

## HEPATOBIILIARY SURGICAL RETRACTOR

### **Field of the Invention**

5 The invention relates to the technical field of medical devices, and specifically to a hepatobiliary surgical retractor.

### **Background to the Invention**

10 A hepatobiliary surgical retractor is a surgical instrument used to expose and retract tissues in the target area during an operation, ensuring that the surgeon can clearly observe the surgical field and operate effectively. In hepatobiliary surgery, retractors are widely applied in procedures involving the liver, gallbladder, bile ducts and related areas, serving to temporarily separate tissues or retract the liver and surrounding structures to enable precise manipulation.

15 In the prior art, when retractors are used to open a patient's wound, disinfectant is usually sprayed onto the outer wall of the retractor. However, as the retractor may shift while expanding the wound, the disinfectant may fail to fully cover and disinfect the wound site, which can result in postoperative infection, prolonged recovery time, or even serious complications, thereby reducing the protective effect of the retractor in maintaining the wound open.

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### **Statement of Invention**

The purpose of the present invention is to provide a hepatobiliary surgical retractor so as to solve the problems raised in the background to the invention.

25 To address the above technical problems, the invention is realised through the following technical solution:

The invention provides a hepatobiliary surgical retractor, comprising a working frame, with table legs fixedly connected to both sides of the bottom of the working frame, and curved plates fixedly connected to both sides of the top of the working frame. The top of each

curved plate is provided with a first slot, and both sides of the top of the curved plate near the first slot are respectively provided with second slots. It further comprises an equidistant hook-lock mechanism, the equidistant hook-lock mechanism including electric telescopic rods, working plates, sliding frames, retractor plates, and a diffusion assembly for expanding the wound. Four electric telescopic rods are provided, the bottoms of the electric telescopic rods being fixedly connected to the top of the working frame, one side of each working plate being fixedly connected to the movable end of the electric telescopic rod, the outer wall of the top end of each sliding frame being slidably connected to the inner wall of the first slot, one end of the outer wall of the sliding frame penetrating the working plate and being fixedly connected to the inner wall of the working plate, and one end of the sliding frame being fixedly connected with a retractor plate.

Further, the diffusion assembly comprises a vertical rod slidably connected to the inner wall of the second slot, the outer wall of the bottom end of the vertical rod being rotatably connected with a moving member, both ends of one side of the working plate being respectively provided with limiting holes, the bottom of the moving member being slidably connected to the inner wall bottom of the limiting holes, and one end of the moving member being fixedly connected with a connecting member.

Further, the top of the connecting member is penetrated by and rotatably connected with a cross rod, the outer wall of the bottom end of the cross rod being slidably connected with a cross hook-lock sleeve, the top of the cross hook-lock sleeve being fixedly connected with a spring frame, and the outer wall of the top end of the spring frame being slidably connected to the inner wall of the connecting member.

Further, the outer wall of the vertical rod is provided with a rotation assembly, the rotation assembly comprising a gear fixedly connected to the outer wall of the top end of the vertical rod, toothed plates being fixedly connected to both sides of the top of the curved plate, and one side of the outer wall of the gear being in meshing connection with the side wall of the toothed plates.

Further, the outer wall of one end of the vertical rod near the moving member is rotatably connected with a belt, one side of the inner wall of the belt away from the vertical rod being

rotatably connected to the outer wall of the top end of the cross rod, the top of the cross rod being fixedly connected with a threaded rod, and the top of the connecting member being fixedly connected with a limiting frame.

5 Further, the outer wall of the top end of the threaded rod is in threaded connection with a threaded plate, one end of the outer wall of the limiting frame being slidably connected to the inner wall of the threaded plate, the bottom of the threaded plate being fixedly connected with a return spring, and the bottom of the return spring being fixedly connected to the top of the connecting member.

10 Further, the bottom of the threaded plate is provided with a pressing assembly, the pressing assembly comprising a round rod fixedly connected to the bottom of the threaded plate, one end of the round rod penetrating the connecting member and extending to the outside of the connecting member, the bottom of the round rod being fixedly connected with an arc-shaped plate, the bottom of the arc-shaped plate being arranged in contact with the top of the cross hook-lock sleeve, and the outer wall of the top end of the cross  
15 hook-lock sleeve being rotatably connected with a rotating ring.

Further, the outer wall of the rotating ring is provided with a disinfection assembly, the disinfection assembly comprising a rotating bar rotatably connected to one side of the outer wall of the rotating ring, one end of the rotating bar away from the round rod being rotatably connected with a sliding block, and the bottom of the connecting member being provided  
20 with a sliding groove.

Further, the outer wall of the top end of the sliding block is slidably connected to the inner wall of the sliding groove, one side of the sliding block being fixedly connected with a transverse rod, one end of the transverse rod away from the sliding block being fixedly connected with a piston plate, and the outer wall of the piston plate being slidably  
25 connected with a liquid storage shell.

Further, the top of the liquid storage shell is fixedly connected to the bottom of the connecting member, one side of the liquid storage shell being in communication with a connecting tube, the bottom of the outer wall of the connecting tube being in communication with an elastic tube, the bottom of the elastic tube being in communication

with a spraying shell, and the top of the spraying shell being fixedly connected to the bottom of the rotating ring.

The invention has the following beneficial effects:

5 (1) In the present invention, the retractor plates are placed inside the wound. The electric telescopic rods are activated and drive the working plates to move, the two working plates move away from each other, the working plates drive the sliding frames to move, and the sliding frames drive the retractor plates to move, so that the two retractor plates move apart, thereby opening the wound and facilitating surgical operations by the doctor. During the movement of the working plates, the working plates drive the moving members to move,  
10 the moving members drive the vertical rods to move, and, being limited by the second slots, the vertical rods slide obliquely along the inner walls of the second slots. At the same time, being limited by the limiting holes, the vertical rods drive the moving members to slide along the inner walls of the limiting holes, causing the two moving members to move away from each other. The moving members drive the connecting members to move, the  
15 connecting members drive the spring frames to move, and the spring frames drive the cross hook-lock sleeves to move, thereby enabling multiple cross hook-lock sleeves and the retractor plates to change spacing equidistantly. This achieves uniform traction on incisions of different lengths, avoiding the need to use multiple independent retractors for larger incisions, and improving the wound-opening effect. The outer wall of the cross  
20 hook-lock sleeve is coated with disinfectant, so that during the process of the cross hook-lock sleeve opening the wound, infection of the wound can be prevented.

(2) In the present invention, during the movement of the vertical rod, the vertical rod drives the gear to move. Being limited by the toothed plate, the gear drives the vertical rod to rotate along the inner wall of the moving member. The vertical rod drives the belt to rotate,  
25 the belt drives the cross rod to rotate, and the cross rod drives the cross hook-lock sleeve to rotate. During the rotation of the cross hook-lock sleeve, it can come into contact with the inner wall of the wound, thereby preventing the cross hook-lock sleeve from rubbing against the wound when in a stationary state, which could otherwise cause damage to the inner wall of the wound, and thus indirectly improving the protective effect when the wound  
30 is being opened.

(3) In the present invention, during the rotation of the cross rod, the cross rod drives the threaded rod to rotate. Being limited by the limiting frame, the threaded rod, during its rotation, drives the threaded plate to move downwards along the outer wall of the limiting frame. The threaded plate drives the round rod to move downwards, and the round rod drives the arc-shaped plate to move downwards. During this downward movement, the arc-shaped plate comes into contact with the top of the cross hook-lock sleeve, causing the cross hook-lock sleeve to move downwards along the outer wall of the cross rod. In this way, the hooking range of the cross hook-lock sleeve is expanded, improving the stability of wound retraction and indirectly enhancing the wound-opening effect.

(4) In the present invention, when the cross hook-lock sleeve descends, it drives the rotating ring to descend, the rotating ring drives the rotating bar to descend, and, being limited by the sliding groove, the rotating bar drives the sliding block to slide along the inner wall of the sliding groove. During the movement of the sliding block, it drives the transverse rod to move, the transverse rod drives the piston plate to move, and the piston plate slides inside the liquid storage shell, thereby pressing the disinfectant inside the liquid storage shell so that it enters the connecting tube. The disinfectant passes through the connecting tube into the elastic tube, then through the elastic tube into the spraying shell, and is sprayed from the spraying shell onto the outer wall of the cross hook-lock sleeve. This prevents the situation where, during the rotation of the cross hook-lock sleeve, the applied disinfectant is completely absorbed by the wound and cannot continue to disinfect the wound in subsequent rotations. The arrangement of the spraying shell enables continuous spraying of disinfectant onto the outer wall of the cross hook-lock sleeve, improving its disinfecting effect on the wound and indirectly enhancing the protective effect during wound retraction. Since the rotating ring rotates on the outer wall of the cross hook-lock sleeve, it also prevents the rotating ring from jamming when the cross hook-lock sleeve rotates.

Of course, any product implementing the present invention does not necessarily need to achieve all of the above-mentioned advantages simultaneously.

#### **Brief Description of the Drawings**

In order to more clearly illustrate the technical solutions of the embodiments of the present invention, the drawings required for the description of the embodiments are briefly introduced below. It is obvious that the drawings described below are merely some embodiments of the present invention, and for those of ordinary skill in the art, other drawings can also be obtained based on these drawings without creative effort.

Figure 1 is a schematic top view of the overall structure of the present invention;

Figure 2 is a schematic sectional view of the overall structure of the present invention;

Figure 3 is a schematic sectional view of the vertical rod of the present invention;

Figure 4 is a schematic sectional view of the connecting member of the present invention;

Figure 5 is a schematic bottom view of the threaded plate of the present invention;

Figure 6 is an exploded schematic view of the cross rod of the present invention;

Figure 7 is an enlarged view of portion A in Figure 2 of the present invention;

Figure 8 is an enlarged view of portion B in Figure 4 of the present invention;

Figure 9 is an enlarged view of portion C in Figure 5 of the present invention.

In the drawings, the parts represented by each reference numeral are as follows: 1 - working frame; 2 - table leg; 3 - curved plate; 4 - first slot; 5 - second slot; 6 - equidistant hook - lock mechanism; 61 - electric telescopic rod; 62 - working plate; 63 - sliding frame; 64 - retractor plate; 65 - diffusion assembly; 66 - rotation assembly; 67 - pressing assembly; 68 - disinfection assembly; 651 - vertical rod; 652 - moving member; 653 - limiting hole; 654 - connecting member; 655 - cross rod; 656 - spring frame; 657 - cross hook - lock sleeve; 661 - gear; 662 - toothed plate; 663 - belt; 664 - threaded rod; 665 - limiting frame; 666 - threaded plate; 667 - return spring; 671 - round rod; 672 - arc - shaped plate; 673 - rotating ring; 681 - rotating bar; 682 - sliding block; 683 - sliding groove; 684 - liquid storage shell; 685 - transverse rod; 686 - piston plate; 687 - connecting tube; 688 - elastic tube; 689 - spraying shell.

### **Detailed Description**

The technical solutions of the embodiments of the present invention will be clearly and fully described below in conjunction with the accompanying drawings of the embodiments. It is evident that the embodiments described are merely part of the embodiments of the present invention, and not all of them. Based on the embodiments of the present invention, all other  
5       embodiments obtained by those of ordinary skill in the art without creative effort shall fall within the scope of protection of the present invention.

#### Embodiment 1

Referring to Figures 1 - 9, the present invention discloses a hepatobiliary surgical retractor, comprising a working frame 1. Both sides of the bottom of the working frame 1 are fixedly  
10       connected with table legs 2, and both sides of the top of the working frame 1 are fixedly connected with curved plates 3. The top of each curved plate 3 is provided with a first slot 4, and both sides of the top of the curved plate 3 near the first slot 4 are respectively provided with second slots 5. It further comprises:

An equidistant hook-lock mechanism 6. The equidistant hook-lock mechanism 6 comprises  
15       electric telescopic rods 61, working plates 62, sliding frames 63, and retractor plates 64.

The retractor plates 64 are placed inside the wound, and the electric telescopic rods 61 are activated. The electric telescopic rods 61 drive the working plates 62 to move, the two working plates 62 move away from each other, the working plates 62 drive the sliding frames 63 to move, and the sliding frames 63 drive the retractor plates 64 to move, so that  
20       the two retractor plates 64 move apart, thereby opening the wound and facilitating surgical operations by the doctor. The equidistant hook-lock mechanism 6 further comprises a diffusion assembly 65 for expanding the wound. During the movement of the working plates 62, the working plates 62 drive the moving members 652 to move, the moving members 652 drive the vertical rods 651 to move, and, being limited by the second slots 5,  
25       the vertical rods 651 slide obliquely along the inner walls of the second slots 5. At the same time, being limited by the limiting holes 653, the vertical rods 651 drive the moving members 652 to slide along the inner walls of the limiting holes 653, causing the two moving members 652 to move away from each other. The moving members 652 drive the connecting members 654 to move, the connecting members 654 drive the spring frames  
30       656 to move, and the spring frames 656 drive the cross hook-lock sleeves 657 to move.

This enables multiple cross hook-lock sleeves 657 and the retractor plates 64 to change spacing equidistantly, thereby achieving uniform traction on incisions of different lengths, avoiding the need to use multiple independent retractors for larger incisions, and improving the wound-opening effect.

5 Four electric telescopic rods 61 are provided, the bottoms of the electric telescopic rods 61 being fixedly connected to the top of the working frame 1. One side of each working plate 62 is fixedly connected to the movable end of the electric telescopic rod 61. The outer wall of the top end of the sliding frame 63 is slidably connected to the inner wall of the first slot 4, one end of the outer wall of the sliding frame 63 penetrates the working plate 62 and is  
10 fixedly connected to the inner wall of the working plate 62, and one end of the sliding frame 63 is fixedly connected with a retractor plate 64.

The diffusion assembly 65 comprises a vertical rod 651 slidably connected to the inner wall of the second slot 5, the outer wall of the bottom end of the vertical rod 651 being rotatably connected with a moving member 652. Both ends of one side of the working plate 62 are  
15 respectively provided with limiting holes 653. The bottom of the moving member 652 is slidably connected to the inner wall bottom of the limiting holes 653, and one end of the moving member 652 is fixedly connected with a connecting member 654.

The top of the connecting member 654 penetrates and is rotatably connected with a cross rod 655. The outer wall of the bottom end of the cross rod 655 is slidably connected with a  
20 cross hook-lock sleeve 657, the outer wall of which is coated with disinfectant. During the process of the cross hook-lock sleeve 657 opening the wound, infection of the wound can be prevented. The top of the cross hook-lock sleeve 657 is fixedly connected with a spring frame 656, the outer wall of the top end of the spring frame 656 being slidably connected to the inner wall of the connecting member 654. The arrangement of the spring frame 656  
25 enables the cross hook-lock sleeve 657 to perform a resetting movement, thereby preventing the cross hook-lock sleeve 657 from jamming during rotation.

The outer wall of the vertical rod 651 is provided with a rotation assembly 66. During the movement of the vertical rod 651, the vertical rod 651 drives the gear 661 to move. Being limited by the toothed plate 662, the gear 661 drives the vertical rod 651 to rotate along the

inner wall of the moving member 652. The vertical rod 651 drives the belt 663 to rotate, the belt 663 drives the cross rod 655 to rotate, and the cross rod 655 drives the cross hook-lock sleeve 657 to rotate. During the rotation of the cross hook-lock sleeve 657, it can come into contact with the inner wall of the wound, thereby preventing the cross hook-lock sleeve 657 from rubbing against the wound when in a stationary state, which could otherwise cause damage to the inner wall of the wound, and thus indirectly improving the protective effect during wound retraction. The rotation assembly 66 comprises a gear 661 fixedly connected to the outer wall of the top end of the vertical rod 651, toothed plates 662 fixedly connected to both sides of the top of the curved plate 3, and one side of the outer wall of the gear 661 being in meshing connection with the side wall of the toothed plates 662.

The outer wall of one end of the vertical rod 651 near the moving member 652 is rotatably connected with a belt 663. One side of the inner wall of the belt 663 away from the vertical rod 651 is rotatably connected to the outer wall of the top end of the cross rod 655. The top of the cross rod 655 is fixedly connected with a threaded rod 664, and the top of the connecting member 654 is fixedly connected with a limiting frame 665.

The outer wall of the top end of the threaded rod 664 is in threaded connection with a threaded plate 666. One end of the outer wall of the limiting frame 665 is slidably connected to the inner wall of the threaded plate 666. The bottom of the threaded plate 666 is fixedly connected with a return spring 667, the arrangement of which enables the threaded plate 666 to perform a resetting movement. The bottom of the return spring 667 is fixedly connected to the top of the connecting member 654.

## Embodiment 2

The bottom of the threaded plate 666 is provided with a pressing assembly 67. During the rotation of the cross rod 655, the cross rod 655 drives the threaded rod 664 to rotate. Being limited by the limiting frame 665, the threaded rod 664, during its rotation, drives the threaded plate 666 to move downwards along the outer wall of the limiting frame 665. The threaded plate 666 drives the round rod 671 to move downwards, and the round rod 671 drives the arc-shaped plate 672 to move downwards. During this downward movement, the

arc-shaped plate 672 comes into contact with the top of the cross hook-lock sleeve 657, causing the cross hook-lock sleeve 657 to move downwards along the outer wall of the cross rod 655. In this way, the hooking range of the cross hook-lock sleeve 657 is expanded, improving the stability of wound retraction and indirectly enhancing the wound-opening effect. The pressing assembly 67 comprises a round rod 671 fixedly connected to the bottom of the threaded plate 666, one end of the round rod 671 penetrating the connecting member 654 and extending to the outside of the connecting member 654. The bottom of the round rod 671 is fixedly connected with an arc-shaped plate 672, the bottom of the arc-shaped plate 672 being arranged in contact with the top of the cross hook-lock sleeve 657. The outer wall of the top end of the cross hook-lock sleeve 657 is rotatably connected with a rotating ring 673. Since the rotating ring 673 rotates on the outer wall of the cross hook-lock sleeve 657, it prevents the rotating ring 673 from jamming when the cross hook-lock sleeve 657 rotates.

The outer wall of the rotating ring 673 is provided with a disinfection assembly 68. When the cross hook-lock sleeve 657 descends, it drives the rotating ring 673 to descend, and the rotating ring 673 drives the rotating bar 681 to descend. Being limited by the sliding groove 683, the rotating bar 681 drives the sliding block 682 to slide along the inner wall of the sliding groove 683. During the movement of the sliding block 682, it drives the transverse rod 685 to move, the transverse rod 685 drives the piston plate 686 to move, and the piston plate 686 slides inside the liquid storage shell 684, thereby pressing the disinfectant inside the liquid storage shell 684 so that it enters the connecting tube 687. The disinfectant passes through the connecting tube 687 into the elastic tube 688, then through the elastic tube 688 into the spraying shell 689, and is sprayed from the spraying shell 689 onto the outer wall of the cross hook-lock sleeve 657. This prevents the situation where, during the rotation of the cross hook-lock sleeve 657, the applied disinfectant is completely absorbed by the wound and cannot continue to disinfect the wound in subsequent rotations. The arrangement of the spraying shell 689 enables continuous spraying of disinfectant onto the outer wall of the cross hook-lock sleeve 657, improving its disinfecting effect on the wound and indirectly enhancing the protective effect during wound retraction. The disinfection assembly 68 comprises a rotating bar 681 rotatably connected to one side of the outer wall of the rotating ring 673, one end of the rotating bar

681 away from the round rod 671 being rotatably connected with a sliding block 682, and the bottom of the connecting member 654 being provided with a sliding groove 683.

The outer wall of the top end of the sliding block 682 is slidably connected to the inner wall of the sliding groove 683, one side of the sliding block 682 being fixedly connected with a transverse rod 685, the end of the transverse rod 685 away from the sliding block 682 being fixedly connected with a piston plate 686, and the outer wall of the piston plate 686 being slidably connected with a liquid storage shell 684.

The top of the liquid storage shell 684 is fixedly connected to the bottom of the connecting member 654, one side of the liquid storage shell 684 being in communication with a connecting tube 687, the bottom of the outer wall of the connecting tube 687 being in communication with an elastic tube 688, the bottom of the elastic tube 688 being in communication with a spraying shell 689, and the top of the spraying shell 689 being fixedly connected to the bottom of the rotating ring 673.

During use, the retractor plates 64 are placed inside the wound, and the electric telescopic rods 61 are activated. The electric telescopic rods 61 drive the working plates 62 to move, the two working plates 62 move away from each other, the working plates 62 drive the sliding frames 63 to move, and the sliding frames 63 drive the retractor plates 64 to move, so that the two retractor plates 64 move apart, thereby opening the wound and facilitating surgical operations by the doctor. During the movement of the working plates 62, the working plates 62 drive the moving members 652 to move, the moving members 652 drive the vertical rods 651 to move, and, being limited by the second slots 5, the vertical rods 651 slide obliquely along the inner walls of the second slots 5. At the same time, being limited by the limiting holes 653, the vertical rods 651 drive the moving members 652 to slide along the inner walls of the limiting holes 653, causing the two moving members 652 to move away from each other. The moving members 652 drive the connecting members 654 to move, the connecting members 654 drive the spring frames 656 to move, and the spring frames 656 drive the cross hook-lock sleeves 657 to move. This enables multiple cross hook-lock sleeves 657 and the retractor plates 64 to change spacing equidistantly, thereby achieving uniform traction on incisions of different lengths, avoiding the need to use multiple independent retractors for larger incisions, and improving the wound-opening

effect. The outer wall of the cross hook-lock sleeve 657 is coated with disinfectant, so that during the process of the cross hook-lock sleeve 657 opening the wound, infection of the wound can be prevented.

5 During the movement of the vertical rod 651, the vertical rod 651 drives the gear 661 to move. Being limited by the toothed plate 662, the gear 661 drives the vertical rod 651 to rotate along the inner wall of the moving member 652. The vertical rod 651 drives the belt 663 to rotate, the belt 663 drives the cross rod 655 to rotate, and the cross rod 655 drives the cross hook-lock sleeve 657 to rotate. During the rotation of the cross hook-lock sleeve 657, it can come into contact with the inner wall of the wound, thereby preventing the cross  
10 hook-lock sleeve 657 from rubbing against the wound when in a stationary state, which could otherwise cause damage to the inner wall of the wound, and thus indirectly improving the protective effect during wound retraction.

During the rotation of the cross rod 655, the cross rod 655 drives the threaded rod 664 to rotate. Being limited by the limiting frame 665, the threaded rod 664, during its rotation,  
15 drives the threaded plate 666 to move downwards along the outer wall of the limiting frame 665. The threaded plate 666 drives the round rod 671 to move downwards, and the round rod 671 drives the arc-shaped plate 672 to move downwards. During this downward movement, the arc-shaped plate 672 comes into contact with the top of the cross hook-lock sleeve 657, causing the cross hook-lock sleeve 657 to move downwards along the outer  
20 wall of the cross rod 655. In this way, the hooking range of the cross hook-lock sleeve 657 is expanded, improving the stability of wound retraction and indirectly enhancing the wound-opening effect.

When the cross hook-lock sleeve 657 descends, it drives the rotating ring 673 to descend, and the rotating ring 673 drives the rotating bar 681 to descend. Being limited by the sliding  
25 groove 683, the rotating bar 681 drives the sliding block 682 to slide along the inner wall of the sliding groove 683. During the movement of the sliding block 682, it drives the transverse rod 685 to move, the transverse rod 685 drives the piston plate 686 to move, and the piston plate 686 slides inside the liquid storage shell 684, thereby pressing the disinfectant inside the liquid storage shell 684 so that it enters the connecting tube 687.  
30 The disinfectant passes through the connecting tube 687 into the elastic tube 688, then

through the elastic tube 688 into the spraying shell 689, and is sprayed from the spraying shell 689 onto the outer wall of the cross hook-lock sleeve 657. This prevents the situation where, during the rotation of the cross hook-lock sleeve 657, the applied disinfectant is completely absorbed by the wound and cannot continue to disinfect the wound in subsequent rotations. The arrangement of the spraying shell 689 enables continuous spraying of disinfectant onto the outer wall of the cross hook-lock sleeve 657, improving its disinfecting effect on the wound and indirectly enhancing the protective effect during wound retraction. Since the rotating ring 673 rotates on the outer wall of the cross hook-lock sleeve 657, it prevents the rotating ring 673 from jamming when the cross hook-lock sleeve 657 rotates.

The above disclosed preferred embodiments of the present invention are merely provided to assist in illustrating the invention. The preferred embodiments do not describe all details exhaustively, nor do they limit the invention solely to the specific embodiments disclosed. It is evident that, based on the content of this specification, many modifications and variations can be made. The embodiments selected and specifically described in this specification are intended to better explain the principles and practical applications of the invention, so that those skilled in the art can better understand and utilise the invention. The present invention is only limited by the claims and the full scope and equivalents thereof.