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Multifunction Awning Blind

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(71) Applicant(s)
SILENT SHADE PTY LTD

(72) Inventor(s)
HOPKINS, Tony

(74) Agent / Attorney
Griffith Hack, Level 15, 376-390 Collins Street, Melbourne, VIC, 3000, AU

ABSTRACT

A multifunction awning blind for a window of a building. The awning blind comprises a blind roller, blind fabric wound on the roller, a pair of side rails, a pair of slider assemblies attached to and movable along the side rails, a pair of side arms pivotally connected to the slider assemblies. Unrolling the blind fabric a first amount causes the arms to extend outward and form a canopy over the window. Unrolling the fabric a second amount causes the arms to extend downward. Unrolling the fabric beyond the second amount causes the slider assemblies to travel downwards along the side rails such that the blind fabric covers more of and potentially the entire window. The multifunction awning blind can thus act as an awning when the sun is high in the sky and can act as a vertical blind to completely cover a window when required.

Fig. 2A

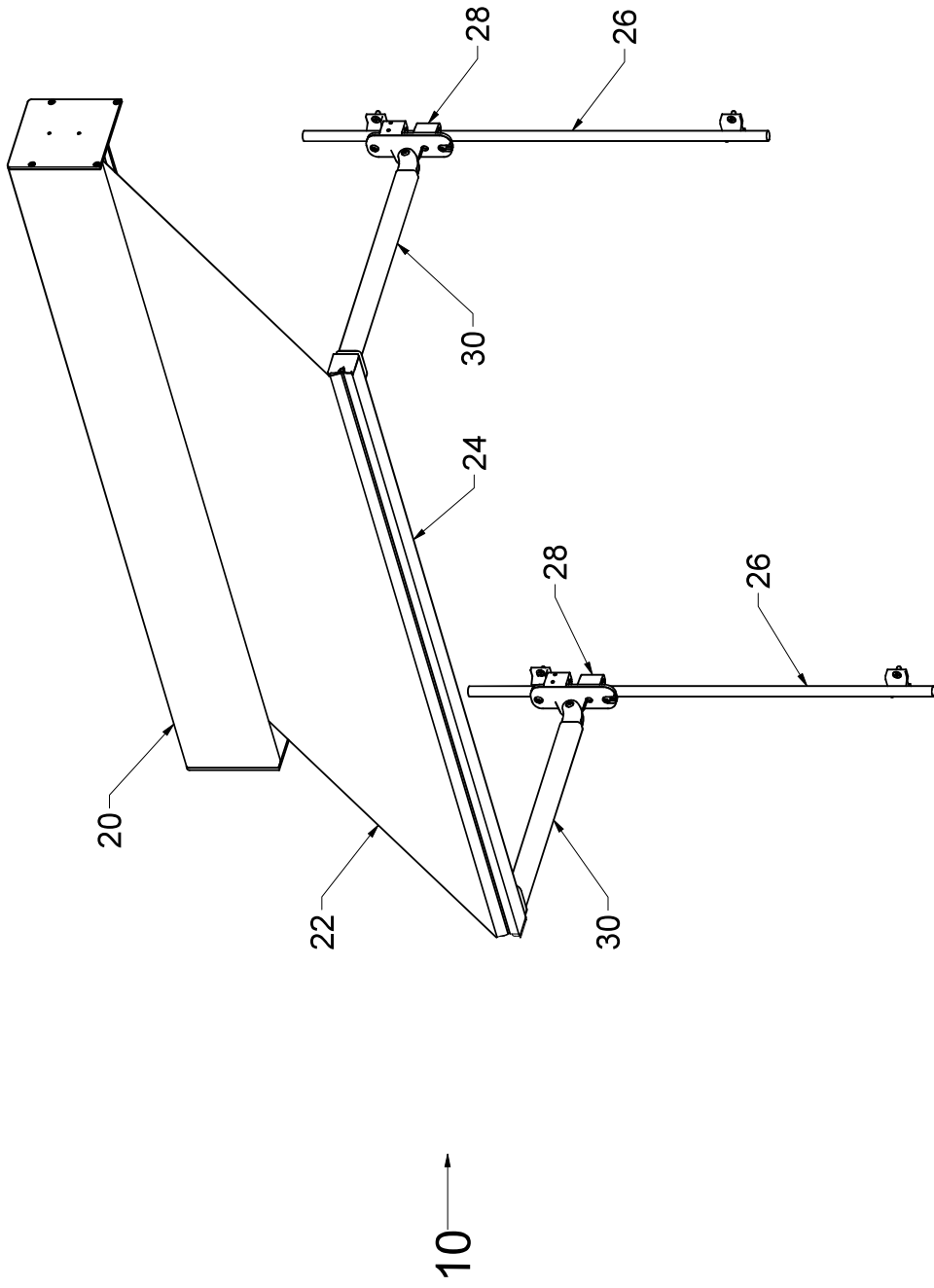


Fig. 2A

MULTIFUNCTION AWNING BLIND

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional application of Australian Patent Application No. 2024235701, which in turn is a national phase entry of
5 International Patent Application No. PCT/AU2024/050216 published as WO2024/187228A1. These applications are incorporated by reference herein in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to window coverings of the type
10 often installed externally on domestic or commercial buildings. More specifically, the invention relates to a multifunction awning that can transform to become a vertical blind to completely cover a window. It will be convenient to describe the invention relation to that example application. It should however be understood that the invention is capable of broader application and use.

15 BACKGROUND TO THE INVENTION

[0003] Awnings and blinds are often installed on windows of a building to shade the window from the sun. Awnings have an advantage in that they generally extend outward from the building and provide shade while enabling views. On the other hand, vertical blinds can completely cover the window and,
20 while they provide maximum protection from the sun at all times of day, including afternoon sun when at its hottest, they restrict the view.

[0004] One commonly available form of domestic shade covering for windows is called an "auto blind" or "auto sunblind". In this type of blind, the blind fabric is wound on a roller (often mounted within a header box or pelmet at the top of the
25 window) that is spring-loaded such that the blind fabric automatically retracts onto

the roller when released. The bottom rail of the blind is fixed to a relatively short pair of arms that slide vertically along guide rails mounted either side of the window. The blind is moved up and down by twisting the bottom rail, to release the arms from a locked position on the guide rails, by hand or using a rod and hook inserted within a ring provided on the bottom rail. The blind is then manually pulled down or pushed up by hand. Being completely manual in operation restricts the use of auto blinds to situations where the blind can be reached - installations above ground floor level, such as on a second or higher floor of a building, are generally not possible.

10 [0005] Another known type of vertical blind capable of completely covering a window is a retractable straight drop blind. In this type of blind, the blind fabric is again wound on a roller that is spring-loaded such that the blind fabric automatically retracts onto the roller. The bottom rail of the blind is held between two guide rails or wires, and it slides up and down along the guides. Such a blind
15 may be manually operated or motorised.

[0006] A known form of window awning is generally referred to as a “retractable fixed pivot arm awning” or “drop arm awning”. These awnings are somewhat similar to the auto blind described above, in that they have a blind fabric wound on a roller and a bottom rail of the blind is fixed to a pair of arms.
20 However, the arms are mounted in fixed positions to the wall of the building alongside the window opening. The arms are spring biased such that they are caused to rotate about their fixed mounting positions as fabric from the roller is unwound, either manually using a crank handle arrangement or motorised. To provide sufficient coverage for a whole window, the arms must generally be much
25 longer than would be required for an auto blind. For example, for a floor to ceiling window of 2.4 meters, each arm would need to be at least 1.2 meters long. This length is inconvenient and potentially dangerous in many installations, for example alongside a footpath or driveway where it would impede passage of pedestrians or vehicles when the arm is extended horizontally.

[0007] Another form of awning is a retractable folding arm awning that extends horizontally, or at predetermined angle below the horizontal, from the building wall above the window opening. This type of awning provides shade over a window but is not capable of controlling its angle of projection to vertically protect the window.

[0008] With the foregoing in mind, it would be desirable to develop a convertible window covering which, on the one hand, can act as an awning when the sun is high in the sky and, on the other hand, act as a vertical blind to completely cover a window when required.

[0009] Any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material formed part of the prior art base or the common general knowledge in the relevant art on or before the priority date of the claims herein.

15 SUMMARY OF THE INVENTION

[0010] The present invention provides a multifunction awning blind for a window or similar opening in a wall of a building. The awning blind comprises:
a blind roller configured to be secured to the wall at the top of the window opening;

20 a blind fabric wound upon the blind roller such that the blind fabric can be wound and unwound from the roller;

a bottom rail secured to a free end of the blind fabric;

a pair of side rails configured to be secured to the wall with one rail on each side of the window opening;

25 a pair of slider assemblies attached to and movable along respective side rails; and

a pair of side arms, each arm having a first end pivotally connected to a respective slider assembly about a pivot axis and being spring biased to pivot

about the axis such that a second end of the arm is urged outwardly away from the window and downward away from the blind roller, and each arm having its second end fixed to the bottom rail such that unrolling the blind fabric allows each arm to pivot about its axis,

5 whereby, in use, unrolling the blind fabric from an initial, fully-retracted starting position up to a first amount causes the arms to extend outward, while the slider assemblies remain in fixed positions on the side rails, such that blind fabric forms a canopy over the window, unrolling the blind fabric beyond the first amount and up to a second amount causes the arms to extend downward, while the slider
10 assemblies continue to remain in the fixed positions on the side rails, until the bottom rail reaches a lowermost position within an arc of motion, and unrolling the blind fabric beyond the second amount and up to a third amount causes the slider assemblies to travel downwards along the side rails such that the arms and bottom rail move downwards and the blind fabric covers more of the window.

15 [0011] In a preferred implementation, the length of the side rails, the length of the side arms and amount of blind fabric provided on the roller together enable the blind to fully cover the window when in the lowermost position. For example, in some embodiments the side arms may be between about 300mm and 500mm in length, and the side rails may be between 1.0m and 2.0m in length. However,
20 any alternative arm and rail lengths may be chosen according to the size of the window opening and any other installation requirements or restrictions. Such variations would be readily apparent to a person skilled in the art and need not be explained in detail. The amount of blind fabric provided on the roller is then selected as required for the installation.

25 [0012] In one embodiment, end stops may be provided at one or both ends of each side rail to limit the range of travel of the slider assemblies along the side rails.

[0013] In one embodiment, each slider assembly comprises a front portion and a rear portion. The front portion is preferably configured to enable the

respective side arm to be pivotally connected to the slider assembly. The rear portion is preferably configured to enable the slider assembly to travel along the respective side rail.

5 [0014] In one embodiment, the rear portion of each slider assembly comprises at least one linear bearing to enable the slider assembly to travel along the respective side rail. In another embodiment, the rear portion of the slider assembly comprises a pair of linear bearings.

10 [0015] Each linear bearing preferably comprises a bush carrying rows of rollers held by a retainer, with each linear bearing being secured within the rear portion by a cradle. Advantageously, the cradle and linear bearing are split lengthwise such that a lengthwise aperture is formed to allow the rear portion of the slider assembly to travel past a mounting bracket securing the side rail to the wall of the building.

15 [0016] In one embodiment, each side arm is spring biased by a spring and cable arrangement located within the side arm. The spring and cable arrangement produce a twisting action between the linear bearing(s) and the respective side rail such that, in use, the twisting action substantially prevents the slider assembly travelling downwards along the respective side rail until the blind fabric is unrolled beyond the second amount. Beyond that amount, the twisting
20 action is relieved and the slider assembly becomes free to travel downwards along the respective side arm.

[0017] In one embodiment, the front portion of the slider assembly comprises a forwardly projecting plate with a transverse aperture to enable the respective side arm to be connected thereto and to pivot about the pivot axis passing
25 through the aperture.

[0018] In one embodiment, the front portion of the slider assembly is secured to the rear portion by means of a pair of fasteners which secure the two portions

together. Alternative, the front portion and rear portion of the slider assembly may be integrally formed.

[0019] In some embodiments the bottom rail may be weighted to assist in providing smooth travel of the slider assemblies along the respective side rails. In
5 some embodiments the blind roller may be motorised to enable the awning blind to be remotely controlled. This can be convenient in many installations.

[0020] To assist the further understanding of the invention, reference is now made to the accompanying drawings which illustrate a preferred embodiment. It is to be appreciated that this embodiment is given by way of illustration only and
10 the invention is not limited to this illustration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Figures 1A-1C show front perspective, front elevation and side cross-sectional views, respectively, of a blind awning in accordance with a preferred embodiment the invention, in a fully retracted (i.e. fully open) position.

15 [0022] Figures 2A-2C show front perspective, front elevation and side cross-sectional views, respectively, of the blind awning of Figures 1A-1C in an extended position where the side arms extend horizontally.

[0023] Figures 3A-3C show front perspective, front elevation and side cross-sectional views, respectively, of the blind awning of Figures 1A-1C in a further
20 extended position where the arms project downwardly (although noting the front and side views of Figures 3B and 3C show the slider assembly and side arms in a slightly lower position than in the perspective view of Figure 3A).

[0024] Figures 4A-4C show front perspective, front elevation and side cross-sectional views, respectively, of the blind awning of Figures 1A-1C in a fully
25 extended (i.e. fully closed) position where the arms project downwardly and are

located at the bottom of the side rails such that the blind fabric completely covers the window.

[0025] Figures 5A and 5B show front and rear perspective views, respectively, of a slider assembly in accordance with one embodiment of the invention.

5 [0026] Figures 6A-6E show front, side, rear, top and bottom views of the slider assembly shown in Figures 5A-5B.

[0027] Figure 7 shows an exploded perspective view of the slider assembly shown in Figures 5A-5B.

10 [0028] Figure 8A and 8B show front and side cross-sectional views, respectively, of a side arm, slider assembly and side rail in accordance with one embodiment.

DESCRIPTION OF PREFERRED EMBODIMENTS

15 [0029] Referring initially to Figures 1A to 4C there is shown a multifunction awning blind 10, in accordance with a preferred embodiment of the invention, for a window 12 or similar opening in a wall 14 of a building. Accordingly, it is to be understood that throughout this specification, including the claims, reference to a "window" or "window opening" is intended to also encompass a door opening, an open archway, or any other form of opening in a wall of a building. The awning blind 10 comprises a blind roller 16 configured to be secured to the wall 14 at the top of the window opening 18. In this example, the roller 16 is located within a protective header box 20. The awning blind 10 also comprises a blind fabric 22, a bottom rail 24, a pair of side rails 26, a pair of slider assemblies 28, and a pair of side arms 30.

25 [0030] Figures 1A-1C show the awning blind 10 in a fully retracted (completely open) position. Figures 2A-2C show the awning blind in an extended

position with its arms 30 projecting horizontally such that the blind fabric 22 forms a canopy or hood over the window 12. Figures 3A-3C show the awning blind in a further extended position with the arms 30 projecting downwardly, and Figures 4A-4C show the awning blind in a fully extended position with the arms 30 again projecting downwardly but now shifted downward towards the bottom of the side rails 26 such that the blind fabric 22 is substantially vertical (Figure 4C) and completely covers the window 12.

[0031] As can be seen initially in Figure 1C, the blind fabric 22 is wound upon the blind roller 16 such that the fabric can be wound and unwound from the roller. The bottom rail 24 is secured to a free end of the blind fabric 22 and the pair of side rails 26 is configured to be secured to the wall 14, with one rail on each side of the window opening 18. The slider assemblies 28 are attached to and can slide up and down along respective side rails 26.

[0032] Each side arm 30 has a first end 31 pivotally connected to a respective slider assembly 28 and is spring biased to pivot about an axis such that a second end 31' of the arm (i.e. its free end) is urged outwardly away from the window 12 and downward away from the blind roller 16. Each arm 30 has its second end 31' fixed to the bottom rail 24 such that unrolling the blind fabric 22 allows each arm 30 to pivot about its axis.

[0033] The awning blind 10 may be manually operated using a crank arm, or it may be motorised such that a user can operate the awning blind remotely. Motorised operation would generally be preferable in most applications.

[0034] To deploy the awning blind 10, the user controls rotation of the blind roller 16 to allow the blind fabric 22 to be unrolled from the roller. This causes the arms 30 to extend outward, away from the wall 14, such that the blind fabric 22 forms a canopy over the window 12. This outward extension continues until the blind fabric 22 is unrolled a "first amount" and the arms 30 reach a horizontal position, 90° to the side rails 26, as shown in Figure 2A-C. The "first amount"

thus corresponds to the length of blind fabric unwound from the roller for the arms to reach the horizontal position.

5 [0035] Unrolling the blind fabric further, beyond the first amount, causes the arms 30 to pivot further about their axes and extend downward until the blind fabric 22 is unrolled a "second amount", at which point the bottom rail 24 reaches a lowermost position as shown in Figure 3A-C. The arms 30 thus rotate in an arc about their respective axes while the slider assemblies 28 remaining in fixed positions on the side rails 26.

10 [0036] The slider assemblies 28 remaining in fixed positions on the slide rails 26 due to the spring-bias of the arms 30 which, in this example embodiment, is caused by a spring and cable arrangement located within each arm (discussed further below). Tension on these cables produces a twisting action between bearings of the slider assemblies 28 and the sides of the rails 26 that prevents the slider assemblies 28 slipping down the rails, as will be explained further below.

15 [0037] Once the arms 30 reach their lowermost position, as shown in Figure 3A, the tension on the springs, and thus twisting force on the rails 26, is released. Unrolling the blind fabric 22 further then causes the slider assemblies 28 to travel downwards along the rails 26 as the fabric 22 is further unrolled. Accordingly, the arms 30 and bottom rail 24 also move downwards such that the blind fabric 22
20 covers more of the window. This continues until the blind fabric has been unrolled a "third amount" corresponding to the blind fabric completely covering the window 12, as shown in Figures 4A-C.

25 [0038] The inventors have found that adding weight to the bottom rail 24 assists in providing smooth travel of the slider assemblies 28 along the side rails 26.

[0039] It will be appreciated that the operation of the awning blind 10, with side arms 30 pivoting between the fully up position shown in Figures 1A and the

down position shown in Figures 3A, is similar to the operation of a conventional retractable fixed pivot arm awning, as described in the Background section above. However, the awning blind of the present invention may be further unrolled to allow the blind to drop down to any length according to the amount of material that is provided on the blind roller.

[0040] It will also be appreciated that the side arms 30 may be made of any length and need not be made half the height of the window to achieve full coverage, as in a conventional fixed pivot arm awning. Choosing shorter arm lengths minimises obstructions where windows are located close to footpaths or driveways. The arms may, for example, be made 500 mm in length and still achieve full coverage of a 2 m window by providing side rails having a 1 m length of travel. Alternatively, the arms may be only 300 mm in length and be combined with rails having a 1.4 m length of travel to achieve the same 2 m window coverage. The lengths of the arms and rails may therefore be chosen according to the intended application and window position. The length of the arms may also be chosen to achieve any desired horizontal projection (when in the 90° horizontal position, as in Figure 2) of the canopy/hood formed over the window. In some situations, a deeper canopy may be desired whereas in other situations a shallower canopy is better.

[0041] Referring now to Figures 5A to 7, there is shown a slider assembly 28 in accordance with an embodiment of the invention. In these drawings, Figures 5A and 5B show front and rear perspective views respectively, Figures 6A-6E show various elevations, and Figure 7 shows an exploded perspective view in which various components of the slider assembly are separated.

[0042] The slider assembly 28 includes a front portion 50 and a rear portion 52. The front portion 50 has a forwardly projecting plate 54 having an aperture 56 to enable a side arm 30 to be connected thereto and enable the arm to pivot about an axis passing through the aperture 56. The front portion 50 is secured to the rear portion 52 by means of a pair of fasteners 58 (in this instance hexagonal

socket head cap screws) which secure the two portions together. Locating bosses 60 are provided to precisely position the front portion 50 relative to the rear portion 52.

5 [0043] In an alternative embodiment, not shown, the front portion 50 and rear portion 52 may be integrally formed as a single piece. The provision of two separate components is not essential.

10 [0044] In the embodiment shown, the front portion 50 includes means to anchor a tension cable 62 for a spring 64 located within the arm 30 (see Figure 8B). In particular, an aperture 66 and guide slot 68 are provided to enable the tension spring 62 to be anchored beneath the front portion 50, pass through the aperture 66 and along the guide slot 68, over the front of the projecting plate 54 and then enter the arm 30 and connect to the spring 64. As explained further below, the tension provided by the spring 64 on the tension cable 62 pulls the arm 30 downwards, towards the position shown in Figures 3A-3C.

15 [0045] The rear portion 52 includes a pair of linear bearings 70 to enable the slider assembly 28 to smoothly travel along a side rail 26. Each linear bearing 70 comprises a bush 72 carrying rows of rollers 74 held by a retainer 76. Each linear bearing 70 is secured within the rear portion 52 by a cradle 78, as best seen in Figure 5B. Both the cradle 78 and linear bearing 70 are split lengthwise such that
20 a lengthwise aperture is formed to allow the rear portion 52 of the slider assembly 28 to travel past mounting brackets 80 that secure the side rails 26 to the wall of the building. Two sets of bearing locking pins 82 ensure that the linear bearings 70 do not move lengthwise within their respective cradles 78.

25 [0046] Referring now to Figure 8A, there is shown a front view of side arm 30 attached to and movable along a side rail 26 by means of a slider assembly 28. A pivot pin 79 passing through the aperture 56 in the plate 54 secures the arm 30 to the slider assembly 28. Also shown in this drawing is the mounting bracket 80 that secures the side rail 26 to the wall 14 of the building.

[0047] Figure 8B shows a cross-sectional side view of this arrangement along the line B-B in Figure 8A. In this view, one can see the tension cable 62 held by a swaged end 84 within a recess provided in the underside of the body of the front portion 50.

5 [0048] In the embodiment shown, the spring 64 is a compression spring located within a hollow body of the arm 30 and the tension cable 62 is secured to the far end of the compression spring by a retainer 86. The retainer 86 is not fixed to the arm 30 and is instead free to move lengthwise within the inner cavity of the arm. In an alternative embodiment, not shown, the spring 64 could instead
10 be a tension spring fastened at some point within the arm 30, such as at or near its free end.

[0049] As will be appreciated from the arrangement shown in Figure 8B, tension on the cable 62 by the spring 64 serves to cause the arm to want to rotate about an axis passing through the pivot pin 79, in an anticlockwise direction in
15 this figure.

[0050] The multifunction awning blind of the present invention has significant advantages over conventional awnings and blinds. It can serve both functions in accordance with the amount of blind fabric released from the roller. These different functions can be employed in different situations or at different times of
20 the day. For example, an awning window (a window of the type that hinges from the top) can be opened to let in airflow with the blind down, thus providing protection from the sun, wind and rain. With the awning blind in a halfway position the blind becomes a hood awning, or canopy, that solves the problem of high sun penetration while allowing the unaffected portion of the window to be
25 free, thus allowing shade while maintaining the view and airflow through an open window. In an upper position, the blind fabric is fully retracted, allowing the window to be completely uncovered. These advantages have not previously been provided by a single product. Embodiments of the awning blind of the

present invention provide these advantages by being able to “transform” between awning and blind functions.

[0051] The awning blind may be motorised so that it can be remotely controlled. This overcomes a problem for elderly people trying to use
5 conventional auto blinds, of the type described in the Background above, when trying to use a rod to manually move the auto blind up-and-down. A motorised blind can also be operated by anyone remotely in difficult to reach applications and multilevel buildings. It may also be operated from inside the building, eliminating the need to go outside in the case of wind, rain, or if the blind is in a
10 hard to reach location.

[0052] Although a preferred embodiment of the invention has been described herein in detail, it will be understood by those skilled in the art that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

15 [0053] In the claims which follow and in the description of the invention, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in
20 various embodiments of the invention.

CLAIMS:

1. A multifunction awning blind for a window or similar opening in a wall of a building, the awning blind comprising:

5 a blind roller configured to be secured to the wall at the top of the window opening;

a blind fabric wound upon the blind roller such that the blind fabric can be wound and unwound from the roller;

a bottom rail secured to a free end of the blind fabric;

10 a pair of side rails configured to be secured to the wall with one rail on each side of the window opening;

a pair of slider assemblies attached to and movable along respective side rails; and

15 a pair of side arms, each arm having a first end pivotally connected to a respective slider assembly about a pivot axis and being spring biased to pivot about the axis such that a second end of the arm is urged outwardly away from the window and downward away from the blind roller, and each arm having its second end fixed to the bottom rail such that unrolling the blind fabric allows each arm to pivot about its axis,

whereby, in use:

20 unrolling the blind fabric from an initial, fully-retracted starting position up to a first amount causes the arms to extend outward, while the slider assemblies remain in fixed positions on the side rails, such that blind fabric forms a canopy over the window,

25 unrolling the blind fabric beyond the first amount and up to a second amount causes the arms to extend downward, while the slider assemblies continue to remain in the fixed positions on the side rails, until the bottom rail reaches a lowermost position within an arc of motion, and

30 unrolling the blind fabric beyond the second amount and up to a third amount causes the slider assemblies to travel downwards along the side rails such that the arms and bottom rail move downwards and the blind fabric covers more of the window.

2. The multifunction awning blind of claim 1 wherein a stop is provided at each end of each side rail to limit a range of travel of the slider assemblies along the side rails.
3. The multifunction awning blind of claim 1 or claim 2 wherein the side rails
5 have a length, the side arms have a length and the blind fabric has an amount which together enable the blind fabric to fully cover the window when in a lowermost position and the blind fabric is unrolled to the third amount.
4. The multifunction awning blind of any one of the preceding claims wherein
10 each slider assembly comprises a front portion and a rear portion, the front portion being configured to enable the respective side arm to be pivotally connected to the slider assembly, and the rear portion being configured to enable the slider assembly to travel along the respective side rail.
5. The multifunction awning blind of claim 4 wherein the rear portion of each
15 slider assembly comprises at least one linear bearing to enable the slider assembly to travel along the respective side rail.
6. The multifunction awning blind of claim 4 wherein the rear portion of the slider assembly comprises a pair of linear bearings to enable the slider assembly to travel along the respective side rail.
7. The multifunction awning blind of claim 5 or claim 6 wherein:
20 each linear bearing comprises a bush carrying rows of rollers held by a retainer;
each linear bearing is secured within the rear portion by a cradle; and
the cradle and linear bearing are split lengthwise such that a lengthwise
aperture is formed to allow the rear portion of the slider assembly to travel past a
25 mounting bracket securing the side rail to the wall of the building.

8. The multifunction awning blind of any one of claims 5 to 7 wherein each side arm is spring biased by a spring and cable arrangement located within the side arm, the spring and cable arrangement producing a twisting action between the linear bearing(s) and the respective side rail such that, in use, the twisting
5 action substantially prevents the slider assembly travelling downwards along the respective side rail until the blind fabric is unrolled beyond the second amount.
9. The multifunction awning blind of any one of claims 4 to 8 wherein the front portion of the slider assembly comprises a forwardly projecting plate with a transverse aperture to enable the respective side arm to be connected thereto
10 and to pivot about the pivot axis passing through the aperture.
10. The multifunction awning blind of any one of claims 4 to 9 wherein the front portion is secured to the rear portion by means of a pair of fasteners which secure the two portions together.
11. The multifunction awning blind of any one of claims 4 to 9 wherein the front
15 portion and rear portion of the slider assembly are integrally formed.
12. The multifunction awning blind of any one of the preceding claims wherein the bottom rail is weighted to assist in providing smooth travel of the slider assemblies along the respective side rails.
13. The multifunction awning blind of any one of the preceding claims wherein
20 the blind roller is motorised to enable the awning blind to be remotely controlled.
14. The multifunction awning blind of any one of the preceding claims wherein the side arms are between about 300mm and 500mm in length and the side rails are between 1.0m and 2.0m in length.

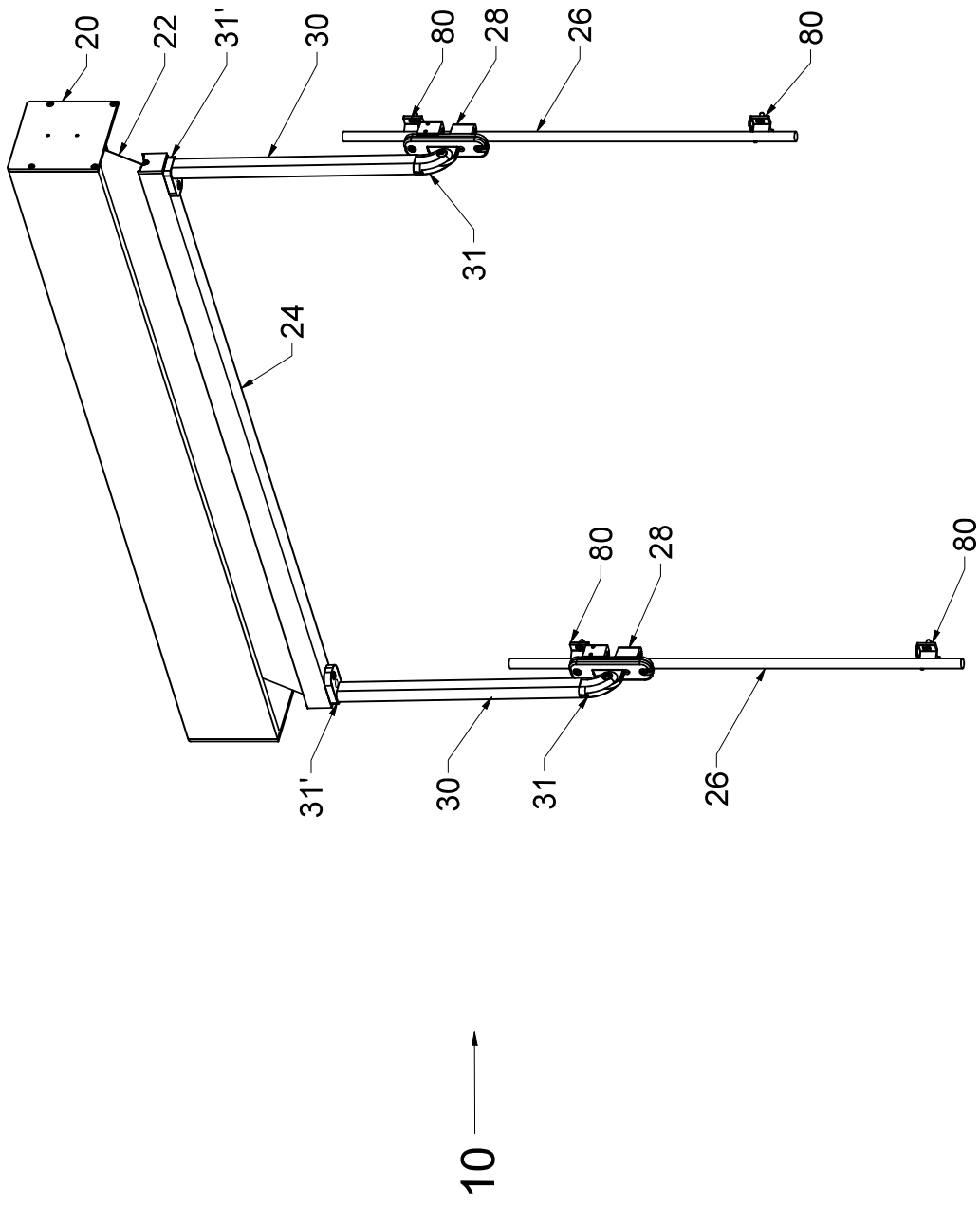


Fig. 1A

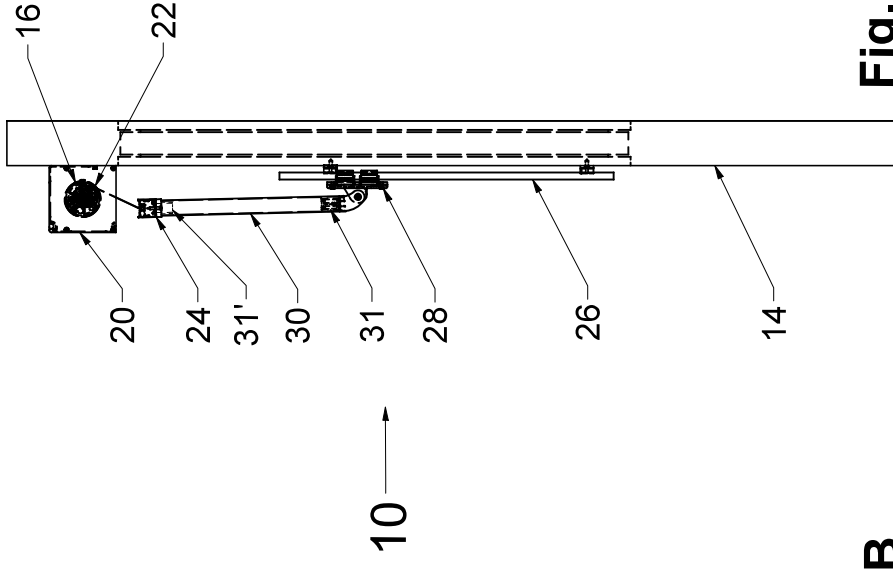


Fig. 1B

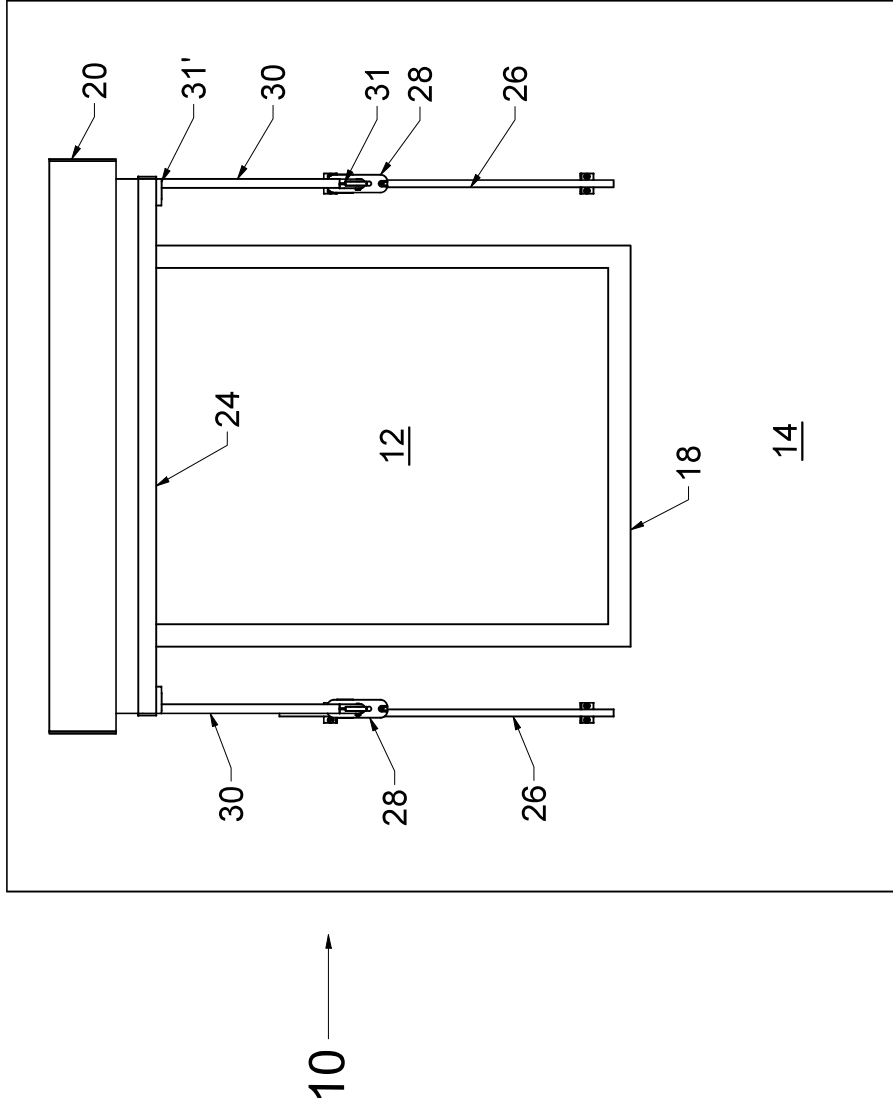


Fig. 1C

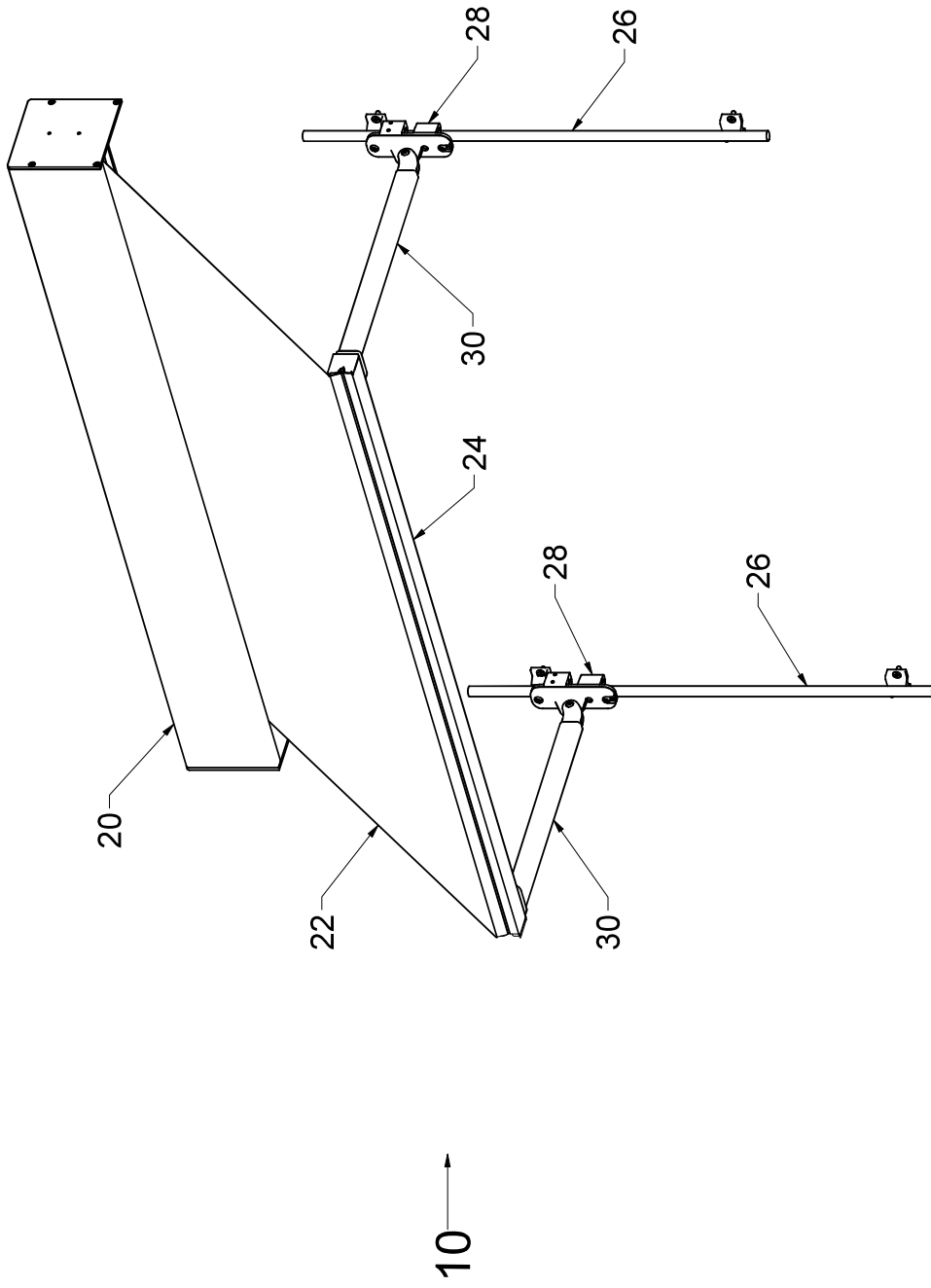


Fig. 2A

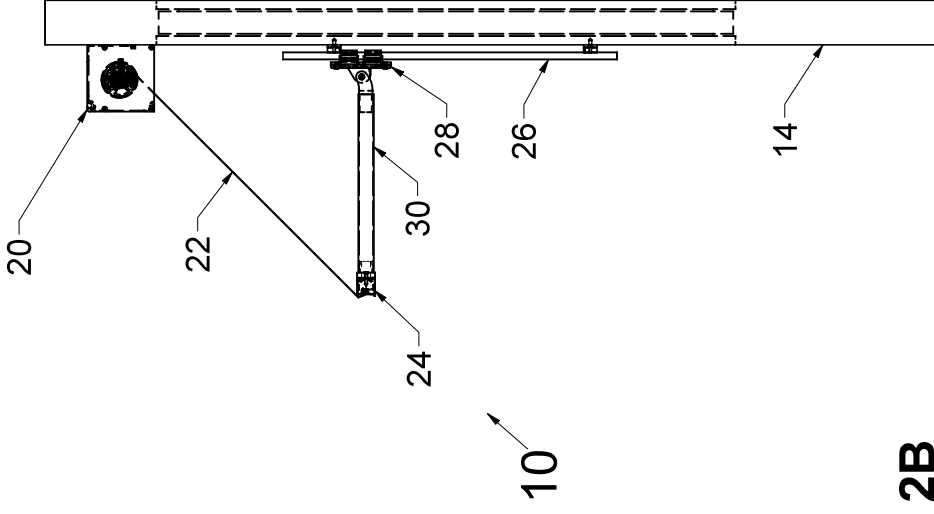


Fig. 2C

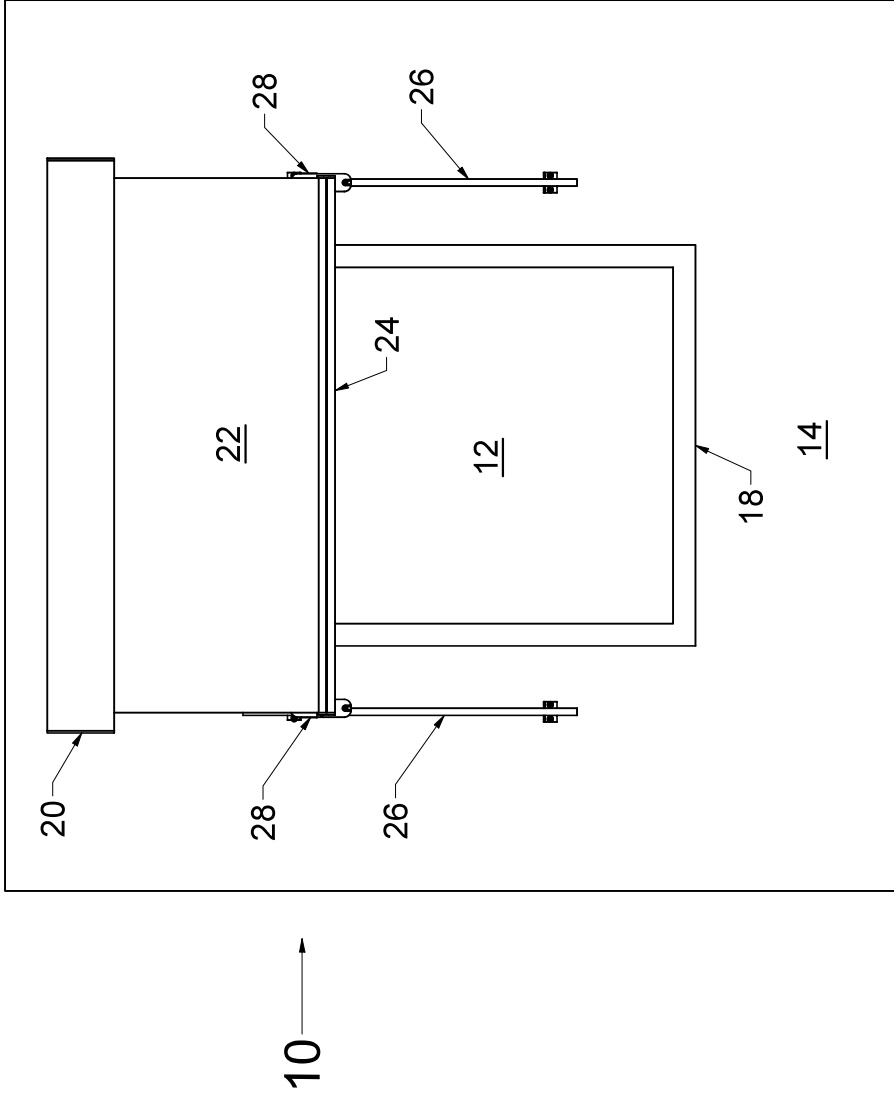


Fig. 2B

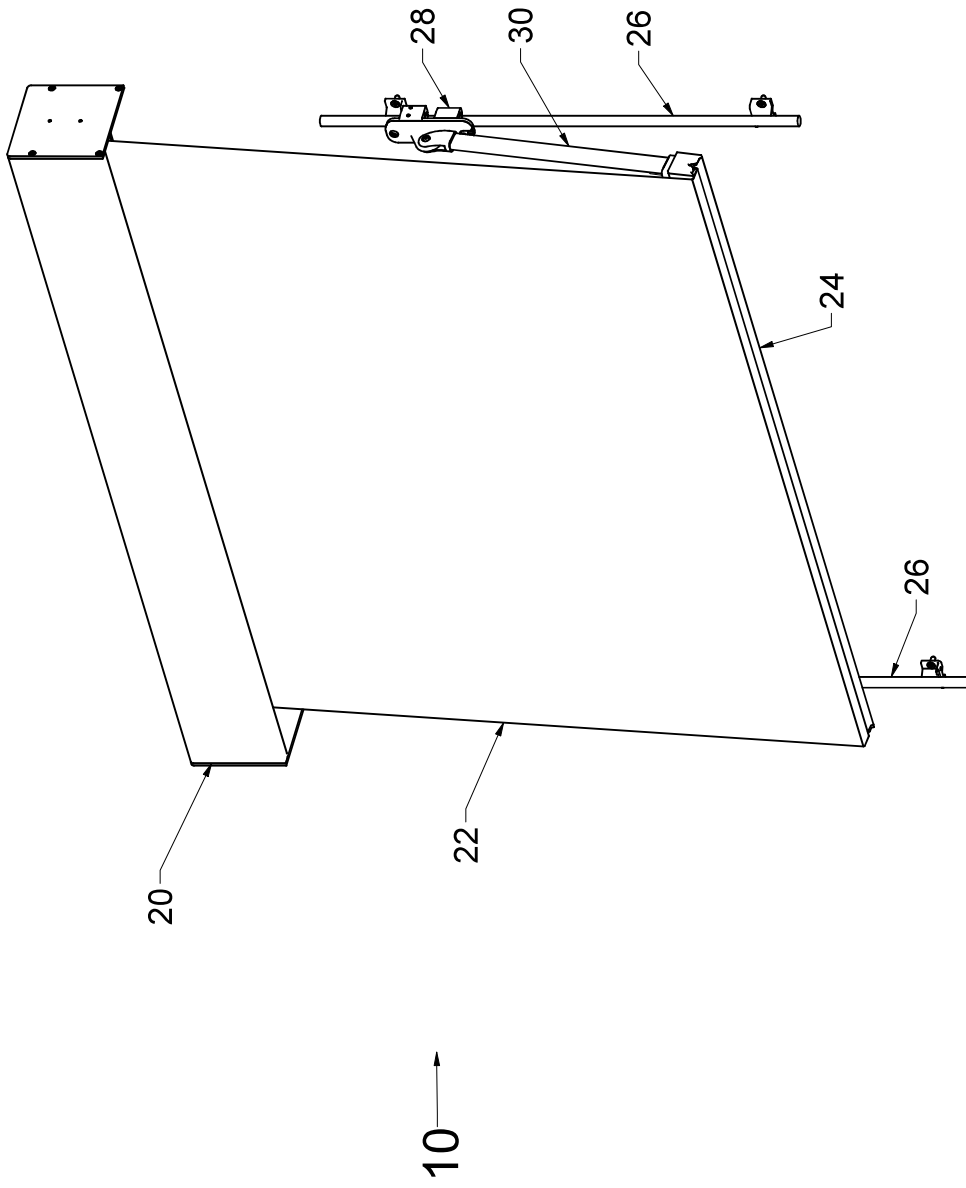


Fig. 3A

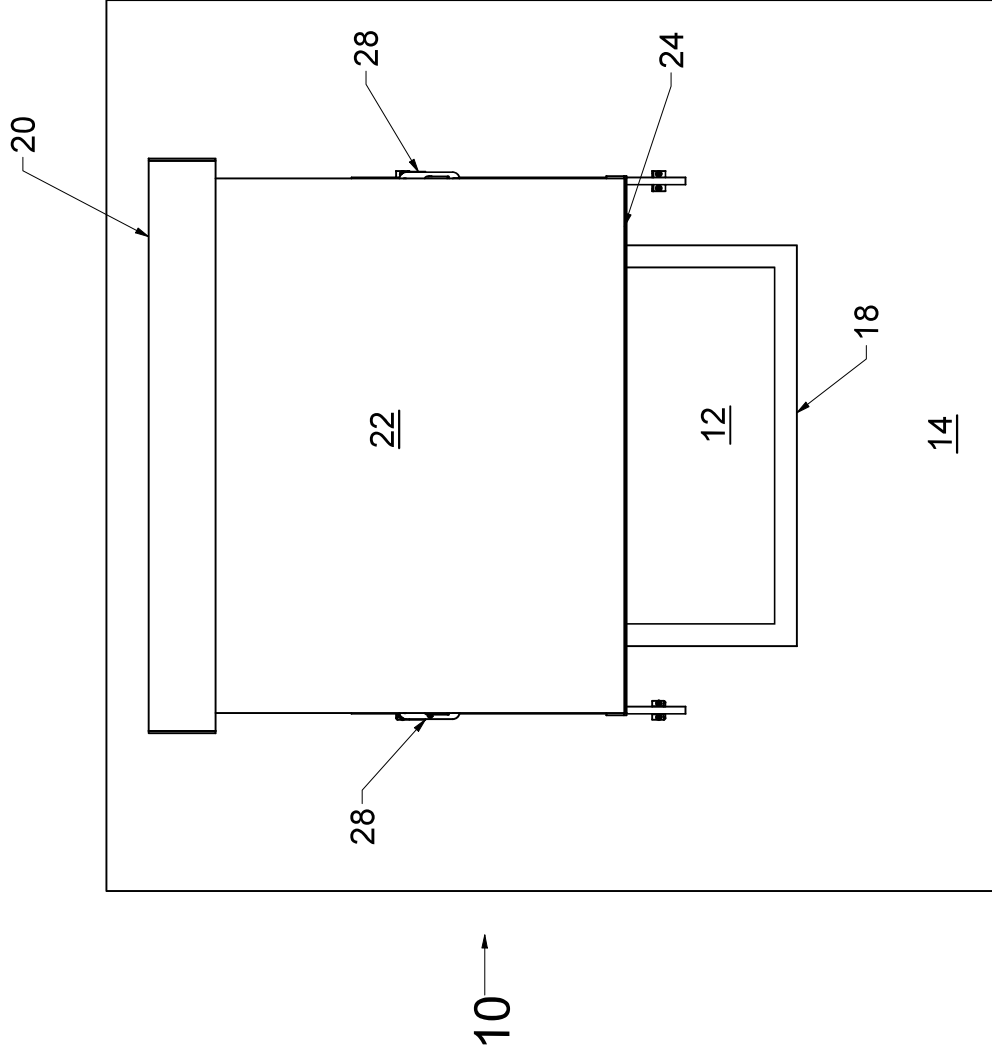


Fig. 3B

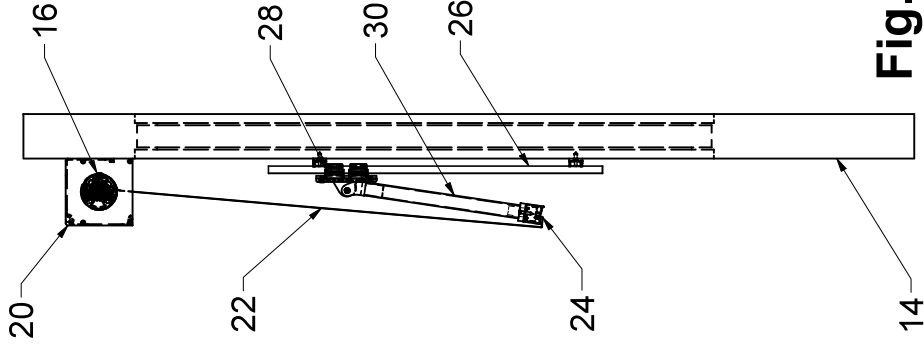


Fig. 3C

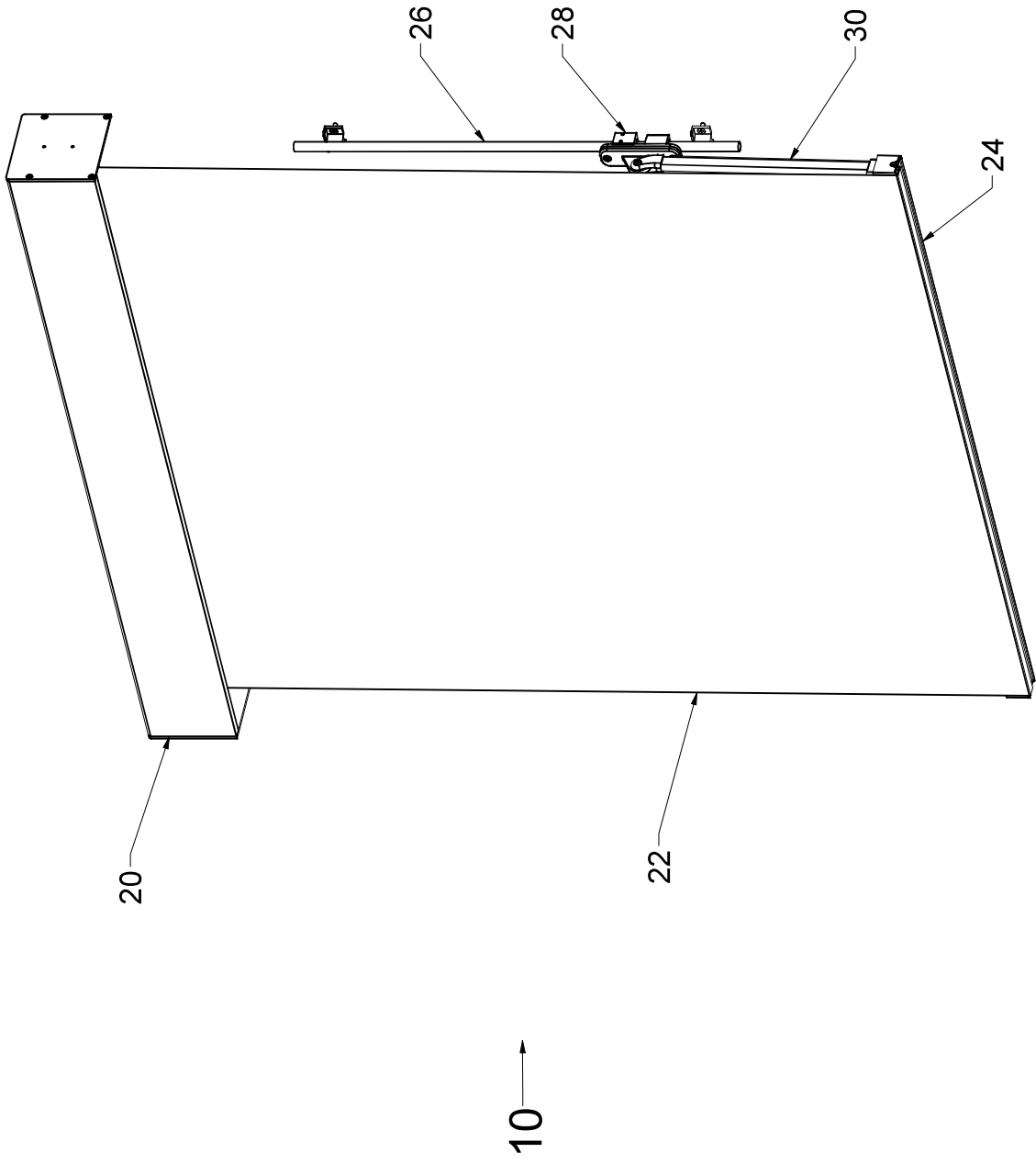


Fig. 4A

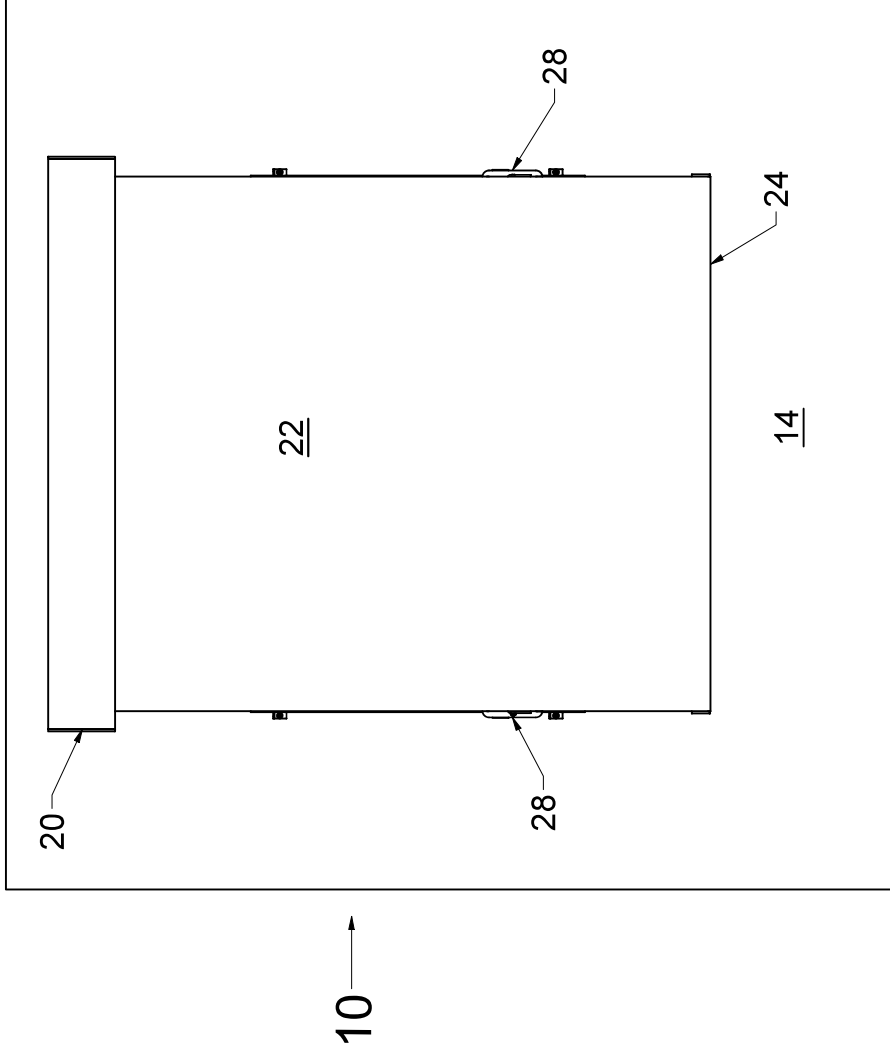


Fig. 4B

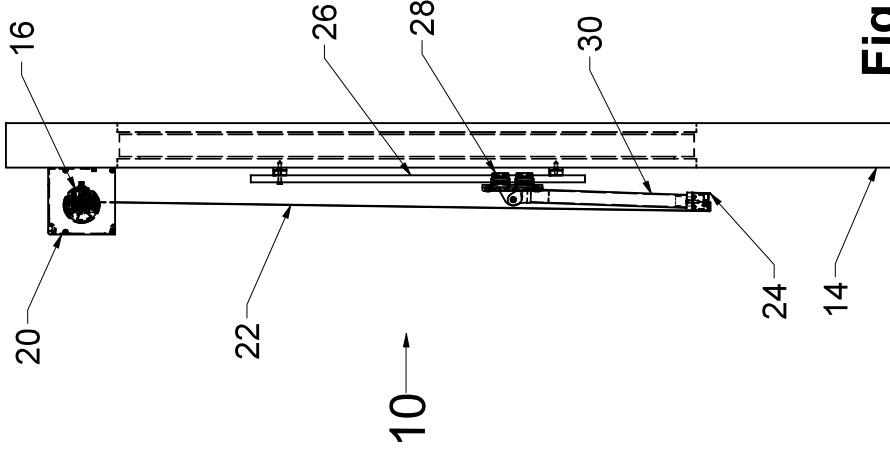


Fig. 4C

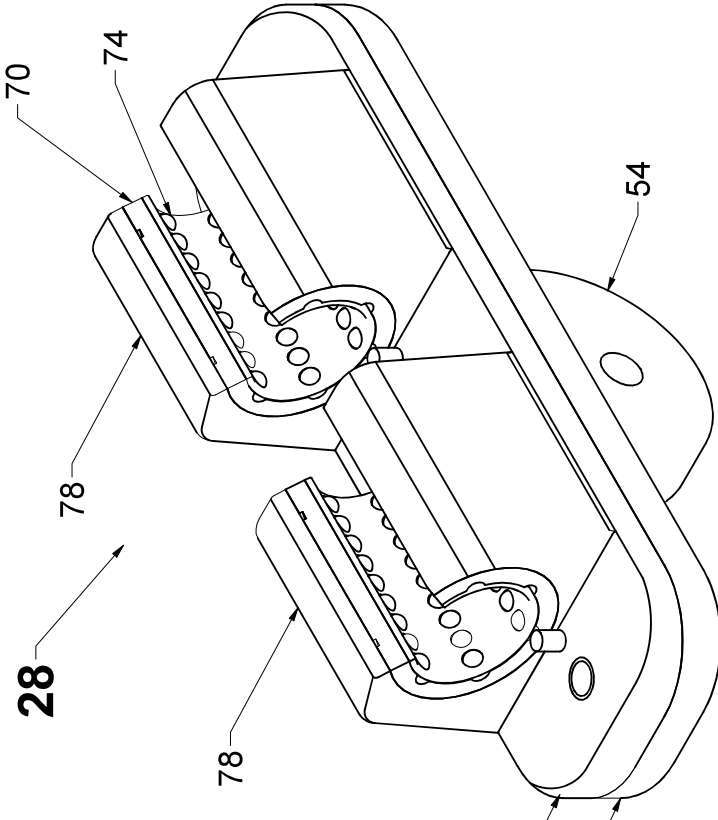


Fig. 5A

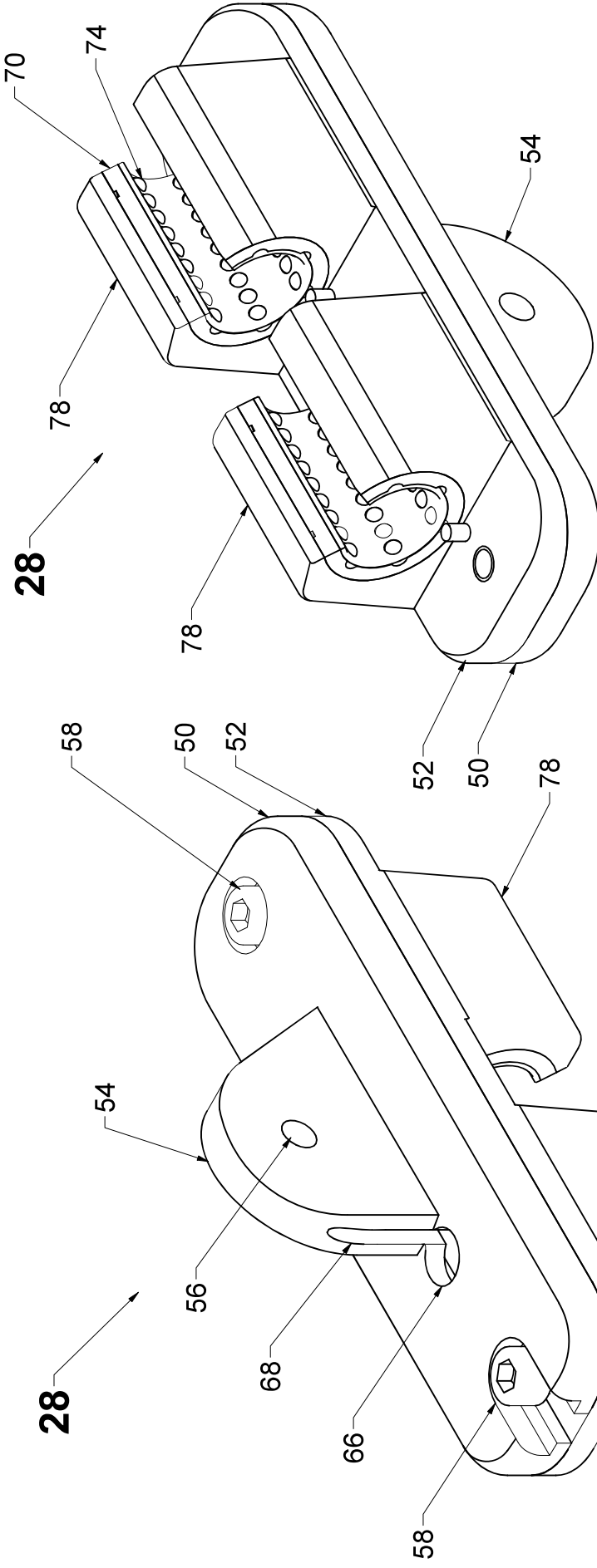


Fig. 5B

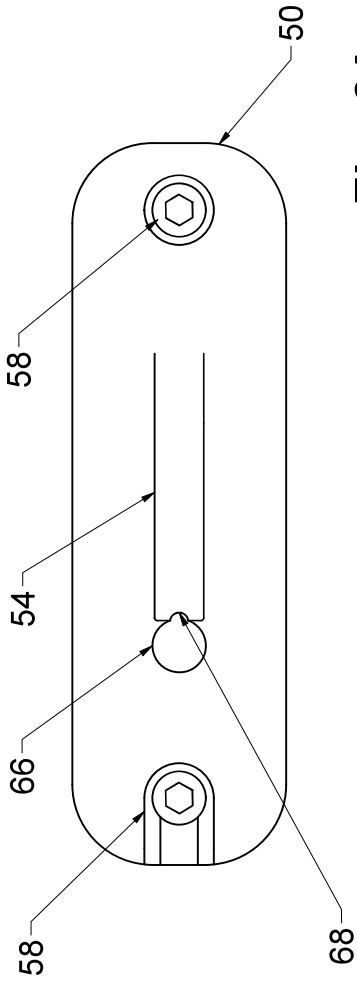


Fig. 6A

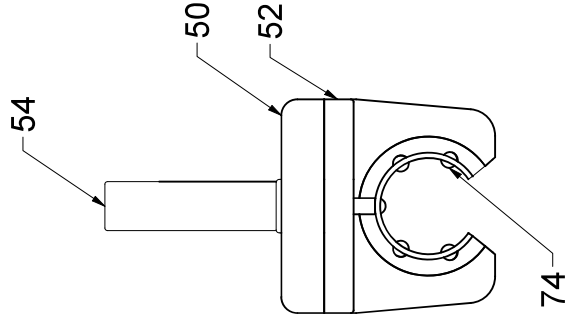


Fig. 6D

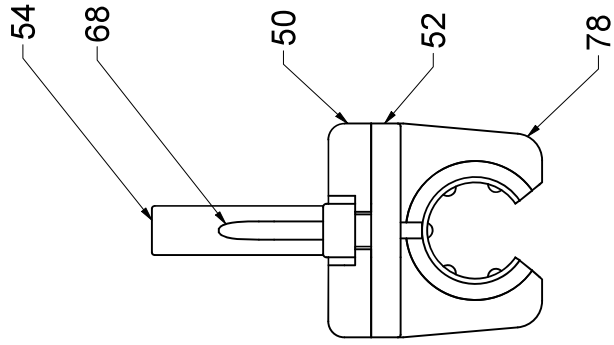


Fig. 6E

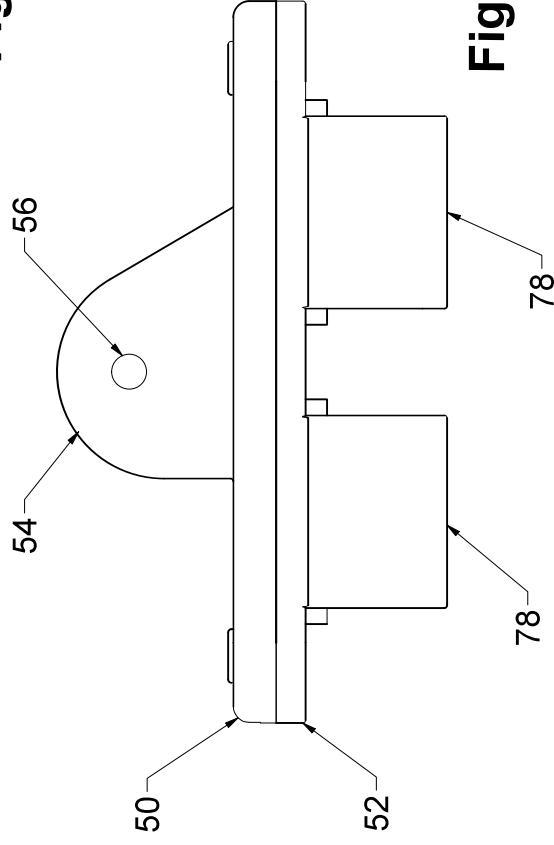


Fig. 6B

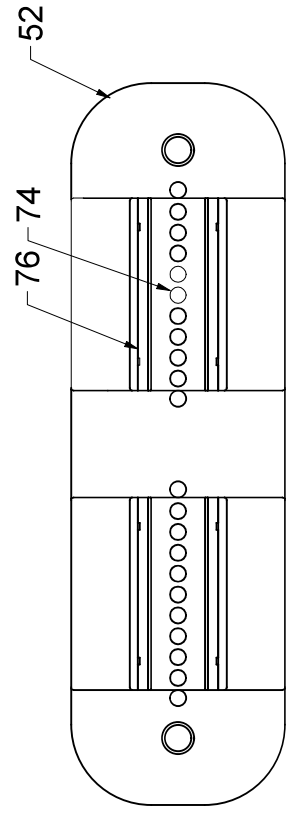


Fig. 6C

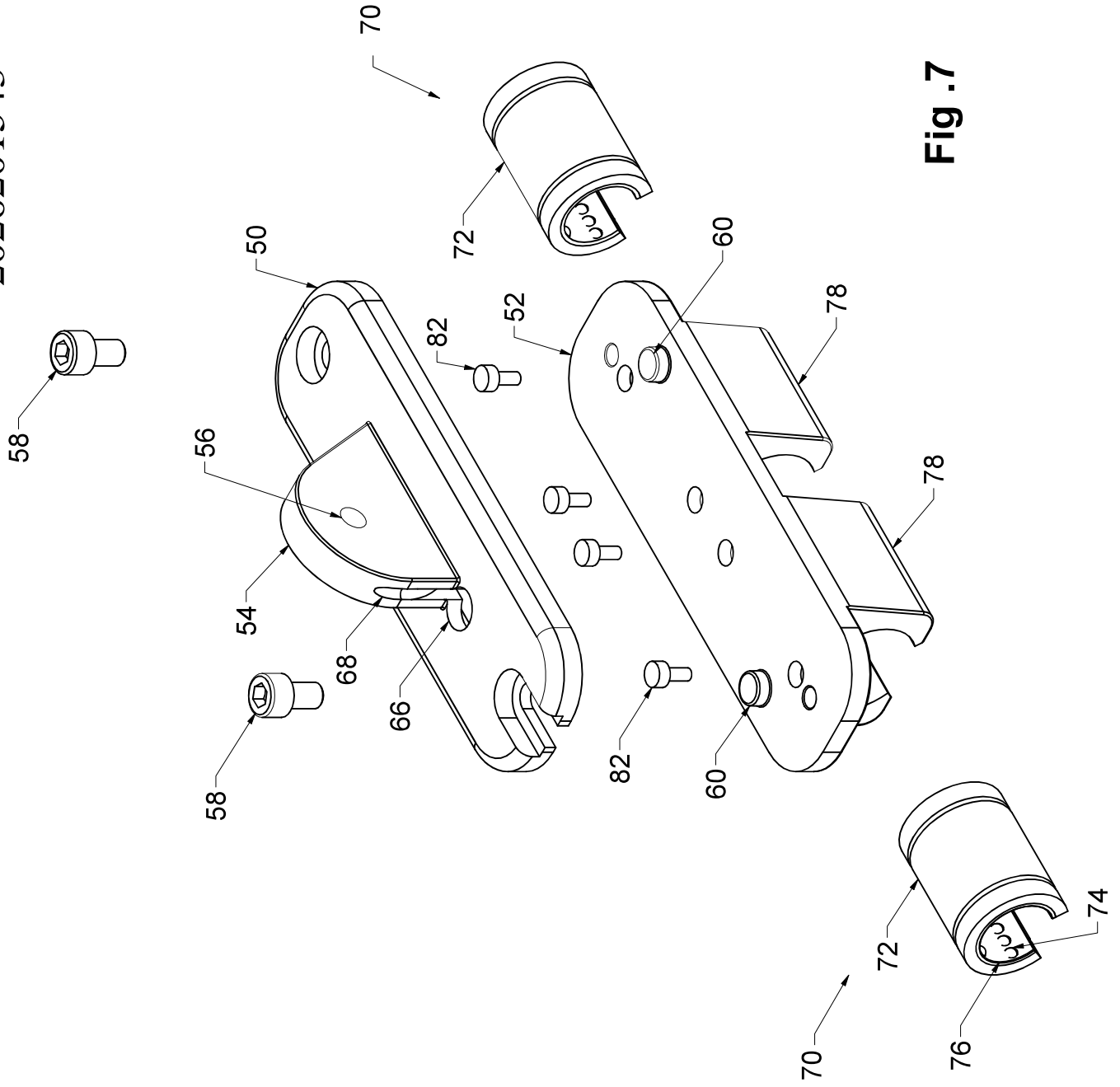


Fig .7

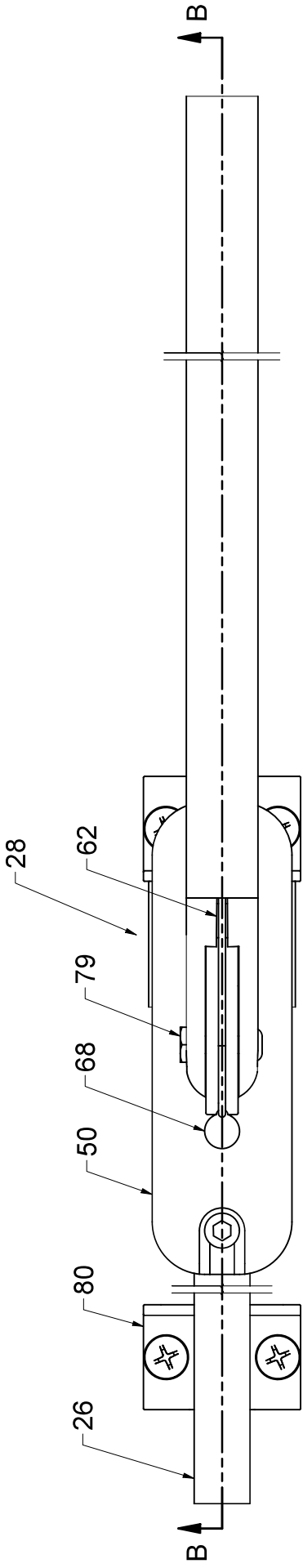


Fig. 8A

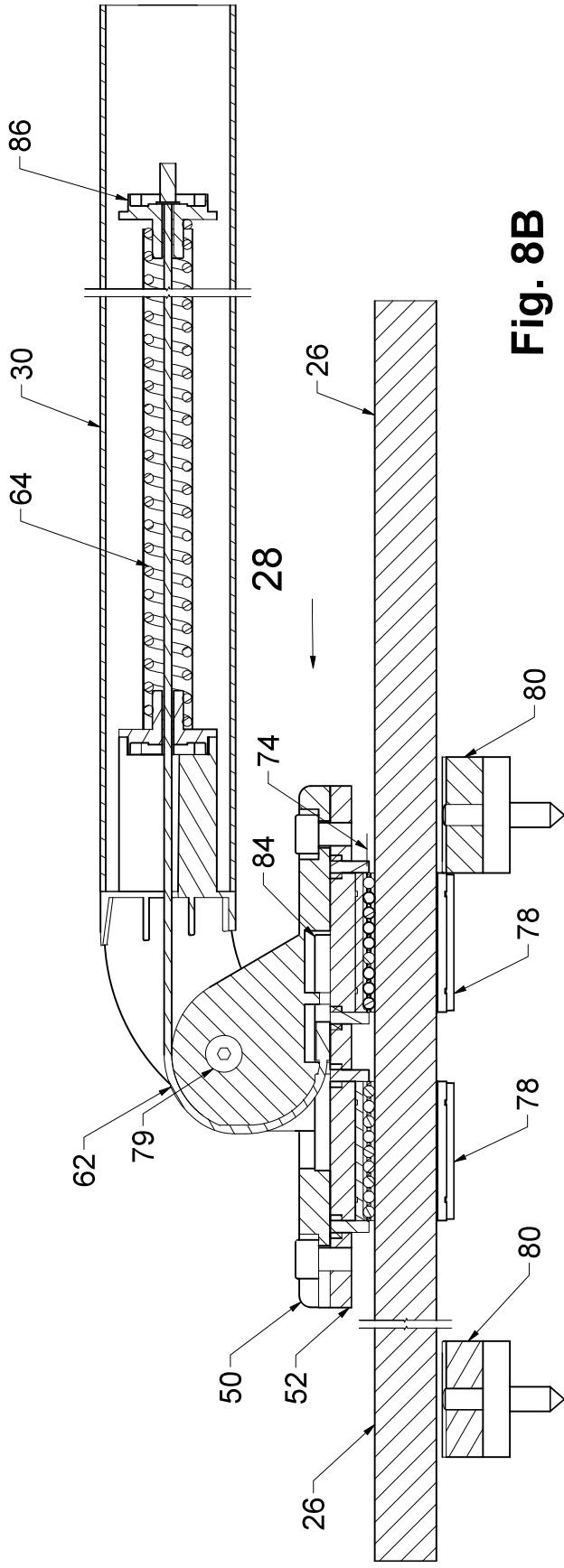


Fig. 8B

SECTION B-B