A sequential processing apparatus, particularly for use in pathology especially histology, comprises support means for supporting at least one row of baths above another row and mechanism for stepping said rows of baths in opposite directions. A transfer device at one end of the rows of baths transfers baths, one at a time, from the upper row to the lower row and a transfer device at the other end of the rows transfers baths, one at a time, from the lower row to the upper row. A specimen or slide carrier is positioned so as to be above the path of movement of at least one of the rows of baths, mechanism being provided for lowering and raising said carrier so as to immerse a specimen or slide in or withdraw it from a bath. In one preferred embodiment of the invention there are two side-by-side groups of baths, each group comprising upper and lower rows of baths and the specimen or slide carrier is moved periodically across the apparatus from a position over a row of baths of one group to a position over a row of baths of the other group.

11 Claims, 6 Drawing Figures
SEQUENTIAL PROCESSING APPARATUS

This invention is for improvements in or relating to sequential processing apparatus.

One particular use of the invention, which is mentioned by way of description of the technology especially histology, where it is required to immerse a specimen of animal tissue sequentially, for predetermined periods, in a series of baths containing various reagents or stains.

One object of the invention is to provide an apparatus which, whilst it is relatively compact, includes a relatively large number of baths as compared with apparatus as available heretofore of comparable size.

A further object of the invention is to provide an apparatus which, without materially increasing its bulk, provides for the rinsing of specimens between their transfer from one bath to another. This is important where it is necessary to avoid the carry-over of reagent of stains from one bath to another.

According to the present invention there is provided a sequential processing apparatus comprising a support means for supporting superimposed rows of baths or the like, a mechanism for moving said superimposed rows of baths in opposite directions, a transfer device at one end of the support means for transferring a bath from the upper row to the lower row, a transfer device at the other end of the support means for transferring a bath from the lower row to the upper row and a carrier for a specimen or the like positioned so as to lie above the path of movement of at least one of the rows of baths and mechanism for lowering and raising said specimen carrier so as to immerse or withdraw a specimen from a bath.

According to a further feature of the invention there is provided a sequential processing apparatus comprising means for supporting two side-by-side groups of baths or the like, each group comprising two superimposed rows of baths, mechanism for moving the superimposed rows of baths in opposite directions, a transfer device at one end of the support means for transferring baths from the upper rows to the lower rows, a transfer device at the other end of the support means for transferring baths from the lower rows to the upper rows, a carrier for a specimen or the like positioned so as to lie above the path of movement of the upper and/or lower rows of baths, mechanism for lowering and raising said specimen carrier so as to immerse a specimen in or withdraw it from a bath and mechanism for moving the specimen carrier laterally to transfer a specimen from a bath of one group to a bath of the other.

In preferred embodiments of the invention at least one additional bath is positioned between the above mentioned groups of baths and is arranged in relation to the laterally moving transfer mechanism, so that between being transferred from a bath of one group to a bath of the other, a specimen may be drained into or immersed in this additional bath and, for example, rinsed with running water.

One particular embodiment of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings which illustrate an application of the invention to a processing machine for use in histology. On the drawings:

FIG. 1 is a perspective view of the machine,
FIG. 2 is a diagram showing the manner of movement of the bath carrying pallets of the machine, and the movement of the specimen carrier,
FIG. 3 is a perspective view showing a chain of pallets for one group of baths of the machine and part of the mechanism for moving said pallets, the other group of baths used in the machine having an identical arrangement of pallets,
FIG. 4 is a perspective view of the pallet moving and raising and lowering mechanism,
FIG. 5 shows an arrangement for stirring the contents of a bath and
FIG. 6 shows an arrangement for raising and lowering the specimen carrier.

Briefly the machine comprises support means, in the form of boxes 10 and 11 for two groups of baths, each group comprising upper and lower rows 12 and 13 and 14 and 15 of baths respectively, a transfer platform 16 at one end of the support means 10, 11 for lowering baths from the upper rows 12 and 13 to the lower rows, 14 and 15, a similar transfer platform 17 at the other end of the support means 10, 11 for raising baths from the lower rows to the upper rows and a specimen carrier casing 18 which is adapted to be raised and lowered and embodies means for moving slides or other specimens from a bath in the upper row 12 to a bath in the upper row 13 and vice versa. The support 10 also carries a single intermediate bath 19 which is supplied with running water.

The baths of each group are moved through the machine on pallets 20, the pallets for one group 12, 14 or 13, 15 being shown in FIG. 6. These pallets are linked together to form parallel pairs of upper and lower chains by means of couplings 21 which permit pallets, as they reach an end of the machine, to be readily detached from the chains so that they can be raised or lowered and reconnected in the chains of pallets.

Movement of the pallets 20 for the baths 12 and 13, through the machine is effected by paws 22 and 23 respectively (see FIG. 4) which are reciprocated by screws 24. The paws 22 and 23 when making a driving stroke engage in holes 25 in the pallets and disengage automatically from these holes when they make their return or idle stroke. This mechanism is housed in the box 18.

The pallets 20 for the baths 14 and 15 are cycled around the machine, the same way as the pallets for the baths 12 and 13, by means of paws 26 and 27 which are oppositely acting with respect to the paws 22 and 23 and are reciprocated by screw devices 28. This mechanism is housed in the box 11.

Lowering and raising of the transfer platforms 16 and 17 to lower and raise the pairs of pallets at opposite ends of the machine, and thereby the baths thereon, is effected by screw and nut mechanism 29 and 30, (see FIG. 4) which move the support devices 16 and 17 respectively up and down between the superimposed rows of pallets.

The screws 24 and 28 for reciprocating the paw devices 22, 23, 26 and 27, which drive the pallets, are driven by an electric motor 31 through the gearings as shown in FIG. 4.

The screw mechanism 29, 30 for raising and lowering the pallets are driven from an electric motor 32 also through gearings as shown in FIG. 4.

Mounted in the specimen carrier casing 18 (see FIG. 5), so as to be raised and lowered therewith, is a specimen or slide carrier 33 adapted to be traversed across the baths of the upper rows 12 and 13 which happen to occupy a position in line with the bath 19 as indicated at 12a and 13a in FIG. 1. This slide or specimen carrier is moved from left to right in a direction right to left along a slide bar or guide by an electric motor 34 which drives a chain 35 having an actuating toothed wheel 36 which works in a slot in a pivoted arm 37 attached to the slidably supported rack or slide carrier 33.

The raising and lowering of the casing 18 is effected by a pinion 38 driven by a motor 39 both of which are mounted on the casing 18. The pinion 38 meshes with a fixed rack 40. The weight of the casing 18 is taken by a constant tension spring device 41.

As shown in FIGS. 1 and 6 it may be assumed that a bath of slides or specimens, in the carrier 33, is immersed in the bath 12a. After immersion in said bath for a predetermined time, the batch is raised out of the bath 12a and, by means of the lateral traversing mechanism 35, is moved to a position over the rinsing bath 19 and allowed to drain or is lowered therein.

After an appropriate period for rinsing the slides are again raised and, after a dwell period for draining if required, moved to a position over the bath 13a and immersed therein. After the required period of immersion in the bath 13a the slides are again raised and the pallets are moved, as indicated in FIG. 2, so that the baths 12b and 13b now occupy a position under the slide carrier casing 18, the rinsing bath 19 remaining stationary. The slides are then lowered into the bath 13b and, after a predetermined period of immersion therein are transferred to the rinsing bath 19 and then to the bath 13b. This cycle of operations continues throughout the period of operation of
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the machine, a pair of baths being periodically lowered, on the platform 16, at one end of the machine, a pair of baths raised, on the platform 17, at the other end, the upper rows of baths moved forwardly and the lower rows rearwardly and the slide carrier being moved step-by-step in alternate directions, across the three baths under it, for periods of immersion and draining or rinsing of the specimens or slides.

It will be understood that the platform 16 and 17 go up and down together, the platform 16 coming up empty and the platform 17 going down empty.

The movements of the baths and the movements of the slide or specimen carrier for predetermined periods of immersion and draining and/or rinsing of the slides in the baths is controlled by known programmer devices 42 and timing devices 43 incorporated in the apparatus as shown in FIG. 4, the electric timing devices being accommodated between the groups of baths 12, 14 and 13, 15. The programmer is of the kind in which a program is selected by appropriate insertion of plugs of pins in holes in a programmer disc.

Preferably devices 44 are provided for stirring the stains or reagents in the baths during the time that the slides or specimens are immersed therein. These rotary stirrers (see FIGS. 5 and 6) may be driven by a motor 45 (see FIG. 4), the stirring being coupled magnetically to magnetic coupling devices 46 driven by said motor.

The mode of operation of the machine above described may be modified so that the slides or specimens are immersed progressively in a series of the baths 12 and are then moved across the machine and immersed progressively in a series of the baths 13 and vice versa.

Modification may, of course, be made in the particular embodiment of the invention described above, by way of example, with reference to the drawings.

For instance, instead of engaging in holes in the pallets the paws 22, 23 and 26, 27 may project between neighboring pallets, so as to engage the ends thereof. Furthermore, instead of raising and lowering the platforms 16 and 17 by screw and nut mechanism said platforms may be raised and lowered by a rack-and-pinion mechanism similar to that above described with reference to FIG. 6 of the drawings.

Reciprocation of the paws 22, 23 and 26, 27 may be effected through a crank and lever mechanism instead of by means of screw devices as shown in FIG. 4.

Linear ball or roller slide devices may be provided where one part of the apparatus is required to move relatively to and on another part.

Separate stirring devices 44, with separate motors, may be provided for stirring the contents of the baths 12a and 13a respectively, thus avoiding the transfer of the stirring device from one bath to another.

We claim:

1. A sequential processing apparatus comprising a support means for supporting at least one row of baths and a mechanism for moving baths or the like above another row, a mechanism for moving baths or the like of one row and baths or the like of the other row in opposite directions, a transfer device at one end of the support means for transferring a bath from the upper row to the lower row, a transfer device at the other end of the support means for transferring a bath from the lower row to the upper row and a carrier for a specimen, slide or the like positioned so as to lie above the path of movement of at least one of the rows of baths and mechanism for lowering and raising said carrier so as to immerse a specimen, slide or the like, or withdraw it from, a bath.

2. A sequential processing apparatus comprising means for supporting two side-by-side groups of baths or the like, each group comprising two superimposed rows of baths, mechanism for moving the superimposed rows of baths in opposite direction, a transfer device at one end of the support means for transferring baths from the upper rows to the lower rows, a transfer device at the other end of the support means for transferring baths from the lower rows to the upper rows, a carrier for a specimen, slide or the like positioned so as to lie above the path of movement of the upper and/or lower rows of baths, mechanism for lowering and raising said carrier so as to immerse a specimen, slide or the like in or withdraw it from a bath and mechanism for moving the carrier laterally to transfer a specimen from a position over a bath of one group to a position over a bath of the other group.

3. Apparatus as claimed in claim 1 wherein the movement of the rows of baths is linear.

4. Apparatus as claimed in claim 1 and having an additional bath alongside one of said rows of baths, and wherein means is provided whereby the specimen or like carrier can be moved laterally for immersion or draining of a specimen or the like into said additional bath.

5. Apparatus as claimed in claim 1 wherein the means for moving the rows of baths comprises pallets, one for each bath, linked together, to form upper and lower chains, by means of coupling devices which permit pallets, as they reach an end of the machine, to be readily detached from the chain so that they can be raised or lowered and re-connected in a chain of pallets.

6. Apparatus as claimed in claim 5 wherein movement of the pallets is effected by reciprocating pawl devices which engage the pallets.

7. Apparatus as claimed in claim 1 wherein the means for transferring a bath from an upper row to a lower row, or vice versa, comprises a transfer platform which is raised and lowered by screw-and-nut or rack-and-pinion mechanism.

8. Apparatus as claimed in claim 7 wherein the weight of the transfer platform and its load is supported by spring means.

9. Apparatus as claimed in claim 2 wherein the specimen or slide carrier is supported on a transfer mechanism casing or frame for movement between the baths of one group and the baths of the other group, and means is provided for raising and lowering said casing or frame so as to immerse the specimen in or withdraw it from a bath, raising and lowering of said casing or frame being effected by a rack-and-pinion or screw-and-nut mechanism, and the weight of said casing or frame being taken by spring means.

10. Apparatus as claimed in claim 2 wherein timing and programming devices for the apparatus are housed between the groups of baths.

11. Apparatus as claimed in claim 1 wherein means is provided for stirring or agitating the contents of a bath, said stirring or agitating means being driven through a magnetic coupling having one of its magnetic elements positioned so as to be external to a bath, the other magnetic element being positioned so as to be within a bath.