DIAGNOSTIC STAINING BUFFER DEVICE FOR PATHOLOGY DEPARTMENTS

Field of the Invention

The present invention relates to the technical field of section staining, and in particular to a diagnostic staining buffer device for pathology departments.

Background to the Invention

In existing intelligent pathology staining machine, glass slide staining racks are transferred during the staining process by connecting mechanical hooks to the handles on the glass slide staining racks, thereby achieving the staining of glass slides. During actual operation, when the mechanical hook lifts the glass slide staining rack from the staining box, the glass slide staining rack may shake, posing a risk of falling. Moreover, since the mechanical hook and the glass slide staining rack are movably connected, the rapid shaking of the glass slide staining rack during the draining process may cause the glass slides to slide vertically within the rack, resulting in potential impact damage to the glass slides. Furthermore, the relative movement of the glass slides within the rack may scrape off the stained substances on the slide surfaces. During the rapid transfer of the glass slide staining rack, if the rack is not securely clamped, it may shake significantly. If it sinks into the staining box during shaking, it may collide with the sidewalls of the box, which may cause damage to the components and result in secondary damage to the staining machine, thereby shortening its service life and reducing the efficiency of pathological diagnosis.

According to a search, Chinese Patent No. CN117538128B discloses a staining device for pathological specimen sections. A clamping assembly is designed for the glass slide staining rack, in which a first insertion rod is inserted into a retaining hole, and the sidewall of the clamping block presses one end of the rod to achieve secure fixation. This method provides more stability compared to direct clamping. However, this clamping method requires precise alignment between the glass slide staining rack and the mechanical arm. If the glass slide staining rack is slightly tilted in the staining box, the first insertion rod may deviate from the

retaining hole, necessitating adjustment before clamping can be performed.

Statement of Invention

In view of the above problems, the present invention aims to provide a diagnostic staining buffer device for pathology departments, which facilitates clamping while enhancing the stability of the support frame, reducing the amplitude of shaking, and preventing damage to glass slides and staining boxes. The device increases constraints on the glass slides and the glass slide staining rack during the draining process, preventing relative sliding between them and thereby reducing the likelihood of glass slide damage during staining.

The main concept of the technical solution adopted in the present invention is as follows: Springs are arranged in a crossed manner above the support frame, with the ends of the springs connected to sliding blocks, which prevent shaking of the glass slide staining rack during rapid movement in the staining process. A flipping structure is designed to limit the two sides of the glass slide staining rack. Semi-open rotating rods are provided at the lower ends on both sides of the glass slide staining rack and are connected to the lower end of the support frame by springs, thereby preventing relative sliding between the glass slides and the glass slide staining rack during draining, which significantly reduces the risk of component damage and accidents. Spring pressing assemblies are arranged on the limiting rods on both sides of the vertical driving mechanism, which saves time and effort and enhances the buffering effect. Moreover, when the elasticity of the springs weakens after prolonged use, the inner spring extension length can be increased by rotating the spring rod, thereby further enhancing the limiting effect on the glass slide staining rack.

To achieve the above objectives, the technical solution adopted by the present invention is as follows:

A diagnostic staining buffer device for pathology departments, comprising:

a loading platform, above which a sliding mechanism is arranged to enable horizontal movement;

a vertical driving mechanism disposed on the sliding mechanism, which is vertically slidably

connected to a support frame, wherein the support frame is connected to a glass slide staining rack;

wherein a buffering mechanism is arranged on the support frame and connected to the vertical driving mechanism.

Further to the foregoing technical solution, the buffering mechanism comprises two symmetrically arranged movable plates, the movable plates are slidably connected to the vertical driving mechanism, and a first sliding block is slidably connected to the inner side of each movable plate.

Further to the foregoing technical solution, a baffle is arranged above the movable plates and fixedly connected to the vertical driving mechanism, a second sliding block and a third sliding block are slidably connected below the baffle, and a first spring is fixedly connected between the second sliding block and the third sliding block.

Further to the foregoing technical solution, the second sliding block and the third sliding block are respectively pivotally connected to a first buffer rod and a second buffer rod, and the other ends of the first buffer rod and the second buffer rod are respectively pivotally connected to the first sliding blocks on both sides.

Further to the foregoing technical solution, a second spring and a third spring are respectively connected to the first buffer rod and the second buffer rod, the other ends of the second spring and the third spring are respectively connected to the support frame, and the second spring and the third spring are arranged in a crossed manner.

Further to the foregoing technical solution, a flipping structure is provided between the support frame and the glass slide staining rack.

Further to the foregoing technical solution, the flipping structure comprises an electromagnet connected above the support frame, with a fifth spring disposed below the electromagnet.

Further to the foregoing technical solution, a support round rod fixedly connected to the glass slide staining rack is arranged at the bottom of the glass slide staining rack. A semi-open rotating rod is rotatably connected to the outer side of the support round rod. An attracting magnet is clamped on the semi-open rotating rod, and the attracting magnet is connected to the other end

of a fifth spring.

Further to the foregoing technical solution, two sets of spring pressing assemblies are symmetrically arranged on both sides of the vertical driving mechanism.

Further to the foregoing technical solution, the spring pressing assembly comprises two limiting rods, the limiting rods are fixedly connected to the sidewall of the vertical driving mechanism, and spring rods are threadably connected to the limiting rods.

The beneficial effects of the present invention are:

1. Based on the buffering mechanism design, a support frame is arranged at the upper end of the glass slide staining rack. A first sliding block is slidably connected on sliding grooves at both sides of the support frame and is respectively connected to a second sliding block and a third sliding block at the upper end of the support frame through connecting rods. Springs are arranged in a crossed manner above the glass slide staining rack, with ends of the springs connected to the sliding blocks, thereby preventing shaking of the glass slide staining rack during rapid movement in the staining process.

2. A flipping structure is designed to limit the two sides of the glass slide staining rack. Semi-open rotating rods are provided at the lower ends on both sides of the glass slide staining rack and are connected to the lower end of the support frame by springs, thereby preventing relative sliding between the glass slides and the glass slide staining rack during draining, which significantly reduces the risk of component damage and accidents.

3. Spring pressing assemblies are arranged on the limiting rods on both sides of the vertical driving mechanism, which saves time and effort and enhances the buffering effect. When the spring elasticity decreases after a period of use, the spring rod can be rotated to extend the length of the internal spring, further enhancing the limiting function on the glass slide staining rack and improving the buffering effect between the glass slide staining rack and the support frame. This significantly improves the working efficiency and automation level of the staining machine, reduces manual operations, thereby enhancing convenience, saving time and effort while freeing the hands, and simultaneously improving the stability of the device.

Brief Description of the Drawings

Figure 1 is a perspective schematic view of the present invention;

Figure 2 is a perspective schematic view of the connection relationship between the support frame and the glass slide staining rack of the present invention;

Figure 3 is a perspective schematic view of Figure 2 from another angle;

Figure 4 is a perspective schematic view of Figure 2 from another angle;

Figure 5 is an enlarged schematic view of a partial structure in Figure 4;

Figure 6 is a perspective schematic view of the connection relationship between the support frame and the vertical driving mechanism of the present invention;

Figure 7 is a perspective schematic view of a partial structure of Embodiment 2 of the present invention;

Figure 8 is an enlarged schematic view of a partial structure in Figure 7;

Figure 9 is a perspective schematic view of the connection relationship of partial structures between the support frame and the glass slide staining rack of the present invention;

Figure 10 is an enlarged schematic view of a partial structure in Figure 9;

Figure 11 is an enlarged schematic view of a partial structure in Figure 9;

Wherein: 1, Loading Platform; 2, Side Plate; 3, Sliding Plate;

4, Vertical Driving Mechanism; 401, Baffle; 402, Limiting Rod; 403, Spring Rod;

5, Support Frame; 501, Movable Plate; 502, Connecting Rod; 503, Hanger; 504, First Buffer Rod; 505, Second Buffer Rod; 506, Second Spring; 507, Third Spring; 508, First Spring;

6, Glass Slide Staining Rack; 601, Supporting Base Plate; 602, Handle; 603, Support Round Rod; 604, Semi-open Rotating Rod;

7, Electromagnet;

8, Attracting Magnet; 9, Fifth Spring.

Detailed Description

To make the objectives, technical solutions, and advantages of the embodiments of the present invention clearer, the technical solutions in the embodiments of the present invention are described clearly and completely below in conjunction with the drawings in the embodiments of the present invention. It is apparent that the described embodiments are part of the embodiments of the present invention, rather than all embodiments. Usually, the components described and shown in the drawings of the embodiments of the present invention may be arranged and designed in various different configurations.

The inventor has found that in existing intelligent pathology staining machines, the position of the glass slide staining rack is transferred by connecting a mechanical hook with the handle on the glass slide staining rack, thereby achieving slide staining. In actual operation, when the mechanical hook lifts the glass slide staining rack out of the staining box, the glass slide staining rack tends to shake, creating a risk of falling. Moreover, due to the movable connection between the mechanical hook and the glass slide staining rack, during the draining process, rapid shaking of the mechanical hook can cause the slides to slide up and down on the staining rack, resulting in collisions and damage to the slides. Additionally, relative sliding of the slides on the staining rack may cause the stained substances on the slides to be scraped off. During the rapid transfer of the glass slide staining rack, if the rack is not securely clamped, it may shake significantly. If it sinks into the staining box during shaking, it may collide with the sidewalls of the box, which may cause damage to the components and result in secondary damage to the staining machine, thereby shortening its service life and reducing the efficiency of pathological diagnosis.

Based on the above findings, the present invention proposes a diagnostic staining buffer device for pathology departments. A support frame is arranged at the upper end of a glass slide staining rack by designing a buffering mechanism. A first sliding block is slidably connected on sliding grooves at both sides of the support frame and is respectively connected to a second sliding block and a third sliding block at the upper end of the support frame through connecting rods. Springs are arranged in a crossed manner above the glass slide staining rack, with ends of the springs connected to the sliding blocks. A flipping structure is designed to provide lateral constraint to the glass slide staining rack. Semi-open rotating rods are arranged at the lower ends on both sides of the glass slide staining rack and are connected to the lower end of the support frame through spring fixing blocks. Spring pressing assemblies are arranged on the

limiting rods on both sides of the vertical driving mechanism, which saves time and effort and enhances the buffering effect. Moreover, when the elasticity of the springs weakens after prolonged use, the inner spring extension length can be increased by rotating the spring rod, thereby further enhancing the limiting effect on the glass slide staining rack.

Embodiment 1

Referring to Figures 1 to 11, the present invention discloses a diagnostic staining buffer device for pathology departments, comprising a carrying assembly. The carrying assembly includes a loading platform 1, wherein a side plate 2 is arranged on one side of the loading platform 1 and fixedly connected to the loading platform 1. Two first sliding rails are formed on the side plate 2. A sliding plate 3 is slidably connected on the first sliding rails. The sliding plate 3 is arranged perpendicular to the side plate 2 and reciprocates along the direction of the first sliding rails. Two second sliding rails are arranged on the sliding plate 3 in the horizontal direction. A vertical driving mechanism 4 is slidably connected on the second sliding rails. The sliding plate 3 moves left and right along the first sliding rails, while the vertical driving mechanism 4 slides back and forth along the second sliding rails. The principle refers to a two-axis mechanical arm. Since the two-axis mechanical arm is prior art and is not the point of improvement here, further description is omitted.

A driver fixing seat is arranged above the vertical driving mechanism 4. The driver adopts a conventional electric push rod, and the driver fixing seat is connected to the electric push rod. A third sliding rail arranged vertically is formed on the side of the vertical driving mechanism 4 away from the sliding plate 3. A support frame 5 is slidably connected on the third sliding rail. The upper part of the support frame 5 is fixedly connected to the ends of two electric push rods. Bolt connection or other connection methods can be adopted here. The electric push rods drive the support frame 5 to slide up and down. The support frame 5 is configured to carry a glass slide staining rack 6, enabling the glass slide staining rack 6 to move up and down with the support frame 5 to facilitate staining of the glass slides placed on the glass slide staining rack 6, thereby facilitating subsequent pathological diagnosis.

The glass slide staining rack 6 comprises a left frame and a right frame. A supporting base plate

601 is arranged at the bottom and is fixedly connected to the left frame and the right frame, respectively. Limiting rods 402 are fixedly arranged on both sides. Each limiting rod 402 has a groove adapted to the thickness of the slide on the side facing each other. The groove positions correspond to each other, and the spacing allows the glass slide to be inserted. Handles 602 extending outward are fixedly connected to the left frame and the right frame. The glass slide staining rack 6 may be integrally connected or connected by bonding, screw, or other methods.

The support frame 5 is slidably connected to the vertical driving mechanism 4. The support frame 5 comprises two symmetrically arranged movable plates 501 sliding on the third sliding rail. Each movable plate 501 includes an integrally connected first movable plate and second movable plate. The first movable plate is positioned near the top, and the second movable plate is located below the first movable plate. Two second movable plates are fixedly connected to a C-shaped connecting rod 502. The end of the connecting rod 502 is fixedly connected to a hanger 503 adapted to the handle 602 of the glass slide staining rack 6. A limiting baffle 401 is arranged above the third sliding rail for positioning and is fixedly connected to the vertical driving mechanism 4. The first movable plate is fixedly connected to the end of the electric push rod. Two electric push rods operate synchronously to drive the movable plates 501 to move up and down.

The glass slide staining rack 6 is adapted to the support frame 5. When it is necessary to move the glass slide staining rack 6, the support frame 5 is first moved so that the hanger 503 on the support frame 5 is positioned below the handle 602 of the glass slide staining rack 6. Then, the support frame 5 moves upward to engage the hanger 503 with the handle 602, allowing the support frame 5 to drive the glass slide staining rack 6 to rise. When the glass slide staining rack 6 needs to be lowered, the support frame 5 moves above the staining box to be placed. The support frame 5 moves downward until the glass slide staining rack 6 contacts the bottom of the staining box. Continuing to move downward causes the glass slide staining rack 6 to disengage from the support frame 5.

A side of the first movable plate 501 facing each other is provided with a fourth sliding rail, on which a first sliding block is slidably connected. A fifth sliding rail is formed on the lower surface of the baffle 401, on which a second sliding block and a third sliding block are slidably connected. A first spring 508 is fixedly connected between the second sliding block and the third sliding

block. The first sliding blocks on both sides are respectively pivotally connected to a first buffer rod 504 and a second buffer rod 505. The other ends of the first buffer rod 504 and the second buffer rod 505 are respectively pivotally connected to the second sliding block and the third sliding block. Second spring 506 and third spring 507 are respectively connected to the first buffer rod 504 and the second buffer rod 505. The other ends of the second spring 506 and the third spring 507 are respectively connected to the connecting rod 502 of the support frame 5. The second spring 506 and the third spring 507 are arranged in a crossed manner with an offset in the front-back direction.

When the support frame 5 drives the glass slide staining rack 6 to descend, the movable plates 501 move downward under the action of the driver. The second spring 506 and the third spring 507 elongate under elastic force and are arranged in a crossed manner, which stabilizes the descent of the support frame 5 and reduces shaking in the left-right direction. During the descent, as the movable plates 501 move downward, one end of the first buffer rod 504 and the second buffer rod 505 descends. Influenced by the lengths of the first buffer rod 504 and the second buffer rod 505, a pulling force acts on the second sliding block and the third sliding block, causing the first spring 508 to elongate. The second sliding block and the third sliding block slide laterally, while the first sliding block moves upward. During this process, the first spring 508 prevents initial damage caused by compression between the first buffer rod 504 and the second buffer rod 505. Moreover, when the first sliding block moves upward, the second spring 506 and the third spring 507 are further stretched, enhancing stability on both sides.

When the support frame 5 drives the glass slide staining rack 6 to ascend, the movable plates 501 move upward under the action of the driver. The second spring 506 and the third spring 507 shorten under elastic force and are arranged in a crossed manner, stabilizing the ascent of the support frame 5 and reducing shaking in the left-right direction. During the ascent, as the movable plates 501 move upward, one end of the first buffer rod 504 and the second buffer rod 505 rises. Influenced by the lengths of the first buffer rod 504 and the second buffer rod 505, a pushing force acts on the second sliding block and the third sliding block, causing the first spring 508 to shorten. The second sliding block and the third sliding block slide toward the middle, while the first sliding block moves downward. During this process, the first spring 508 prevents later damage caused by compression between the first buffer rod 504 and the second buffer rod 505.

Embodiment 2

As shown in Figures 1 to 11, two sets of spring pressing assemblies are symmetrically arranged on both sides of the vertical driving mechanism 4. Two limiting rods 402 are fixedly connected to the sidewall of the vertical driving mechanism 4, and each limiting rod 402 is provided with a receiving groove. A spring rod 403 passes through each receiving groove, with one end of the spring rod 403 fixedly connected to a fourth spring. The outer surface of the spring rod 403 is provided with external threads, which are threadedly engaged with internal threads formed on the inner wall of the receiving groove. During installation, the spring end is oriented inward. The spring pressing assemblies save time and effort, enhance the buffering effect, and when the elasticity of the fourth spring weakens after prolonged use, the length of the inwardly oriented fourth spring can be increased by rotating the spring rod 403, thereby further enhancing the limiting effect on the glass slide staining rack 6. The spring pressing assemblies can press against both sides of the glass slide staining rack 6 during rapid movement in the front, rear, left, and right directions, preventing significant shaking of the glass slide staining rack 6 and avoiding slide damage.

Embodiment 3

As shown in Figures 1 to 11, two sets of flipping structures are provided to limit both sides of the glass slide staining rack 6. When the glass slide staining rack 6 moves up and down with the support frame 5, the flipping structures reduce the autonomous oscillation of the glass slide staining rack 6 caused by inertia, thereby preventing detachment from the support frame 5.

At the junction between the supporting base plate 601 of the glass slide staining rack 6 and the left and right frames, a support round rod 603 is provided. The support round rod 603 is fixedly connected to the supporting base plate 601. One side of the supporting base plate 601 is rotatably connected to a semi-open rotating rod 604, which is capable of rotating from a horizontal position to a vertical position. In the vertical position, the semi-open rotating rod 604 contacts the outer peripheral surface of the support round rod 603.

An electromagnet 7 is arranged at the bottom of the hanger 503 of the support frame 5. The electromagnet 7 is electrically connected to the driver of the vertical driving mechanism 4. An attracting magnet 8 is clamped on the upper surface of the semi-open rotating rod 604. The electromagnet 7 and the attracting magnet 8 are connected via a fifth spring 9. In the initial state, the semi-open rotating rod 604 is in a horizontal position, and the fifth spring 9 is in a stretched state. During the up-and-down oscillation in the draining process, the fifth spring 9 provides a buffering effect. When entering the staining box, the electromagnet 7 is energized upon receiving a signal, generating magnetic force to attract the attracting magnet 8, thereby causing the semi-open rotating rod 604 to rotate into a vertical position. At this point, the semi-open rotating rod 604 fits against the glass slide staining rack 6, reducing the length of the glass slide staining rack 6.

The operating procedure of the present invention is as follows:

1. During slide staining, the glass slide staining rack 6 is first connected to the support frame 5. The movable plate 501 moves downward under the action of the driver, causing the second spring 506 and the third spring 507 to elongate under elastic force. The springs are arranged in a crossed manner to ensure stable descent of the support frame 5 and to reduce lateral oscillation. During the descent, the lowering of the movable plate 501 causes one end of the first buffer rod 504 and the second buffer rod 505 to move downward. Due to the lengths of the first buffer rod 504 and the second buffer rod 505, a pulling force is applied to the second and third sliding blocks, thereby stretching the first spring 508. The second and third sliding blocks slide laterally in opposite directions, and the first sliding block moves upward. In this process, the first spring 508 prevents the first buffer rod 504 and the second buffer rod 505 from being damaged due to excessive compression at the initial stage. Meanwhile, the upward movement of the first sliding block further stretches the second spring 506 and the third spring 507, enhancing stability on both sides.

When the support frame 5 drives the glass slide staining rack 6 to ascend, the movable plate 501 moves upward under the action of the driver. The second spring 506 and the third spring 507 shortened under the elastic force, and their crossed configuration ensures stable upward movement of the support frame 5, minimizing lateral oscillation. During the ascent, the upward movement of the movable plate 501 causes one end of the first buffer rod 504 and the second

buffer rod 505 to rise. Due to their respective lengths, a pushing force is applied to the second and third sliding blocks, causing the first spring 508 to contract. The second and third sliding blocks slide inward toward the centre, and the first sliding block moves downward. In this process, the first spring 508 helps prevent damage to the first buffer rod 504 and the second buffer rod 505 from compression during the later stage.

2. When entering the staining box, the electromagnet 7 is energized upon receiving a signal, thereby becoming magnetized and generating an attractive force on the attracting magnet 8, causing the semi-open rotating rod 604 to rotate into a vertical position. At this point, the semi-open rotating rod 604 fits against the glass slide staining rack 6, reducing the length of the glass slide staining rack 6.

3. After the staining is completed, liquid draining is required. The support frame 5 drives the glass slide staining rack 6 to oscillate vertically. During this shaking process, the fifth spring 9 provides a buffering effect.

The foregoing shows and describes the basic principles, main features, and advantages of the present invention. Persons skilled in the art should understand that the present invention is not limited to the above embodiments. The above embodiments and descriptions merely illustrate the principles of the invention. Various modifications and improvements may be made without departing from the spirit and scope of the invention, all of which fall within the scope to be protected. The scope of the present invention is defined by the appended claims and their equivalents.