.

KEITH SINCLAIR MILLS.