Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 2801901 C 2019/04/23

(11)(21) 2 801 901

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2011/06/07
(87) Date publication PCT/PCT Publication Date: 2011/12/15
(45) Date de délivrance/Issue Date: 2019/04/23
(85) Entrée phase nationale/National Entry: 2012/12/06
(86) N° demande PCT/PCT Application No.: US 2011/039473
(87) N° publication PCT/PCT Publication No.: 2011/156395
(30) Priorité/Priority: 2010/06/08 (US61/352,632)

(51) Cl.Int./Int.Cl. *E06B 7/08* (2006.01),
*E06B 7/00* (2006.01)

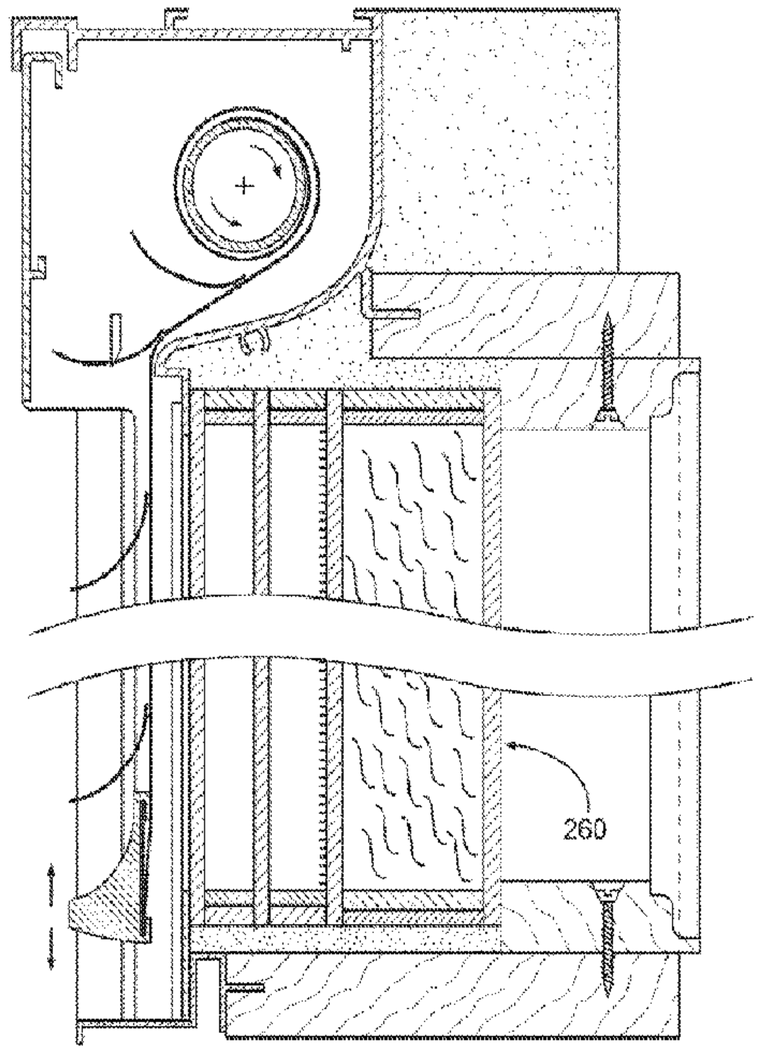
(72) Inventeurs/Inventors:
COLSON, WENDELL B., US;
HARTMAN, DAVID P., US;
FOGARTY, DANIEL M., US

(73) Propriétaire/Owner:
HUNTER DOUGLAS INC., US

(74) Agent: GOWLING WLG (CANADA) LLP

(54) Titre : ENSEMBLE UNITAIRE POUR UN FENETRAGE ARCHITECTURAL, PRODUISANT UNE COMMANDE DE GAIN DE CHALEUR SOLAIRE DYNAMIQUE

(54) Title: A UNITARY ASSEMBLY FOR AN ARCHITECTURAL FENESTRATION, PROVIDING DYNAMIC SOLAR HEAT GAIN CONTROL




(57) Abrégé/Abstract:
The present disclosure is related to a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, which (1) provides a track-based frame structure/blind combination in which the blind is self-correcting should the blind material fall outside of the track; (2) provides directional shading, where the assembly provides for dynamically controlling the amount of light allowed to reach the heat storage unit; (3) provides a blind motor without limiter switches and with a quick-release slip-ring; and (4) provides a heat storage unit which is a thermally efficient, transparent and translucent structure, with which gain from sunny winter days is greater than nighttime loss, so as to provide supplemental heat.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 December 2011 (15.12.2011)

PCT

(10) International Publication Number
WO 2011/156395 A1

(51) International Patent Classification:
*E06B 7/08* (2006.01)

(21) International Application Number:
PCT/US2011/039473

(22) International Filing Date:
7 June 2011 (07.06.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/352,632 8 June 2010 (08.06.2010) US

(71) Applicant *(for all designated States except US)*: **HUNTER DOUGLAS INC.** [US/US]; 2 Park Way, Upper Saddle River, New Jersey 07458 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **COLSON, Wendell B.** [US/US]; 14 Byron Road, Weston, Massachusetts 02493 (US). **HARTMAN, David P.** [US/US]; 66 Fruit Street, Ashland, MA 01721 (US). **FOGARTY, Daniel M.** [US/US]; 193 Danforth Street, Framingham, Massachusetts 01701 (US).

(74) Agent: **BOMZER, T. David**; Day Pitney LLP, 7 Times Square, New York, New York 10036 (US).

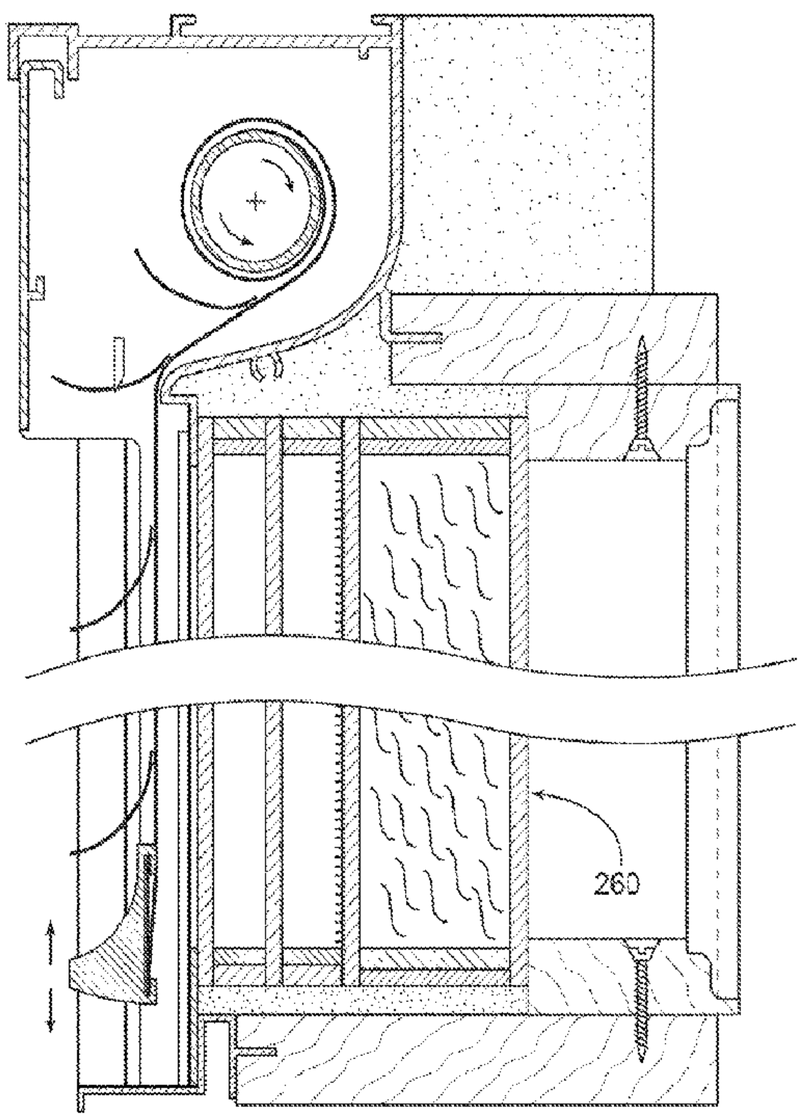
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG,

*[Continued on next page]*

(54) Title: A UNITARY ASSEMBLY FOR AN ARCHITECTURAL FENESTRATION, PROVIDING DYNAMIC SOLAR HEAT GAIN CONTROL

FIG. 27




(57) Abstract: The present disclosure is related to a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, which (1) provides a track-based frame structure/blind combination in which the blind is self-correcting should the blind material fall outside of the track; (2) provides directional shading, where the assembly provides for dynamically controlling the amount of light allowed to reach the heat storage unit; (3) provides a blind motor without limiter switches and with a quick-release slip-ring; and (4) provides a heat storage unit which is a thermally efficient, transparent and translucent structure, with which gain from sunny winter days is greater than nighttime loss, so as to provide supplemental heat.

WO 2011/156395 A1

WO 2011/156395 A1

ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published**:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

# A UNITARY ASSEMBLY FOR AN ARCHITECTURAL FENESTRATION, PROVIDING DYNAMIC SOLAR HEAT GAIN CONTROL

[0001]

## BACKGROUND OF THE DISCLOSED EMBODIMENTS

[0002] The objective of the present disclosure is to obtain a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, which: (1) provides a track-based frame structure/blind combination in which the blind is self-correcting should the blind fabric fall outside of the track; (2) provides directional shading, where the assembly provides for dynamically controlling the amount of light allowed to reach the heat storage unit; (3) provides a blind motor without limiter switches and with a quick-release slip-ring; and (4) provides a heat storage unit which is a thermally efficient, transparent and translucent structure, with which gain from sunny winter days is greater than nighttime loss, so as to provide supplemental heat.

[0003] According to a further object of the disclosure, options for the heat storage unit include a window-sized unitary collector and a collector comprising an array of smaller, individual collectors.

[0004] Regarding the first objective, blind fabric in a roller blind is not capable of remaining within a track without additional structural track guides. Should the fabric fall outside of the tracks, known track guides are unable to realign the blind fabric so as to enable the fabric to be automatically reinserted into the tracks. This patent document provides a solution to this problem.

[0005] Aspects of the remaining three objectives have been solved by the named inventor, as disclosed in International Patent Application No. PCT/US09/64682 for a "Slatted Roller Blind," filed November 17, 2009 on behalf of Hunter Douglas Inc., of Upper Saddle River, New Jersey, USA, and which named as an inventor W. Colson; and International Patent Application No.

PCT/US2007/008616 for "Solar Heating Blocks," filed April 5, 2007 on behalf of Hunter Douglas Inc., and which named as an inventor W. Colson. This patent document provides a unitary solution which heretofore has been unknown.

## SUMMARY OF THE DISCLOSED EMBODIMENTS

[0006] The patent document discloses a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, which: (1) provides a track-based frame structure/blind combination in which the blind is self-correcting should the blind fabric fall outside of the track; (2) provides directional shading, where the assembly provides for dynamically controlling the amount of light allowed to reach the heat storage unit; (3) provides a blind motor without limiter switches and with a quick-release slip-ring; and (4) provides a heat storage unit which is a thermally efficient, transparent and translucent structure, with which gain from sunny winter days is greater than nighttime loss, so as to provide supplemental heat.

In accordance with one aspect of the present invention, there is provided a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly including an exterior side along an outdoors side of the architectural fenestration and an interior side along an indoors side of the architectural fenestration, the assembly comprising: a solar energy collector comprising: a glazing; and a heat storage element disposed on the interior side of the assembly relative to the glazing; and a roller shade positioned on the exterior side of the assembly relative to the glazing, the roller shade comprising: a shade material; and louvers projecting outwardly from the shade material; wherein the roller shade is movable along the exterior side of the assembly between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector.

In accordance with another aspect of the present invention, there is provided a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly comprising: a solar energy collector comprising: a glazing with a low emissivity coating; and a heat storage gel; wherein the low emissivity coating is disposed on a surface of the glazing such that the low emissivity coating is thermally coupled to the heat storage gel via the glazing; and a shade located on an exterior side of the solar energy collector, the shade including shade material;

wherein the shade is movable along the exterior side of the solar energy collector between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector.

In accordance with another aspect of the present invention, there is provided a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly including an exterior side along an outdoors side of the architectural fenestration and an interior side along an indoors side of the architectural fenestration, the assembly comprising: a heat storage unit; a shade including shade material, the shade configured to be moved between retracted and extended positions along the exterior side of the assembly to dynamically control an amount of sunlight being transmitted to the heat storage unit; and a guide for guiding the shade material in a vertical direction when unwinding and winding the shade material; wherein the heat storage unit is disposed on the interior side of the assembly relative to the shade.

In accordance with a further aspect of the present invention, there is provided a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, comprising a solar energy collector comprising: a first glazing; a second glazing spaced apart from the first glazing such that an interior cavity is defined between the first and second glazings; and a thermal storage medium disposed within the interior cavity, the thermal storage medium comprising an aqueous hydrogel configured to adhere to an adjacent surface of each of the first and second glazings as heat is stored within the thermal storage medium; and a shade including shade material, the shade being located on an exterior side of the assembly relative to the solar energy collector; wherein the shade is movable along the exterior side of the assembly between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector.

In accordance with another aspect of the present invention, there is provided a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly including an exterior side along an outdoors side of the architectural fenestration and an interior side along an indoors side of the architectural fenestration, the assembly comprising: a solar energy collector disposed on the interior side of the assembly, the solar energy collector comprising: a first sealed cavity including an insulating gas stored therein; and a second sealed cavity including an aqueous thermal storage medium stored therein; and a shade disposed on the exterior side of

the assembly, the shade movable along the exterior side of the assembly between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector; wherein, when the shade is moved to the retracted position, sunlight is allowed to be transmitted through the first sealed cavity and into the second sealed cavity such that solar energy is stored within the aqueous thermal storage medium.

In accordance with another aspect of the present invention, there is provided an assembly for covering an architectural opening, comprising: a shade including a shade material, said shade material movable between a retracted position and an extended position; a frame positioned relative to the architectural opening, said frame defining a guide track configured to receive opposed side sections of said shade material as said shade material is moved between said retracted and extended positions, said guide track including a first side track and an opposed second side track; and a bottom rail coupled to a bottom end of said shade material, said bottom rail extending widthwise between a first end positioned adjacent to said first side track and a second end positioned adjacent to said second side track, said bottom rail including a first track guide extending from said first end into said first side track and a second track guide extending from said second end into said second side track; wherein said first and second track guides are maintained within said first and second side tracks as said shade material is moved between said retracted and extended positions.

In accordance with another aspect of the present invention, there is provided an assembly for covering an architectural opening, comprising: a shade including a shade material, said shade material movable between a retracted position and an extended position; a frame positioned relative to the architectural opening, said frame defining a guide track configured to receive opposed side sections of said shade material as said shade material is moved between said retracted and extended positions, said guide track including a first side track and an opposed second side track; and a transverse alignment guide positioned above said first and second side tracks, said transverse alignment guide configured to support an underside of said shade material as said shade material is moved between said retracted and extended positions, said transverse alignment guide defining a forward edge; wherein said forward edge is vertically aligned with said first and second side tracks.

In accordance with a further aspect of the present invention, there is provided an assembly for covering an architectural opening, comprising: a shade including a shade material and a plurality of louvers coupled to and extending outwardly from said shade material, said shade material including opposed side sections and being movable between a retracted position and an extended position, each of said louvers including a first edge and a second edge opposite said first edge, each said louvers further comprising opposed side segments that overlie said opposed side sections of said shade material; and a frame positioned relative to the architectural opening, said frame defining a guide track configured to receive both said opposed side sections of said shade material and said opposed side segments of said louvers as said shade material is moved between said retracted and extended positions, said guide track including a first side track and an opposed second side track; wherein said opposed side segments are notched so that each side segment defines a notch depth that is less than a louver depth defined between said first and second edges of each of said louvers.

## BRIEF DESCRIPTION OF THE FIGURES

[0007] Certain embodiments of the invention will be described through the use of the accompanying drawings, which are not to be considered as limiting, and in which:

[0008] Figure 1 illustrates the sun facing side of a disclosed slatted roller blind;

[0009] Figure 2 illustrates a side view of the blind illustrated in Figure 1;

[0010] Figure 3 illustrates a perspective view of the blind illustrated in Figure 1;

[0011] Figure 4 illustrates a disclosed slatted roller blind in which the slats are height-wise progressively spaced;

[0012] Figure 5 illustrates a torque limiting motor coupling;

[0013] Figure 6 illustrates an exploded view of a blind assembly configuration which includes the motor coupling of Figure 5 as well as a quick-release slip-ring;

[0014] Figure 7a illustrates an elevational view of the proximate portion of the assembly of Figure 6, with sectional lines B-B;

[0015] Figure 7b illustrates the cross sectional plan view of the assembly of Figure 6 along sectional lines B-B identified in Figure 7a;

[0016] Figure 7c illustrates a plan view of the of the assembly of Figure 6, with sectional lines D-D;

[0017] Figure 7d illustrates the cross sectional view of the axial proximate end of the assembly of Figure 6 along sectional lines D-D identified in Figure 7c, illustrating the torque limiter coupling and the distal side bracket in the background;

[0018] Figure 8 illustrates a magnified cross sectional view of the proximate end of the assembly as illustrated in Figure 7b;

[0019] Figure 9 illustrates a magnified version of Figure 7d, illustrating the torque limiter coupling and the distal side bracket in the background;

[0020] Figure 10 illustrates a magnified cross sectional view of the distal end of the assembly as illustrated in Figure 7c, which illustrates the quick-release slip-ring;

[0021] Figure 11 illustrates a triple glazing with a gel fill for heat storage and dissipation;

[0022] Figure 12 illustrates a quad glazing with a gel fill for heat storage and dissipation;

[0023] Figure 13A illustrates a heat storage block configuration, partially assembled, from an interior perspective;

[0024] Figure 13B illustrates a heat storage block configuration, partially assembled, from an exterior perspective, including a heat-absorbing mask on the exterior side;

[0025] Figure 13C is a schematic illustration of a heat storage block configuration, partially assembled, from an interior perspective, against a glazing on the exterior side;

[0026] Figure 14 illustrates a top sectional view of a unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, and which includes a slatted blind and a triple glazing window;

[0027] Figure 15 illustrates a side sectional view of the assembly of Figure 14, where the blind fabric is unwound;

[0028] Figure 16 illustrates a further top sectional view of the embodiment in Figure 14, with the sectional view illustrating the structure of the bottom rail;

[0029] Figure 17 illustrates a side sectional view of the assembly of Figure 16, where the blind fabric is retracted;

[0030] Figure 18 illustrates the embodiment of Figure 14-17, with the blind fabric unwound in a track;

[0031] Figure 19 further illustrates the embodiment of Figure 14-17, with a portion of the blind pulled from the track;

[0032] Figure 20 further illustrates the embodiment of Figure 14-17, with the blind retracted;

[0033] Figure 21 further illustrates the embodiment of Figure 14-17, with the blind fabric again unwound in the track;

[0034] Figure 22 illustrates a top sectional view of a unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, and

which includes a slatted blind and a triple glazing window having a tinted interior lite;

[0035] Figure 23 illustrates a side sectional view of the assembly of Figure 22;

[0036] Figure 24 illustrates a top sectional view of a unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, and which includes a generic blind and a triple glazing window;

[0037] Figure 25 illustrates a side sectional view of the assembly of Figure 24;

[0038] Figure 26 illustrates a top sectional view of a unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, and which includes a slatted blind and a quad glazing window of Figure 12;

[0039] Figure 27 illustrates a side sectional view of the assembly of Figure 26;

[0040] Figure 28 illustrates a top sectional view of a unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, and which includes a slatted blind, a triple glazing window, a solar heating block array of Figure 13, and a mask on the solar heating block array;

[0041] Figure 29 illustrates a side sectional view of the assembly of Figure 28;

[0042] Figure 30 illustrates a top sectional view of a unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, and which includes a slatted blind, a triple glazing window, the solar heating block array of Figure 13,

and the mask on the interior surface of the interior lite; and

[0043] Figure 31 illustrates a side sectional view of the assembly of Figure 30.

## DETAILED DESCRIPTION OF THE DISCLOSED EMBODIMENTS

[0044] Various components of the unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, have been previously introduced in the incorporated patent documents. These components will now be briefly discussed.

[0045] THE SLATTED ROLLER BLIND

[0046] Turning to Figure 1, the slatted roller blind 10 includes plural slats or louvers 12, which provide the blind with directional shading. A roller 14 is also included, and the axial length of the roller 14, spans the width of the blind 10. The roller 14 is designed to support the blind 10 without additional ladder cords. The illustrated roller 14 is about twenty inches long.

[0047] The slatted roller blind includes a screen 16. The width of the screen, defined by opposing side edges 18, 20, is substantially the same as the width of the roller 14. The length of the screen 16, which is the length of the blind 10, is defined by opposing top and bottom screen edges 22, 24. The top edge 22 is connected directly to the roller 14 and the bottom edge 24, when unwound, is vertically distanced therefrom. The screen length can be a typically available length for off-the-

shelf roller blinds or can be a tailored length as specified for upscale window or door treatments.

[0048] The plural louvers 12 include, e.g., first and second vertically spaced slats 26, 28. Each of the slats has substantially the same length, defined by opposing side edges 30, 32 in first slat 26, and opposing side edges 34, 36 in the second slat 28. Furthermore, the length of the slats is substantially the same as the length of the roller 14.

[0049] Each of the slats 26, 28 also has substantially the same circumferential dimension, defined by opposing front and back edges 38, 40 in the first slat 26, and opposing front and back edges 42, 44 in the second slat 28. The depth of each slat 36, 38 is proportional to Pi, which is effectively about a third of the circumference of the outer diameter of the roller 14.

[0050] Figures 2 and 3 illustrate the edge curvature of the louvers 12. As illustrated in Figure 2, when retracted, the blind 10, with the screen 16 and louvers 12 wound about the roller 14, forms a spiral curve 46. The curvature of each slat edge is defined by the segment of the spiral curve 46 on which the respective slat is positioned when the blind is retracted. As such, the curvature in the set of louvers 12 changes progressively between each adjacent slat 26, 28. That is, slats nearer to the top of the blind 10 have a mean, or average radius which is less than that for slats nearer to the bottom of the blind.

[0051] The slatted roller blind, due to its compact retracted configuration, can be fabricated in relatively long units and rather easily subdivided with a hand or electric saw. For



8854358.1

example, the blind can be fabricated in sixteen-foot width (i.e., along the axial length of the roller), which is about two and a half times the typical blind width. Statistically, such a width provides a reasonable yield when cutting for custom sized shades of the normal size range between three and eight feet wide.

[0052] In the embodiment illustrated in Figure 4, a progressive spacing can also be provided between slats, as illustrated in exaggerated form in the figure. Here, the blind 10 is installed such that the front edge of the slats projects towards the direct incident light.

[0053] As illustrated, vertical spacing between adjacent slats, i.e., lengthwise along the screen, progressively increases, starting at the top slat and continuing to the bottom slat. For example, turning to the top three slats 48, 50, 52, the distance between the second and third slats 50, 52 is greater than the distance between the first and second slats 48, 50. The actual spacing gradient between each slat could increase by, for example, ten-thousandths to fifteen-thousandths of an inch.

[0054] In the figure, direct incident light is illustrated in as sets of essentially parallel lines 54, 56. Due to the progressive spacing, direct light is blocked from passing through the top pair of slats 48, 50. However, some direct light is capable of passing through, for example, the bottom pair of slats (the aforementioned first and second slats) 26, 28.

[0055] The progressive spacing provides more view and less shade through the bottom slats 26, 28 as compared with the top slats 48, 50. As a result, sunlight is allowed to enter and brighten a space while being blocked from the eyes of persons standing in the space. Other spacing options include the reversed spacing progression, a constant spacing between slats, a progression defined by non-linear gradient, such as a parabolic gradient, or a non-uniform gradient.

[0056] Materials used for the slatted roller blind 10 include, for the roller 14 illustrated in Figure 1, an aluminum tube having an outer diameter of approximately one inch and a wall thickness of approximately a sixteenth of an inch. Other tube materials and sizes could be utilized, including, e.g., a two inch outer diameter tube.

[0057] For external purposes, a rollable screen or film suitable for outdoor exposure is utilized. A film material may include clear polyester while screen materials may include metal, such as aluminum, or plastic, vinyl, fiberglass, and the like. A typical window screen, for example, can be fabricated from an aluminum mesh or core-and-sheath, such as vinyl-coated fiberglass yarns, or polyethylene coated polypropylene yarns, which are heat-fused after weaving to fix the yarns at their crossing points. A screen in the form of a wire mesh material may be oriented at a forty-five degree angle or some other angle which offsets the mesh from a typical window or door screen orientation, so as to avoid a visual moiré pattern. Regarding the film option, one benefit of a film as compared with the screen is a relatively unobstructed view between the slats.

[0058] The slats 26, 28 are manufactured from a thermoplastic, such as PVC, PET (polyester) or polycarbonate, e.g., seven to fifteen mils thick PVC, PET, or PC film, which is thermo-formable at between one hundred and seventy and two hundred and fifty degrees F. This temperature range is just one example, and a different (e.g., larger) range, depending on material conditions, would fall within the scope of the invention. The slats 26, 28 can be adhered to the screen 16 at the respective slat rear edges 40, 44 using a co-polyester adhesive hot-melt, applied under pressure.

[0059] ROTARY MOTOR WITHOUT LIMITER SWITCHES AND WITH A QUICK-RELEASE SLIP-RING

[0060] Figure 5 illustrates a torque limiter coupling 60 in the disclosed motor which is unable to apply torque in the unwind direction and is able to slip in the winding direction upon reaching a threshold torque level.

[0061] The motor coupling 60 includes an adaptor shaft 62, which is a keyed cylinder, adapted to fit outside of a motor drive shaft. Surrounding the adaptor shaft 62, centered between opposing ends 64, 66 of the adaptor shaft 62, is a one-way bearing 68. On the outer race of the bearing 70, a slip-clutch 72 is provided which is designed to slip against the bearing.

[0062] Holding the slip-clutch in place, on its radial outer surface 74, is a spring 76, the selection of which, in combination with clutch material and clutch material thickness, defines the threshold torque required to slip the clutch against the bearing. The slip-clutch 72 configuration is selected so

that slip occurs at a greater torque than required to wind the roller blind fabric. On the other hand, the configuration is selected so that slip occurs at a lower torque than required to strain the motor.

[0063] The bearing 68, clutch 72 and spring 76 are axially centered against each other and have substantially the same axial dimension. The shaft 62 is longer than the bearing, clutch and spring, which provides the benefits outlined in the incorporated patent document.

[0064] Providing the axial buffer zone on both sides of the coupling 60 enables reversing the coupling 60 depending on whether the motor is placed on the left or right hand side within the roller tube, due to, e.g., the location of available wiring. Reversing the coupling is achieved by sliding the adaptor shaft 62 off of the motor shaft and reinstalling the adaptor shaft 62 so that the distal end 66 of the adaptor shaft 62, rather than the proximate end 64, faces the distal end of the motor.

[0065] A cavity 78 is defined between opposing, circumferentially spaced edges 80, 82 of the slip-clutch 72 and edges 84, 86 of the spring 76, rendering the slip-clutch 72 and spring 76 "C" shaped. Specifically, a base 88 of the cavity is the outer race of the bearing 70, a first side of the cavity 90 is defined by aligned edges 80, 84 of the clutch 72 and spring 76, and a second side of the cavity 92 is defined by aligned edges 82, 86 of the clutch 72 and spring 76.

[0066] The cavity 78 positioned against a tang 94, illustrated in figures 6-9, and discussed below. The tang has a

radial inner surface 96 which does not reach the bearing, as well as opposing circumferential surfaces 98, 100. The tang 94 moves circumferentially between opposing sides of the cavity so that one of the tang surfaces 98, 100 presses against a respective one of the cavity surfaces 90, 92, whereby the tang rotates with the slip-clutch 72.

[0067] Turning to figures 6-9 the coupling 60 is applied to an assembly including a rotary motor 102 powered by a timed-pulse of current. In these figures, and figure 10, with respect to the motor in a plan view, "axial proximate" or "proximate" means closer to the right side of the figure. On the other hand, "axial distal" or "distal" means further from the right side of the figure. In these figures, the timer electronics are not identified. However, obtaining timer electronics and remotely integrating the timer functionality is within the skill-set of the ordinary artisan who has read this disclosure.

[0068] The motor coupling 60 is fitted on the proximate end 104 of the motor 102, i.e., on the motor drive shaft 106, so that the distal end of the adaptor shaft 66 is positioned against a distal end 108 of the drive shaft 106. An end cap 110, through which the motor drive shaft 106 connects with the motor coupling 60, securely connects the motor 102 to the roller tube 14. This connection enables the motor 102 to turn with the roller tube 14, subject to slippage provided by the motor coupling 60, as discussed below.

[0069] The end cap 110 forms an axially extending cup-type cavity having a distal base portion 114, and which opens on its proximate end 116. The cap base portion 114 includes a radially central opening 118 which is large enough for the adaptor shaft

62 of the motor coupling 60 (Figure 5) to pass through. The cap base portion 114 is axially between the proximate end 104 of the motor 102 and the distal end 120 of the bearing, clutch and spring components of the motor coupling 60. This configuration enables removal of the motor coupling 60 without disassembling the end cap and motor from each other. The rolling direction of the roller bearing 60 with respect to the motor shaft can be reversed without extensive handling of the system to enable operation of the motor in either a left-handed or right-handed assembly.

[0070] A minimum amount of axial play 122 is provided between the cap base portion 114 and the distal end 120 of the bearing, clutch and spring components of the motor coupling 60. This configuration prevents binding of these components during use. The cap base portion 114 is axially thick enough to seat and physically isolate motor mounts 124 from the coupling 60. The motor mounts 124 include a plurality of circumferentially spaced rubber bushings 126, serving as vibration isolators, in which standoff mounts 128 and screws 130 are inserted for connecting the end cap 110 to motor 102. Aside from the elastic material of the bushings 126, the bushings also axially space the end cap 110 from the motor 102, to further isolate motor vibrations. The opened proximate end 116 of the end cap 110 includes a radially outward extending lip 132. The lip 132 seats against a proximate end 188 of the roller tube 14.

[0071] Fixed to the proximate side of the architectural opening is the stationary wall bracket 134 connected via screws 136. The wall bracket 134 can slidably receive a stationary tube bracket 138. The tube bracket 138 is removable and insertable into the wall bracket 134 via a flexible extension

140 with a grip portion 142. A clip 144 securely connects the tube bracket 138 with the wall bracket 134, and which can be released by flexing the grip portion 142. Removing tube bracket 138 from the wall bracket 134 removes the blind assembly from the architectural opening. On the other hand, inserting the tube bracket 138 into the wall bracket 134 installs the blind assembly into the architectural opening.

[0072] Fixedly connected to the distal side 146 of the stationary tube bracket 138 is the proximate end 148 of a drive ring 150. These components are connected via, e.g., circumferentially spaced screws 152. The drive ring 150 is an axially extending cup-type cavity having a proximate base 154 and which opens on its distal end 156. The distal end 156 has a diameter enabling it to fit into the opening in the proximate end 116 of the end cap 110. A radially inward step 158 at the drive ring base 154 is adapted for being releasably gripped by circumferentially spaced flexible gripping members 160 formed at the end cap lip 132.

[0073] The drive ring base 154 is axially thick enough to seat and encase the screws 152 in countersunk openings 162. The drive ring 150 is configured such that when it is inserted into and encased by the end cap 110, a distal surface 164 of the drive ring base 154 sits essentially against the proximate end 166 of the bearing, clutch and spring components of the motor coupling 60.

[0074] The drive ring base 154 includes an adaptor shaft support cavity 168, which is an axially extending cup-type cavity formed in its radial center and which opens into the drive ring 150. The support cavity 168 is large enough to seat

the proximate portion 64 of the adaptor shaft 62 which extends axially past the proximate end 166 of the bearing, clutch and spring components of the motor coupling 60.

[0075] The length of the distal portion 66 of the adaptor shaft 62 is the same as that of the proximate portion 64 of the adaptor shaft 62. This enables fitting the distal portion 66 in the support cavity 168 for reversing the motor coupling 60 about the motor shaft 106, depending on whether the blind is a left-handed or right-handed assembly. Between the distal end of the drive ring base 164 and the distal end of the drive ring 156, the above mentioned tang 94 is provided. When inserted into the end cap 110, the distal end of the tang 170, which defines the distal end of the drive ring 156, is essentially axially flush with the distal end of the bearing/clutch and spring 120. This provides a maximum connection between the tang 94 and the cavity 78 in the coupling 60.

[0076] As the drive ring and tang are stationary, movement in the motor translates into rotating the motor, not the tang. The connection between the motor and the roller tube via the end cap turns the roller tube with the motor so long as the motor is not rolling against the tang via action of the bearing or slipping against the tang via action of the clutch.

[0077] The tube bracket 138 is formed with an axially extending cup-type cavity 172, which opens on the distal end 146 of the tube bracket 138 for receiving the drive ring support cavity 168. The tube bracket cavity 172 is sized to seat and encase the screws 152 connecting the tube bracket 138 to the drive ring 150.

[0078] The above motor configuration provides a rotary drive motor for the roller blind. This configuration differs from the customary drive system for blinds in which the motor is stationary. It also differs from the customary systems in that the limiter system is replaced by electronics, providing a timed-pulse of power, which is combined with the torque limiting motor coupling 60. With these components, the rotary motor is self regulating if subjected to obstructions during a winding/unwinding operation and/or if the blind is reinstalled any number of times for any reason.

[0079] Illustrated in figures 6, 7 and 10, is a quick-release slip-ring 174 which carries power to the spinning motor 102. Such a slip-ring 174 serves as an electrical and mechanical disconnect point for the blind. The electrical connection is provided between a rotating slip-ring housing 176, at its distal end 178, and a stationary slip ring bracket 180, which is attached to an architectural opening via, e.g., screws 182.

[0080] Within the stationary bracket 176 is a spring contact 184 and a flat contact 186, electrically separated from each other. One of these contacts is a hot contact and the other is a neutral contact. These contacts are positioned within a cavity 188 in the stationary bracket 176, similar in type to the cavity 168 in the tube bracket 120.

[0081] Radially centrally disposed within the rotating housing 176 is a spring mounted nickel coated brass pin 190, with an associated compression spring 192 and spring seat 194 fixed at an axially intermediate location on the pin 190. A radial opening 196 in the proximate side of the housing is large enough to allow a proximate end 198 of the pin 190 to pass, but

not the spring 192. As such, the spring action occurs between the radial opening 196 and the spring seat 194, forcing the pin 190 in the distal direction from within the housing 176.

[0082] An insulating nickel coated brass sleeve 200 fixed at the distal end of the housing 178 has a proximate edge 202 against which the spring seat 194 comes to rest, restraining the pin 190 within the sleeve 200 and rotating housing 176. When the slip-ring 174 is connected to the stationary bracket 180, the spring 192 forces the distal end 202 of the pin against the flat contact 186.

[0083] The spring contact 184 comprises two contacts 204, 206, each extending axially from the cavity 188 and each bent radially inward to press against an exposed portion of a brass sleeve 208 on the outside of the insulating sleeve 200. Wires 210, 212 are soldered to respective points 214, 216 on the proximate end of the pin 190 and along a proximate end of the axial length of the brass sleeve 208. The solder point 214 on the brass sleeve 208 is positioned far enough towards the proximate end of the sleeve 208 to not obstruct axial motion of the contacts 204, 206 against the sleeve 208, discussed below.

[0084] When installed, an electrical connection exists between the contact 186, the pin 190 and the wire 212. An electrical connection also exists between the contact 184, the brass sleeve 208 and the wire 210. The wires connect to the motor for completing the power circuit. One of the wires is connected to the hot contact on the motor and one is connected to the neutral contact on the motor. Their connection to the pin and brass sleeve depends on which of these conductive

members will be connected to the hot contact or neutral contact at the stationary bracket 180, which is determined in advance.

[0085] The rotating housing 176 includes a distal end lip 218, serving the same purpose of the proximate end lip in the end cap 110. An axially extending cup-shaped cavity 220 in the rotating housing 176, which opens towards its distal end 178, is radially large enough to enable the contacts 204, 206 to flex against the brass sleeve 208.

[0086] The cavity 220 is axially deep enough to allow for axial play 222 between the rotating housing and stationary bracket 176, 180 to account for variations in bracket spacing, which is a function of the size of the architectural opening. For the same reason, the axial length of exposed portion of the brass sleeve 208, distal from the solder point 214 for the wire 212, matches that of the depth of the cavity 220. Similarly, the reach, from the pin 190 to the flat contact 186, accounts for the same variations in axial play.

[0087] Accordingly, the above disclosed embodiment provides a quick-release slip-ring which is capable of powering a roller blind motor without hard wiring the blind motor to wires at an architectural opening. This configuration enables installing and removing motorized roller blinds much more quickly and easily than with typical connections.

[0088] WINDOW-SIZED UNITARY SOLAR ENERGY COLLECTOR

[0089] Turning to Figure 11, the solar storage device is a passive heating system 230 comprising a sealed glazing unit with two sealed cavities 232, 234, where the first sealed cavity is

on the exterior side of the unit and the second cavity 234 is on the exterior side of the unit. This configuration is not to be confused with common triple glazings for insulating purposes, where each cavity is configured primarily to achieve an optimal thermal resistivity ("R" value). In this unit, the first cavity 232 is typically filled with a noble gas 236, krypton, etc., and is the insulating component. The second cavity 234 is filled with an aqueous medium 238 and sealed, and is the thermal storage component. In this triple glazing, the interior cavity is configured primarily to achieve an optimal thermal capacitance ("C" value).

[0090] Spacers 240 in the first cavity 232 contain a desiccant while ordinarily spacers 242 in the second cavity 234 would not. Spacers 240 in the first cavity 232 would be designed to minimize heat flow, while that is less important in the second cavity 234.

[0091] The outer, or first, lite 244 is typically glass of a low iron type to maximize solar gain. The #3 surface has a low-e coating on it, so that the second lite 246 is a low-e type. The inner, or third lite 248 is a standard clear, or is tinted.

[0092] The aqueous medium 238 is a hydrogel which has cohesion characteristics enabling it to adhere to the #4 and #5 surfaces, which are separated by the spacer 242, where the spacer is formed from a glass material attached to surface #4 and #5 by an acrylic adhesive. As compared with a foam spacer, a spacer formed form glass would be without the gases which can otherwise become trapped in the foam spacer and which could

migrate into the gel space, which could adversely impact the performance of the system.

[0093] Further regarding the aqueous medium, such a suitable medium for this purpose would be comprised primarily of sodium polyacrylate and water—a hydrogel in which water is partially solidified between adjacent lites 246 and 248. In such a hydrogel, water is contained within a substantially dilute crosslinking system exhibiting very little to no flow in a steady state. Such a hydrogel could be filled into the cavity in a degassed liquid state, and later gelled. Furthermore, a microencapsulated phase change material could be added to the hydrogel to boost its heat capacity.

[0094] A product containing the suitable cohesion and UV characteristics is manufactured in the art of fire resistive panels by SAFTI FIRST, of San Francisco, CA, USA. Specifically, SAFTI FIRST manufactures a product under the name of SuperLite II-XL (one hundred and twenty minute rating). In its typically manufactured form, this product has a thickness of just 1 1/4 -1 ½ inches and is clear.

[0095] While the inventors found the SuperLite II-XL product to be relatively serviceable, SAFTI FIRST modified the SuperLite II-XL for purposes of application in the present invention by request of the inventors, to provide the following characteristics, wherein the numbering is not intended to identify the relative level of importance of any one characteristic: (1) an aqueous gel 1 1/4" thick with at least 80% water content; (2) an aqueous gel with mechanical stability of between 120 degrees Fahrenheit and 160 degrees Fahrenheit;

(3) an aqueous gel with UV stability capable of 1500 hours in a QUV chamber without yellowing or discoloring or the formation of bubbles or voids; (4) an aqueous gel with a thermal stability such that no yellowing or discoloring happens during repeated cycling of temperatures between 40 degrees Fahrenheit and 160 degrees Fahrenheit; and (5) an aqueous gel that is adhered to the glass lites such that the gel is supported by the glass. In addition, the fire retardants were not added to the formula, which may have otherwise contained such substance. This resulting product proved to be well suited for the application of the disclosed embodiments because of , for example, its relative UV stability.

[0096] A suitable glass for the second lite 246 is a tempered Pilkington Energy Advantage(TM) low-e glass. This glass is obtainable from Pilkington North America Inc., Toledo, Ohio, USA. The Pilkington Energy Advantage(TM) low-e glass is designed to provide a high light transmittance and a high solar transmittance, allowing more of the sun's rays to enter the gel 238 as solar energy, which can be converted into usable heat.

[0097] The third lite 248 comprises PPG Graylite-Fourteen, obtainable from PPG Industries, Inc., Harmarville, PA, USA. The PPG Graylite, as compared to the other lites in the passive heating system 230, absorbs a high percentage of the incoming energy, both visible and infrared. As with the glass used for the second lite 246, the PPG Graylite-Fourteen glass blocks a significant amount of UV energy so as to prevent interior fabrics from fading. The absorption of incoming energy serves to further heat the gel, such heat to be stored in the gel for

later. It also serves to minimize the sunwashing effect, discussed earlier.

[0098] An alternative to Greylight-Fourteen for sunwashing control would be to tint the gel itself with silver nitrate, which readily mixes with water and forms a suspension of colloidal silver particles. Silver nitrate may be added in appropriate amounts to the aqueous polymerizable solution used to fill the cavity 234 between lites 246, 248.

[0099] With the gel 238 adhering to the #4 and #5 surfaces, the sealed heat storage part, or cavity 234, can be manufactured to a very large size. Since the sealed insulating cavity is the same size as, and integral with, the heat storage cavity, having a large heat storage cavity 234 enables the use of an equally large sealed insulating cavity 232. This minimizes the number of glass elements, seals, the risk for failure, costs, undesirable appearance, and thermal shorts. This is an alternative to other systems, in which glass blocks containing water were limited in size and in height to about two feet, requiring an extensive array of dividers and separate sheets of glass.

[00100] Turning to the insulating cavity 232, a suitable first lite 244 would be a high-gain glass, having a solar heat gain coefficient (SHGC) of seven-tenths or greater and preferably about nine-tenths. A Pilkington Optiwhite, low iron glass can be used as the first lite 244 in the passive heat system 230. The Pilkington Optiwhite provides a high light transmission (i.e., it is ultra clear) and high solar heat transmittance, and it is sealable.

[00101] The spacer 240 between the first lite 244 and the second lite 246 is a Super Spacer (TM) type from Edgetech USA, Cambridge, Ohio, USA. The spacer 240 is engineered, all foam, "NO-Metal" technology and is dual sealed (that is, sealed against the #2 and #3 surfaces), warm edge spacer system that uses a high-performance acrylic adhesive for its primary seal, backed by a moisture vapor seal 250 (discussed in greater detail below) acting as a secondary seal. The all foam construction of the spacer 240 is non-conductive, blocking heat flow through the window, providing an optimum thermal performance. Spacer 242 is manufactured from glass, such as clear float glass, and is about a quarter of an inch thick, rather than the silicone spacer typically available with the SuperLite product. Spacer 242 is a primary seal that is also backed by a moisture vapor seal 252 (discussed in greater detail below) acting as a secondary seal.

[00102] The size of the spacer 240, corresponding to the space between lites 244 and 246 is substantially the same as typical spacing between lites in a double glazing. The first cavity 232 is filled with a noble gas, such as argon or an argon/krypton mixture so as to provide insulation from exterior temperatures. The separation would be about one half of an inch for argon, three-eighths of an inch for krypton, or one-quarter of an inch for xenon. Typically, the insulating cavity 232 is 1/4 -1/2" in depth, with a correspondingly sized spacer 240. Further, the heat storing cavity 234 is typically 1/2 ~ 4" in depth, with a correspondingly sized spacer 242.

[00103] Sealants 250, 252 are provided about the perimeter of the cavities 232, 234. The sealants are manufactured from, e.g., one part Silicone, two part silicone, polyisobutylene (a.k.a., butyl rubber), hot melt butyl, polyurethane,

polysulfide, and acrylic latex. The sealant enables the spacers 240, 242 to make a firm, airtight seal.

[00104] Turning to Figure 12, there is illustrated a further embodiment of the thermal storage device, which is a quad glazing 254 (four lites) configured with two thermally insulating cavities and one thermal storage cavity. That is, the IGU here, designed for colder climates, has two separately sealed exterior-side insulating cavities 256, 258 filled with krypton or the like, and one interior sealed cavity filled with the hydrogel 260.

[00105] The two exterior lites are the same as the exterior lite in the first embodiment and the third and forth lites are the same as the second and third lites in the first embodiment. The seals and spacers about the middle cavity would be the same as in the exterior insulating cavity while those about the interior cavity would be the same as those previously disclosed on the interior cavity. The low-e coating would be used on the #5 surface (surfaces #1-#8 exist in this embodiment) for minimizing radiant heat loss and transferring solar energy efficiently to the thermal mass in direct thermal connection with it.

[00106] ARRAY OF INDIVIDUAL SOLAR HEATING CELLS

[00107] Turning to Figures 13A-C, these figures are based on the solar heating blocks in the incorporated patent document. These figures illustrate a panel 270 of blocks from inside the building, where the panel 270 sits behind one or more layers of

insulating glass, e.g., glazing 272 (in schematic Figure 13C), having southern exposure. The illustration provides three stacked heating blocks 274, 276, 278, e.g., forming a partial array or matrix (rows/columns) of solar heating blocks. Such a partial stacked configuration would exist, e.g., midway through an installation. As disclosed herein, the blocks interlock with one another to provide some structural integrity to the panel 270 as a whole

[00108] The glazing 272 and panel 270 are mounted in a common frame 280 (in schematic Figure 13C), where the panel 270 is flanked between glass stops, e.g., glass stop 282, and block stops, e.g., block stop 284, on its opposing side edges as well as opposing top and bottom edges (not illustrated). As with typical stops, the stops 282, 284 can be made of wood and positioned with screws 286 to ensure structural integrity. For reasons discussed below, the top block stop would be removably positioned (e.g., with accessible screws) while the other stops can be permanently fixed in place.

[00109] Each solar heating block comprises a block body having three sections 288, 290, 292, which effectively slices the block in two vertical planes, so as to provide an externally facing section 288, a middle section 290 and an internally facing section 292. The block body, including all sections, is molded plastic, such as an acrylic plastic, and the sections are heat-welded or sealed together, forming inner and outer weld seams 294, 296, to produce a watertight connection.

[00110] More specifically, the exterior and middle sections are formed from clear or transparent plastic to allow for a

maximum transmission of energy from the low-e glazing disposed at the exterior side of the block. The interior section is formed from translucent/white plastic which allows for a soft-white transmission of visible light.

[00111] Each block section is formed with a relatively small wall thickness such that the block body, when assembled, forms an internal cavity (not illustrated). The cavity is filled with water fed through an opening 298 in a corner of the middle section 290 of the block. Before sealing the opening 290, the water filled block is heated to one hundred and sixty degrees for an extended period of time (e.g., several hours) at typical room pressure, until dissolved gas in the water has been brought to a minimum level, in a process akin to degassing. Then, while still warm, the opening 298 is sealed. It has been found that a relatively small amount of air bubbles will form in a block manufactured this way.

[00112] Regarding the water, a light diffusing agent may be used to color the water white or some other hue. This provides a pleasant affect when viewed through the translucent/white plastic. Furthermore, the water may include antifreeze and antimicrobial agents. For example, the water may include table salt (sodium chloride) or calcium chloride, which function both as antifreeze and antimicrobial agents. In addition, distilled water may be used to minimize the mineral and microbial content of the water being used to fill the block body.

[00113] Weight of the water limits the size of the block body. Accordingly, with a generally square body of perhaps eight to twelve inches on a side (in a front view), a total thickness of three to six inches is acceptable. Otherwise, the block may

become overly heavy and unwieldy, and may generate a large hydrostatic pressure which could result in a leak.

[00114] Each block includes eight T-slotted sockets or feet, (four on top, four on bottom), e.g., 300, 302, 304, 306. Fitted into the slots are I-shaped peg connectors 309, which extend into and out of the slots by about a quarter of an inch. Accordingly, each I-peg connector can connect four adjacent feet in a matrix of blocks. The I-peg connectors are softer than the block material, and the flexibility of the I-peg connectors provides a tight relationship between blocks in adjacent columns and aligns blocks disposed in a common row.

[00115] A forward lip 308 of the exterior facing section 288 and a rearward lip 310 of the middle section extend outwardly to cover the same plan area as covered by the feet 300-306. That is, the cross sectional shape of a squared "U" is created with the rear surface 312 of the front lip and the front surface of the rear lip 314 on the outside of the "U." The bottom of the "U" is formed by the side surfaces 318, 320 of the front and middle bock sections. The feet in the front section 288 are against the rear surface 312 of the front lip 308 while the feet in the middle section 290 are against the front surface 314 of the rear lip 310.

[00116] It is to be appreciated that, but for the front face 316 of the forward block section 288, the middle section 290 and forward section have the same shape and can therefore be manufactured from molds having essentially the same shape. Due to the similar structural configurations, an installer need not be concerned with the top or bottom orientation of the blocks during assembly of the panel.

[00117] Furthermore, due to the similar structural configurations with the front and middle sections 288, 290, the fill hole 298 can be drilled out of the corners of the side surface 318 of the middle block section or the side surface 320 of the forward block section (not illustrated). Such drilling can occur before or after the block sections are manufactured.

[00118] The rear section 292 has a constant plan area, e.g., when viewing from the rear, which covers the plan area defined by the outer edges of the lips 308, 310. As such, side surfaces of the rear section, e.g., vertical surface 326 and horizontal surface 328, are welded to the outer edges of the rear lip, e.g., vertical edge 330 and horizontal edge 332, forming the rear weld seam 296. The combination of these outer side edges and surfaces provide the block with a sturdy surface suitable for stacking purposes.

[00119] When installed, the top layer of feet in the top row of blocks is not equipped I-pegs. In order to disassemble the block panel, the top block stop is unscrewed and removed. Then, each block in the top row of blocks is lifted, one by one, until the block clears the I-pegs in the top layer of feet in the immediately lower row of blocks. It is to be appreciated that a certain amount of space is required above the top row blocks to achieve this lifting. That space is hidden by the top block stop. To remove the side blocks in the top row, the adjacent blocks are lifted and removed, and then the side blocks are lifted, slid towards the center, and removed. Sliding to the center is required to clear the vertical (side) block stops.

[00120] A heat-absorbing mask 334 can be adhered to the exterior side of each block, before assembly of the panel. The heat-absorbing mask may be a perforated plate which is black on one side and white, or some other light color, on the other side. The perforations take up from twenty to fifty percent of the area of the heat-absorbing mask, so that the area not represented by the perforations is between fifty and eighty percent of the total area. The heat-absorbing mask is oriented so that the black side faces the low-e glazing, while the white or light side faces inwardly toward the interior of the building. As such, the heat-absorbing mask absorbs light energy while the white surface dims the light, and both occur without coloring the light.

[00121] SELF-CORRECTING TRACK-BASED FRAME STRUCTURE

[00122] As indicated, the present patent document is directed to a unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control. Various disclosed embodiments include a track-based frame structure and blind combination in which enables the blind to be self-correcting, should the blind material 16 fall or be pulled outside of the track. One such frame assembly is illustrated in the figures, starting with Figures 14-17.

[00123] The assembly 400 includes a frame 402, which is made from aluminum, includes a header housing 402. On opposing internal sidewalls of the header housing including, e.g., wall 406, are the brackets for removably mounting and powering the blind motor, disclosed above. A removable faceplate 408 is provided as a protective element for enclosing the blind within

the header housing 402. The faceplate 408 can be clipped to exterior surfaces of the housing.

[00124] The housing 402 includes a vertically downwardly facing channel 410 at its top-exterior edge 412, adapted to receive a channel 414 of the same shape and orientation at the top edge 416 of the faceplate 408. The second channel 414 differs from the first 410 in that it is smaller and is therefore capable of fitting within the first.

[00125] When the faceplate is installed, the bottom edge of the faceplate rests on pegs on the housing (not illustrated), which prevents the faceplate from dropping vertically past the position illustrated in the figure. Accordingly, at rest, the faceplate channel 414 remains within the housing channel 410. The illustrated vertically oriented gap between the channels 410, 414 enables lifting the faceplate away from the pegs during installation and removal. During removal, for example, the ability to lift the faceplate off the pegs enables pitching the faceplate away from the housing and thereafter removing the faceplate from the housing.

[00126] The blind 10 is recessed within the header housing 404 such that exterior surfaces of the housing, e.g., exterior surface 418 in Figure 18, along with the channel 410 provide a base for seating the faceplate 408. The faceplate 408 is large so its bottom edge 420 extends below a bottom surface 422 of the bottom rail 424 of the blind when retracted (Figure 17).

[00127] The header housing 404 has an essentially horizontal top member 426, extending, rearward, e.g., towards the interior of the opening, from its top edge 412. At a rear edge of the

top member 428, the header housing 404 turns downward at a right angle. A rear-vertical member 430 of the header drops to a point 432 at which it turns forward with a curvature that is essentially a quarter-round surface 434. The amount of drop in the rear surface 430 and the location of the curved surface 434 is such that these surfaces do not touch the installed blind 10 at any time, whether or not retracted.

[00128] Forward of the curved surface 434, toward the front (exterior) of the header housing 404, is an additional curved surface which is also substantially a quarter-round surface 436, serving as a transverse alignment guide. This transverse alignment guide 436 is the part of the header housing 402 with which the installed blind material 16 connects throughout the winding and unwinding process. The intermediate surface 438 connecting the rear of the housing with the transverse alignment guide 436, is inclined downwardly towards the transverse alignment guide 436 to ensure that this surface 438 does not contact the blind material 16 during operation of the blind.

[00129] A forward edge 440 of the transverse alignment guide 436 is over a pair of side tracks 442, 444 such that blind material 16 is guided downwardly into the tracks 442, 444. In addition, a pair of opposing vertical guides, e.g., guide plate 446 in figures 18 and 19, center the blind material 16 widthwise so as to align the blind material 16 when entering the opposing tracks. The guides, e.g., guide 446, which are mirror images of each other, project rearward into the housing 404 and are essentially rectangular, where the rear edge 448 is rounded toward the respective side wall in the housing, e.g., wall 406.

[00130] Extending rearward from the forward tip of the transverse alignment guide 436 is a stop-surface 452 for mating with a rearward overhang 454 integrated into the bottom rail. The bottom rail overhang 454 extends between opposing ends of the bottom rail, but not into the tracks 442, 444 (Figure 16). The bottom rail overhang 454 extends rearward, past the drop line for the blind material 16. The mating of the stop-surface 452 with the overhang 454 defines the maximum vertical retraction of the blind 10 (Figure 17). For this reason, the bottom rail overhang 454 is essentially at the bottom edge 24 of the blind material 16 allowing maximum retraction into the header housing 404.

[00131] Turning more specifically to the tracks 442, 444, the bottom of the tracks is defined by the bottom exterior frame 456 of the assembly, is below the bottom edge 458 of the glazings so as to enable fully covering the glazings. Each track 442, 444 forms a square "C" channel, with opposing openings 460, 462. Centers of the openings are in-line with the vertical drop of the blind material 16 and are large enough to fit elongated, widthwise vertically extending stems 464, 466 of "T" shaped track guides 468, 470 disposed within a matching elongated "C" channel 472 in the bottom rail. The interior cavity in each track "C" channel is large enough to fit heads of the "T" shaped track guides 468, 470, where the track guides 468, 470 are sized to securely hold and guide the bottom rail 424 during winding and unwinding operations.

[00132] The top end 476 of the channel 472 in the bottom rail 424 is formed so that it does not contact the stop-surface 452 in the header housing 404. On the other hand, as indicated, the bottom end 478 of the channel in the bottom rail 424 includes

the rearward overhang 454 which contacts the stop-surface 452 in the header housing 404. This defines the maximum retraction of the blind into the header housing 404.

[00133] For decoration purposes, and for allowing water and ice, etc., to fall off the bottom rail 424, the front segment 480 of the bottom rail 424 is smaller than the rear segment, and a top surface 482, which connects the two segments, is curved to form, e.g., a partial "U" shape.

[00134] Turning also to the blind 10, illustrated in figures 14 and 15-21, opposing side segments 484, 486 of the louvers 12 are notched so that these segments can, along with the roller blind material 16, travel in the tracks 442, 444 along with the track guides 468, 470 of the bottom rail 424. As such, the blind material 16 is wider, and the louvers 12 are longer, than the length of the bottom rail 424. It is to be appreciated that the roller tube 14 for the blind 10 is as long as the blind material 16 is wide.

[00135] The above structure, with a glazing on the rearward side 488, 490 of the track channels, combines to form a system in which blind material 16 is self-correcting if the blind material 16 pulls out of the track in the exterior direction. For example, in Figure 19, blind material segment 492 is out of the track while segment 494 is within the track. As illustrated in Figure 20, the stiffness of the louvers 12 ensures that the blind material 16 will not bunch-up anywhere along the width of the blind material 16 during winding.

[00136] Once the blind material 16 has been wound past the level where it has come out of the track, which may be at the

bottom rail 424, the configuration of Figure 20 would have been reached and the blind material 16 will have been fully re-aligned. That is, as illustrated in Figure 21, once the motor actives to unwind the blind material 16, the material 16 will unwind from the roller tube 14, over the transverse alignment guide 436, and between side alignment guides, and thereafter properly reenters the track channels 442, 444. Accordingly, blind material 16 unwound at this point will be properly within the tracks.

[00137] As can be appreciated, a substantially planar transparent member other than a fixed glazing, such as a storm door, can be positioned against the rear of the track members and which would provide the same self-correcting aspects of the disclosed embodiments.

[00138] THE UNITARY ASSEMBLY - THE SUPPORT FRAME

[00139] Turning to Figures 22 and 23, the exterior face of the support frame 402 includes front surfaces 498, 500, which are forward of the tracks, 442, 444, are coplanar and extend away from each other. The front frame surfaces 498, 500 are connected to the opposing front surfaces of the tracks 442, 444 by respective angled trim/facia surfaces 502, 504.

[00140] The span of the front surfaces 498, 500, is such as to allow adjacently positioned assemblies 400 to connect on end surfaces 506, 508, which extend rearward at substantially right angles from the front surfaces 498, 500.

[00141] Four internally facing surfaces 510, 512, 514, 516, are provided for receiving four rectangular wooden insulating

frame members 518, 520, 522, 524 on the interior side of the unitary structure. Two of those surfaces 510, 512 connect at substantially perpendicular angles to the end surfaces 506, 508 and extend to rear facing surfaces 488, 490 of the tracks. A third of these surfaces 514 is connected at a perpendicular angle to the bottom exterior frame 456 of the frame 402. A fourth of these surfaces 516 is connected to a rear face of the header housing 404, approximately where the rearward curved surface 434 meets the vertical interior member 430 of the header housing 404. Each of these rearward facing surfaces 510. 512, 514, 516 includes a rearward projecting bracket member 526, 528, 530, 532 which fits within a receiving channel (same location in the figures) in each frame member 518, 520, 522, 524. The brackets and channels are permanently adhered to each other.

[00142] The cavity 534 between the opposing frame members 518, 520, 522, 524, as well as internally exposed surfaces of the track 442, 444 and header housing 402, defines the volume for situating the glazings and heat storage components, introduced above and provided in alternative embodiments, below. The cavity 534 is larger than the size of the glazings so that the glazings can be further encased, on top, bottom and sides, in insulating foam fill 536. Additional insulating foam 538 is provided in the area rearward of the housing and above the top frame member. This foam 538 helps to keep horizontal the top frame member 524.

[00143] An adhesive glazing compound is layered between the connecting side surfaces of the #1 surface of the first lite of each disclosed glazing alternative and the rear face of the tracks at 488, 490. The glazing compound connects the #1 lite, at top and bottom ends, to a downwardly extending lip 540,

connected to the rear edge of the stop-surface 452 and an upwardly extending lip 542, connected to the bottom exterior frame 456 of the system.

[00144] Four substantially rectangular glass stops 544, 546, 548, 550 are provided and sized such that a forward face 552, 554, 556, 558 of the glass stops sits at the interior (rearward-most) surface of the glazings and/or heat storage element, whichever is furthest rearward. Opposing surfaces 560, 562, 564, 566 of the glass stops are countersunk 568, 570, 572, 574 so that screws (same location) can set the glass stops to the opposing surfaces of wooden framing members.

[00145] Rear edges 576, 578, 580, 582 of the glass stops extend just beyond rear edges 584, 586, 588, 590 of the frame members 518, 520, 522, 524 and are provided with an edge profile, such as an Ogee styled edge known in the furniture industry, so that decorative edge members, e.g., member 592, can be installed. These edge members are the frame components visible to the interior occupant and define the rearmost surface of the assembly. However, should there not be enough meat in the glass stops to mill an edge profile, a square profile can be utilized and rear facia members can be omitted (see Figure 29).

[00146] The above structure, along with the track and blind, defines the basic unitary frame and track structure for an architectural fenestration.

[00147] In addition to the motor controls discussed above, a thermostat can be provided on the interior side, mounted on a wall in the room where the glazing is located. The thermostat provides the dynamic component of the objective which is to

utilize the unitary assembly to provide dynamic heat gain control to an architectural fenestration.

[00148] Specifically, the thermostat would communicate with the roller blind motor electronics and instruct the blind to unwind when the temperature in the room increases above an upper comfort level set point and wind the blind when the temperature in the room drops below a lower comfort level set point. By measuring the temperature in the room, the temperature of the thermal storage unit itself can reach a much higher level. This enables the thermal storage unit to store more energy which can be transferred to the room interior over a longer period of time.

[00149] ALTERNATIVE GLAZING AND BLIND CONFIGURATIONS

[00150] The above frame and blind configuration can be augmented with the disclosed glazing options as well as more generic glazing options. The configuration can also be configured with alternative roller blinds. These alternative configurations will now be disclosed with continued reference to the accompanying figures.

[00151] TRIPLE GLAZING

[00152] According to one disclosed embodiment, the unitary assembly for an architectural fenestration, which provides dynamic solar heat gain control, is that illustrated in Figures 14-17. This embodiment includes the above disclosed unitary frame and blind with notched louvers, driven by the disclosed motor, which is controllable by a thermostat.

[00153] The embodiment is fitted with a glazing 594 which is illustrated as a triple glazing. The particular triple glazing has essentially the same configuration and materials as utilized in the quad glazing configuration 254 disclosed in connection with the window-sized unitary solar energy collector. The low-e surface, as with the quad glazing 254, is the #5 surface.

[00154] Notably missing from this configuration, as compared with the quad glazing 254, is the heat storage chamber 258, including the disclosed gel 260 and fourth lite with the #7 and #8 surfaces. Accordingly, this embodiment will strongly heat an interior space when sun hits it.

[00155] TRIPLE GLAZING WITH TINTED INTERIOR LITE

[00156] Turning to Figures 22 and 23, this alternative configuration is essentially the same configuration as illustrated in Figures 14-17. The glazing 596 in this configuration is essentially the same as the glazing 594 previously disclosed. The primary difference is that in this glazing 596, the third lite, which is the interior lite, is tinted. As compared with the previously disclose glazing 594, the tinted glass itself will become very hot when sun hits it. This heat will in turn, heat the interior space with less glare than with the glazing 594.

[00157] TRIPLE GLAZING WITH GENERIC ROLLER BLIND

[00158] Turning to Figures 24 and 25, this alternative configuration is essentially the same configuration as illustrated in Figures 14-17. The same glazing 594 is utilized as well. The primary difference is the use of a generic

fiberglass roller blind 600 rather than the slatted roller blind 10. Other aspects of the blind are consistent with the slatted blind. For example, the bottom rail 424 has the same size and function as with the slatted blind 10 and it includes the track guides, e.g., 468.

[00159] Utilizing the generic fiberglass blind could result in the loss of the self-correcting function of the above disclosed embodiments. However, other stiffeners could be added to the blind 600 in the widthwise direction to prevent bunching of the blind during rollup and to enable the self-correcting aspect of the blind and frame combination.

[00160] QUAD GLAZING WITH GEL FILL

[00161] Figures 26 and 27 illustrate the usage of the quad glazing 254 disclosed above. As indicated, the glass stops 544, 546, 548, 550 are smaller to accommodate for the larger volume in the cavity 534 taken up by the glazing. As compared with previously disclosed triple glazing 594, the gel 260 will soak up the heat and dissipate it into the interior over time.

[00162] TRIPLE GLAZING WITH BLOCK STORAGE UNITS AND HEAT ABSORBING MASK

[00163] Figures 28 - 31 illustrate two embodiments which are configured with the triple glazing of Figures 29 and 30 along with the panel of solar heating cells 270 illustrated in Figures 13A-13C. In the embodiments, glass and block stops, e.g., 282, 284 are illustrated, which are screwed into the adjacent frame members. As illustrated in Figures 29 and 31, spacing 602 above to top row of blocks is provided, enabling lifting the blocks

for removal purposes. In the configuration of Figures 28-29, the heat absorbing mask 334 is illustrated on the exterior side of the blocks. In the configuration of Figures 30-31, the mask is on the interior surface of the interior lite, i.e., the #6 surface.

[00164] Accordingly, what has been disclosed is a unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, which: (1) provides a track-based frame structure/blind combination in which the blind is self-correcting should the blind material fall outside of the track; (2) provides directional shading, where the assembly provides for dynamically controlling the amount of light allowed to reach the heat storage unit; (3) provides a blind motor without limiter switches and with a quick-release slip-ring; and (4) provides a heat storage unit which is a thermally efficient, transparent and translucent structure, with which gain from sunny winter days is greater than nighttime loss, so as to provide supplemental heat.

[00165] The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not as restrictive. The scope of the invention is, therefore, indicated by the appended claims and their combination in whole or in part rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly including an exterior side along an outdoors side of the architectural fenestration and an interior side along an indoors side of the architectural fenestration, the assembly comprising:

a solar energy collector comprising:

a glazing; and

a heat storage element disposed on the interior side of the assembly relative to the glazing; and

a roller shade positioned on the exterior side of the assembly relative to the glazing, the roller shade comprising:

a shade material; and

louvers projecting outwardly from the shade material;

wherein the roller shade is movable along the exterior side of the assembly between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector.

2. The assembly of claim 1, further comprising:

a motor rotatably coupled to the roller shade such that rotation of the motor moves the roller shade between the retracted and extended positions; and

a thermostat coupled to the motor, the thermostat configured to drive the motor such that the roller shade is moved to the retracted position when a temperature in a room disposed on the interior side of the assembly falls below a lower temperature setpoint and to the extended position when the temperature in the room exceeds an upper temperature setpoint.

3. The assembly of claim 1, wherein the heat storage unit comprises a water-filled solar storage block or a sealed cavity including an aqueous-based hydrogel stored therein.

4. The assembly of claim 1, wherein, when the roller shade is in the extended position, the louvers are configured to block at least a portion of direct sunlight from being transmitted to the solar energy collector.

5. The assembly of claim 1, wherein the shade material corresponds to a screen that is configured to provide a view through the roller shade when the roller shade is in the extended position.

6. A unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly comprising:

a solar energy collector comprising:

a glazing with a low emissivity coating; and

a heat storage gel;

wherein the low emissivity coating is disposed on a surface of the glazing such that the low emissivity coating is thermally coupled to the heat storage gel via the glazing; and

a shade located on an exterior side of the solar energy collector, the shade including shade material;

wherein the shade is movable along the exterior side of the solar energy collector between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector.

7. The assembly of claim 6, further comprising:

a motor rotatably coupled to the shade such that rotation of the motor moves the shade between the retracted and extended positions; and

a thermostat coupled to the motor, the thermostat configured to drive the motor such that the shade is moved to the retracted position when a temperature in a room disposed on an interior side of the assembly falls below a lower temperature setpoint and is moved to the extended position when the temperature in the room exceeds an upper temperature setpoint.

8. The assembly of claim 6, wherein the heat storage gel comprises an aqueous-based hydrogel, the aqueous-based hydrogel having cohesion characteristics such that it adheres to an adjacent surface of the glazing.

9. The assembly of claim 6, wherein;

the shade material corresponds to a screen configured to provide a view through the shade when the shade is in the extended position;

the shade further comprises louvers extending outwardly from the screen; and

when the shade is in the extended position, the louvers are configured to block at least a portion of direct sunlight from being transmitted to the solar energy collector.

10. The assembly of claim 6, wherein the glazing corresponds to an intermediate glazing of the solar energy collector, the solar energy collector further comprising:

an exterior glazing spaced apart from the intermediate glazing in a direction of an exterior side of the assembly so as to define a first cavity between the exterior and intermediate glazings; and

an interior glazing spaced apart from the intermediate glazing in a direction of an interior side of the assembly so as to define a second cavity between the exterior and intermediate glazings;

wherein an insulating gas is provided within the first cavity and the heat storage gel is provided within the second cavity.

11. The assembly of claim 10, wherein a depth of the second cavity is greater than a depth of the first cavity.

12. A unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly including an exterior side along an outdoors side of the architectural fenestration and an interior side along an indoors side of the architectural fenestration, the assembly comprising:

a heat storage unit;

a shade including shade material, the shade configured to be moved between retracted and extended positions along the exterior side of the assembly to dynamically control an amount of sunlight being transmitted to the heat storage unit; and

a guide for guiding the shade material in a vertical direction when unwinding and winding the shade material;

wherein the heat storage unit is disposed on the interior side of the assembly relative to the shade.

13. The assembly of claim 12, further comprising:

a motor rotatably coupled to the shade such that rotation of the motor moves the shade between the retracted and extended positions; and

a thermostat coupled to the motor, the thermostat configured to drive the motor such that the shade is moved to the retracted position when a temperature in a room disposed on the interior side of the assembly falls below a lower temperature setpoint and to the extended position when the temperature in the room exceeds an upper temperature setpoint.

14. The assembly of claim 12, wherein the heat storage unit defines a sealed cavity including an aqueous-based hydrogel stored therein, the solar energy collector further comprising:

a high gain, insulating glazing disposed between the sealed cavity and the shade.

15. The assembly of claim 12, wherein the heat storage unit corresponds to a water-filled solar storage block, the assembly further comprising:

a glazing disposed between the solar storage block and the shade.

16. The assembly of claim 15, further comprising:

a heat absorbing mask disposed on one of (i) an exterior face of the block; or

(ii) an interior face of the glazing.

17. A unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, comprising a solar energy collector comprising:

a first glazing;

a second glazing spaced apart from the first glazing such that an interior cavity is defined between the first and second glazings; and

a thermal storage medium disposed within the interior cavity, the thermal storage medium comprising an aqueous hydrogel configured to adhere to an adjacent surface of each of the first and second glazings as heat is stored within the thermal storage medium; and

a shade including shade material, the shade being located on an exterior side of the assembly relative to the solar energy collector;

wherein the shade is movable along the exterior side of the assembly between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector.

18. The assembly of claim 17, further comprising:

a motor rotatably coupled to the shade such that rotation of the motor moves the shade between the retracted and extended positions; and

a thermostat coupled to the motor, the thermostat configured to drive the motor such that the shade is moved to the retracted position when a temperature in a room disposed on an interior side of the assembly falls below a lower temperature setpoint and is moved to the extended position when the temperature in the room exceeds an upper temperature setpoint.

19. The assembly of claim 17, wherein the aqueous hydrogel comprises a combination of sodium polyacrylate and water.

20. The assembly of claim 17, wherein:

the shade material corresponds to a screen configured to provide a view through the shade when the shade is in the extended position;

the shade further comprises louvers extending outwardly from the screen; and

when the shade is in the extended position, the louvers are configured to block at least a portion of direct sunlight from being transmitted to the solar energy collector.

21. The assembly of claim 17, wherein:

the shade further comprises louvers extending outwardly from the shade material; and

when the shade is in the extended position, the louvers are configured to block at least a portion of direct sunlight from being transmitted to the solar energy collector.

22. The assembly of claim 17, wherein the second glazing is spaced apart from the first glazing in a direction of an interior side of the assembly, wherein:

the assembly further comprises a third glazing spaced apart from the first glazing in a direction of an exterior side of the assembly such that an exterior cavity is defined between the first and third glazings; and

an insulating gas is provided within the exterior cavity.

23. The assembly of claim 22, wherein a depth of the interior cavity is greater than a depth of the exterior cavity.

24. A unitary assembly for an architectural fenestration, providing dynamic solar heat gain control, the assembly including an exterior side along an outdoors side of the architectural fenestration and an interior side along an indoors side of the architectural fenestration, the assembly comprising:

a solar energy collector disposed on the interior side of the assembly, the solar energy collector comprising:

a first sealed cavity including an insulating gas stored therein; and

a second sealed cavity including an aqueous thermal storage medium stored therein; and

a shade disposed on the exterior side of the assembly, the shade movable along the exterior side of the assembly between a retracted position and an extended position to dynamically control an amount of sunlight being transmitted to the solar energy collector;

wherein, when the shade is moved to the retracted position, sunlight is allowed to be transmitted through the first sealed cavity and into the second sealed cavity such that solar energy is stored within the aqueous thermal storage medium.

25. The assembly of claim 24, wherein the second sealed cavity is defined between adjacent walls of a solar collector block, the aqueous thermal storage medium corresponding primarily to water.

26. The assembly of claim 24, further comprising:

a motor rotatably coupled to the shade such that rotation of the motor moves the shade material between the retracted and extended positions; and

a thermostat coupled to the motor, the thermostat configured to drive the motor such that the shade is moved to the retracted position when a temperature in a room disposed on the interior

side of the assembly falls below a lower temperature setpoint and to the extended position when the temperature in the room exceeds an upper temperature setpoint.

27. The assembly of claim 24, wherein a depth of the second sealed cavity is greater than a depth of the first sealed cavity.

28. The assembly of claim 24, wherein the aqueous thermal storage medium corresponds to an aqueous-based hydrogel.

29. The assembly of claim 28, wherein the aqueous-based hydrogel comprises a combination of sodium polyacrylate and water.

30. The assembly of claim 28, wherein the aqueous-based hydrogel has cohesion characteristics such that it adheres to adjacent surfaces defining the second sealed cavity.

31. The assembly of claim 28, wherein the solar energy collector further comprises:

an intermediate glazing positioned between the first and second sealed cavities;

an interior glazing spaced apart from the intermediate glazing in a direction of the interior side of the assembly such that the second sealed cavity is defined between the intermediate and interior glazings; and

an exterior glazing spaced apart from the intermediate glazing in a direction of the exterior side of the assembly such that the first sealed cavity is defined between the intermediate and exterior glazings.

32. The assembly of claim 31, wherein a low emissivity coating is disposed on an exterior surface of the intermediate glazing such that the low emissivity coating is thermally coupled to the aqueous-based hydrogel via the intermediate glazing.

FIG. 1

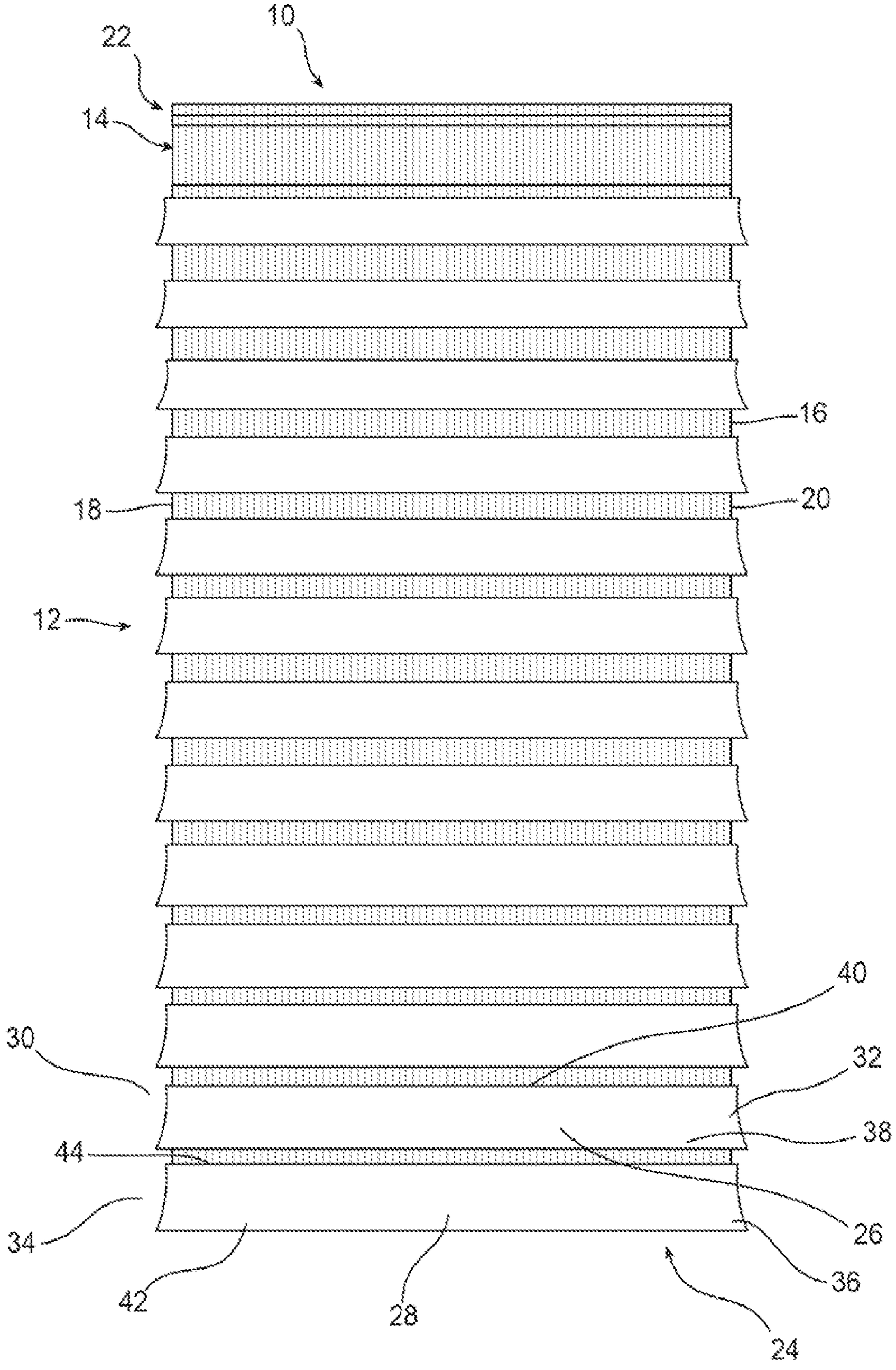


FIG. 2

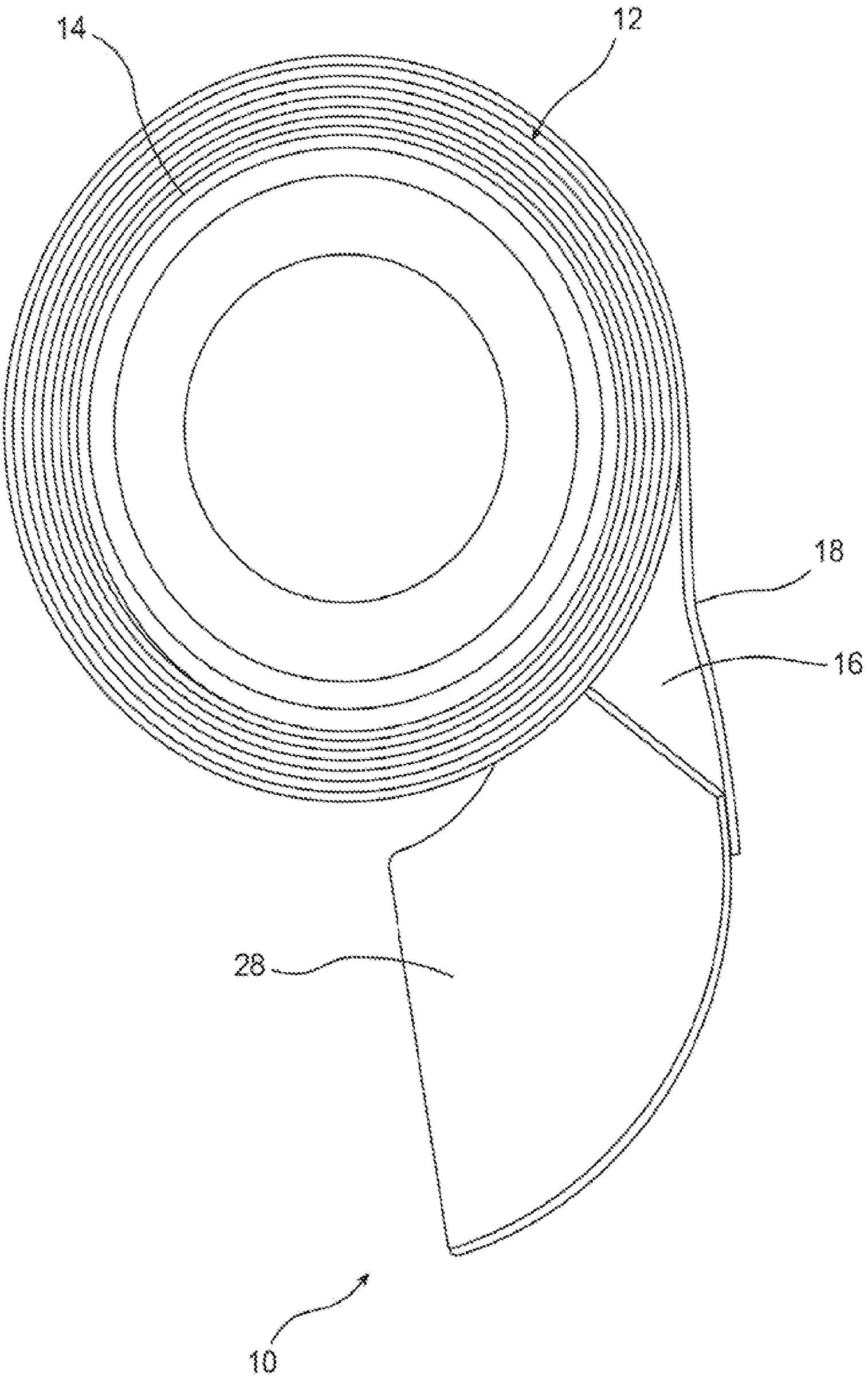


FIG. 3

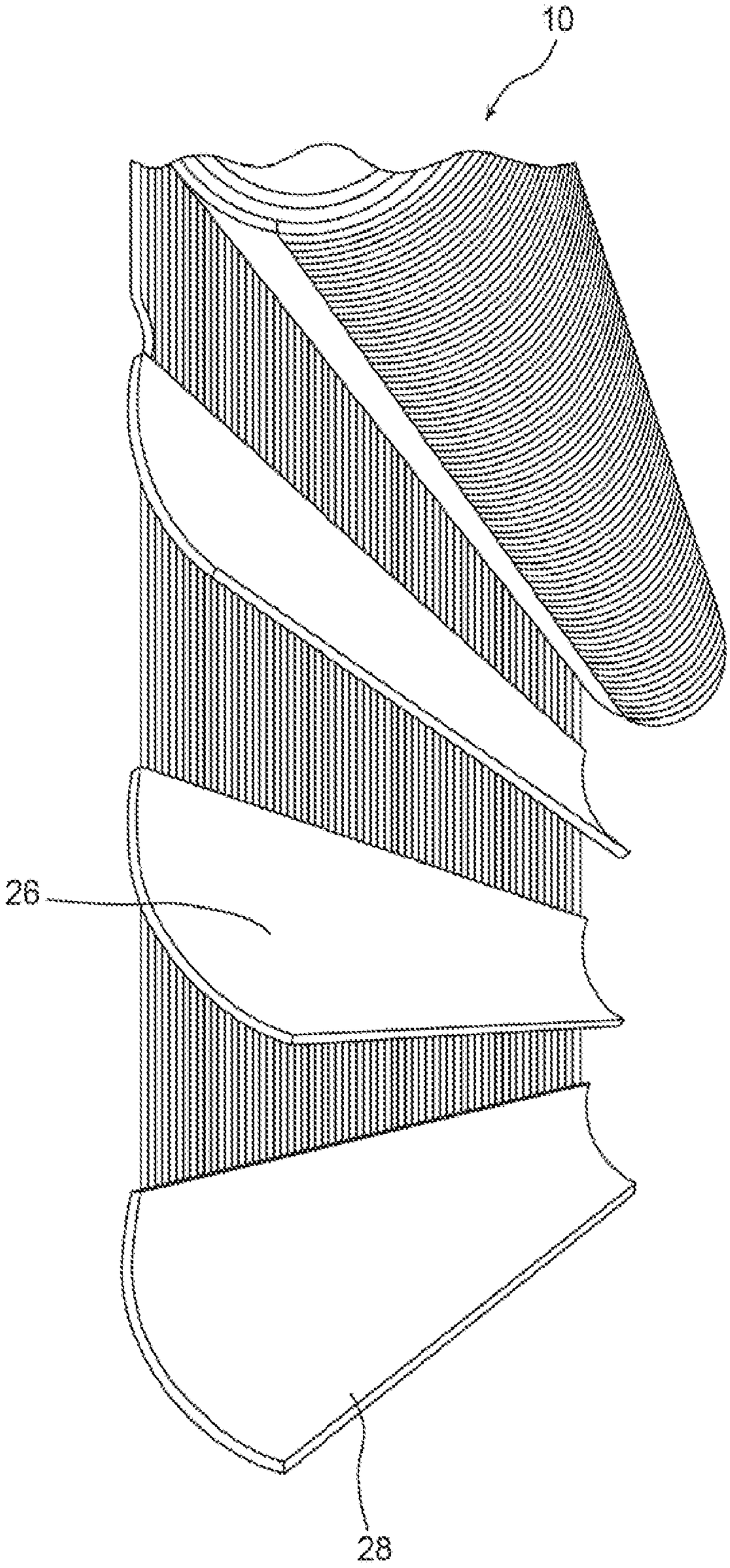


FIG. 4

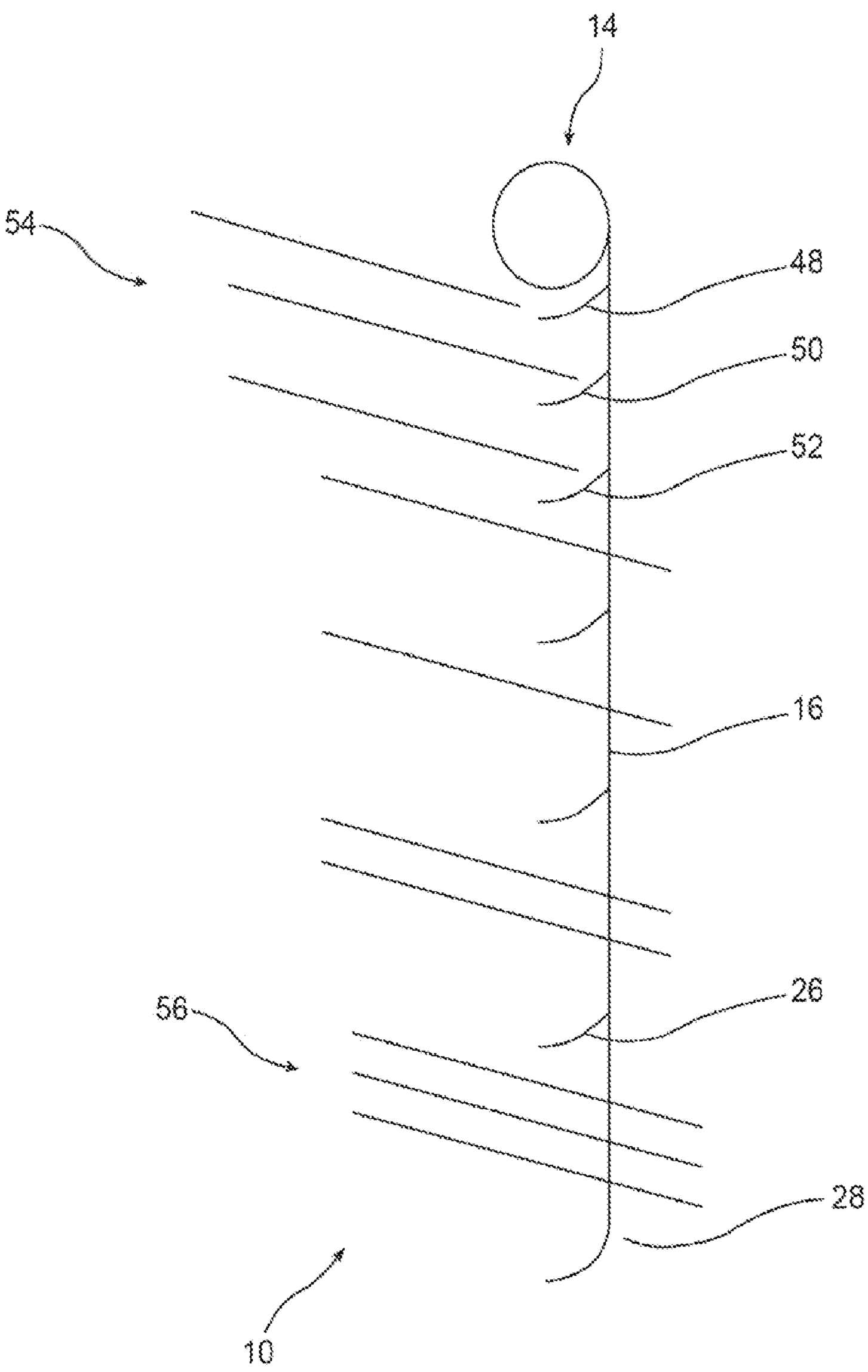
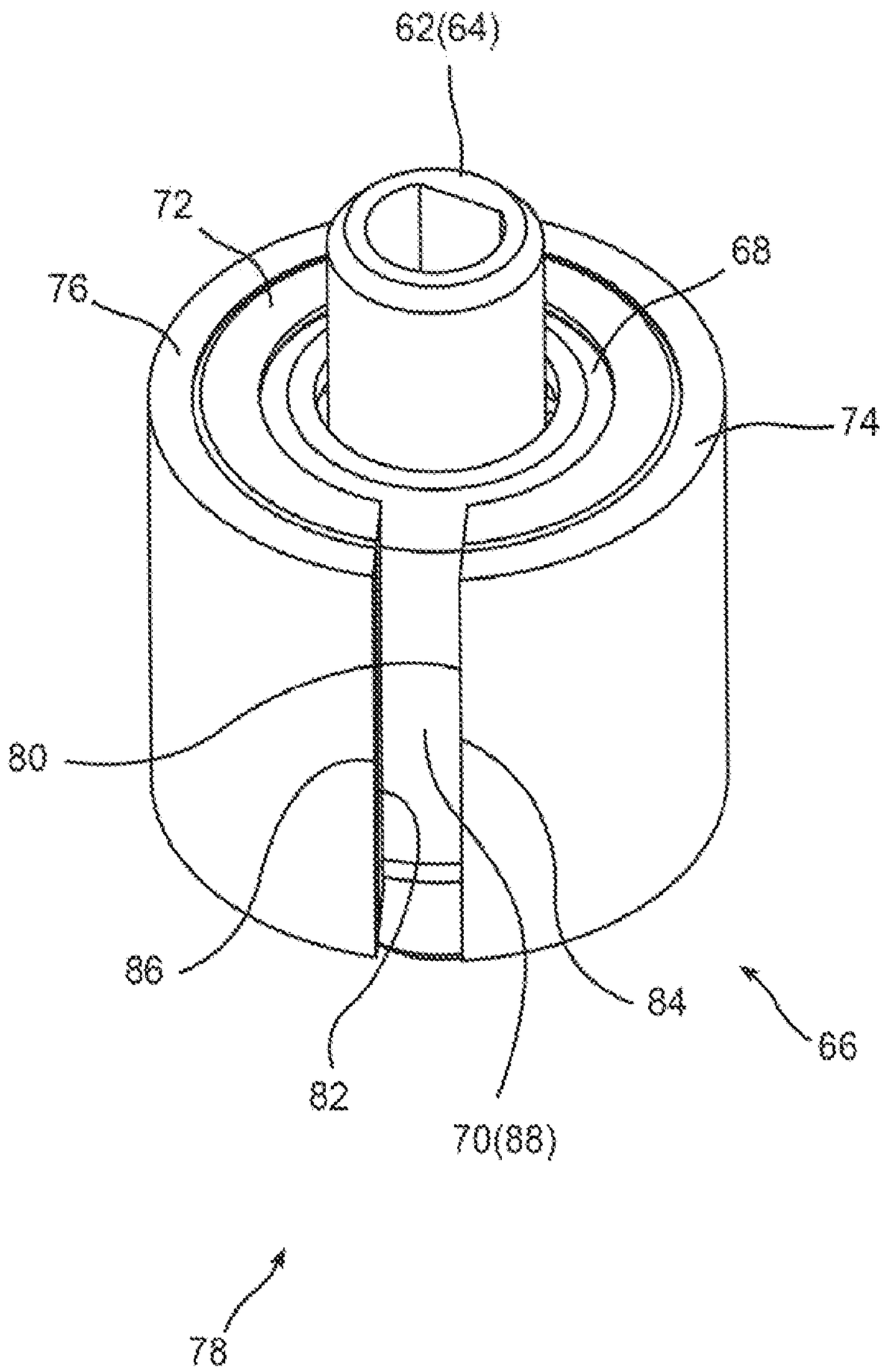


FIG. 5



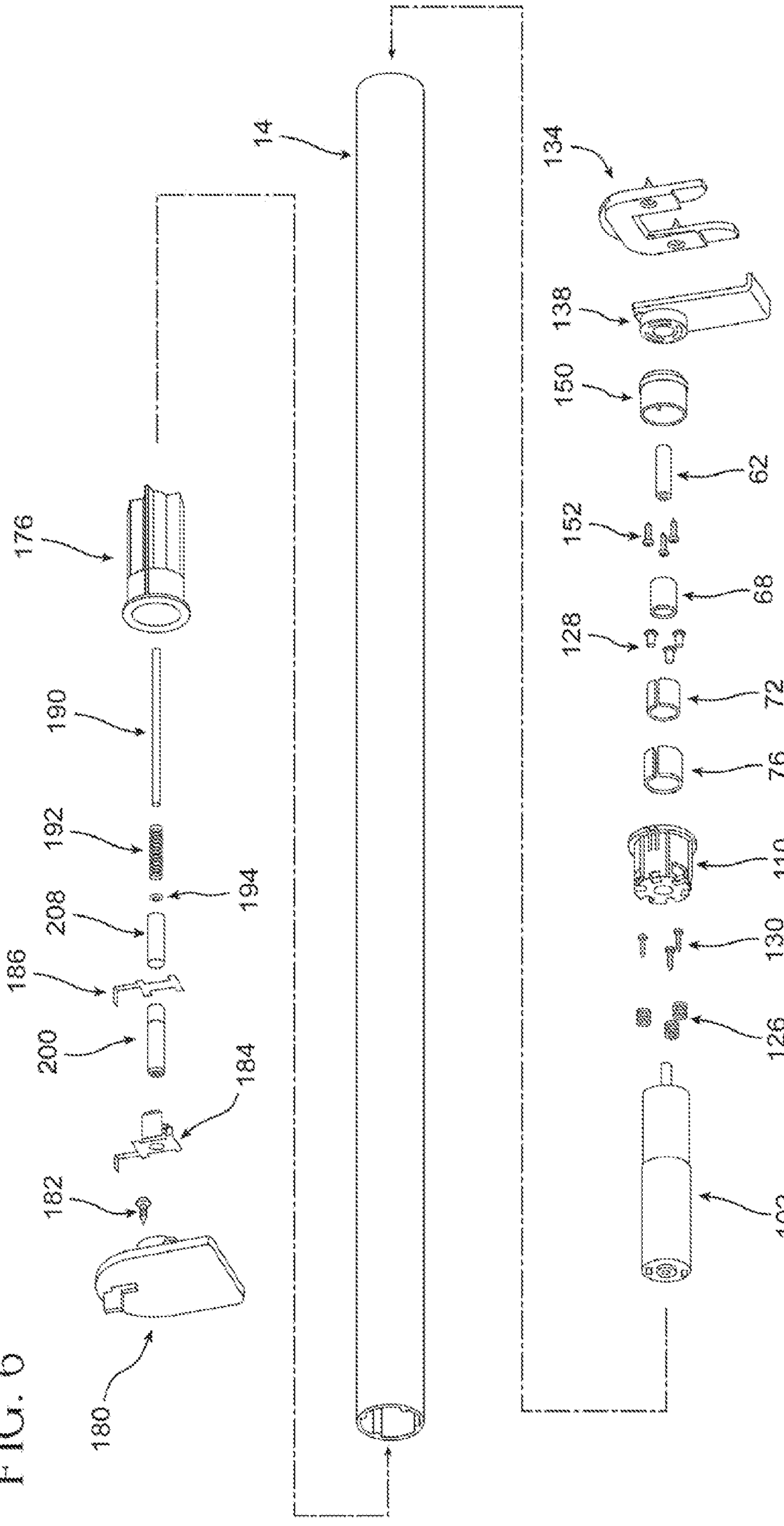

14
134
138
150
62
152
68
128
72
76
110
130
126
102
176
190
192
194
208
186
200
184
182
180

FIG. 6

FIG. 7A

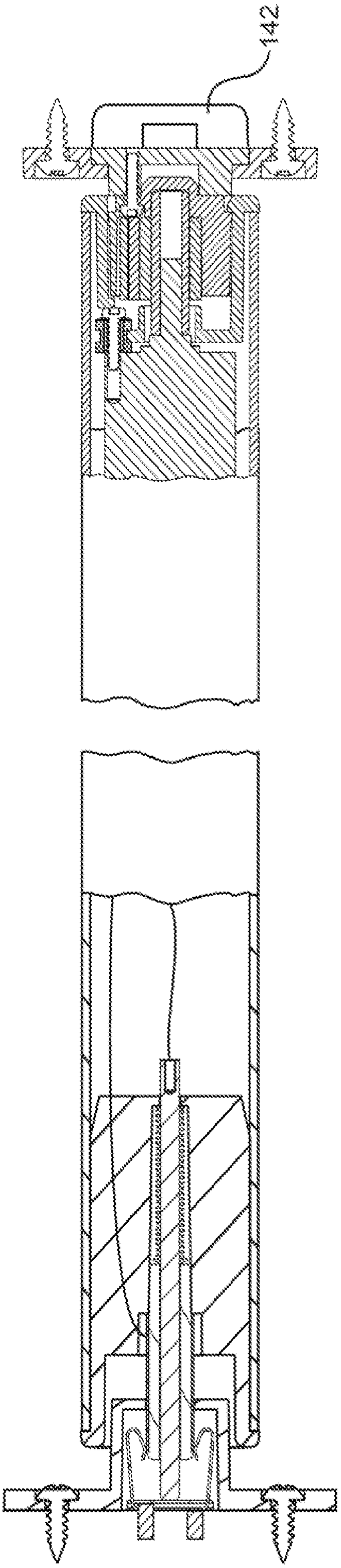


FIG. 7B

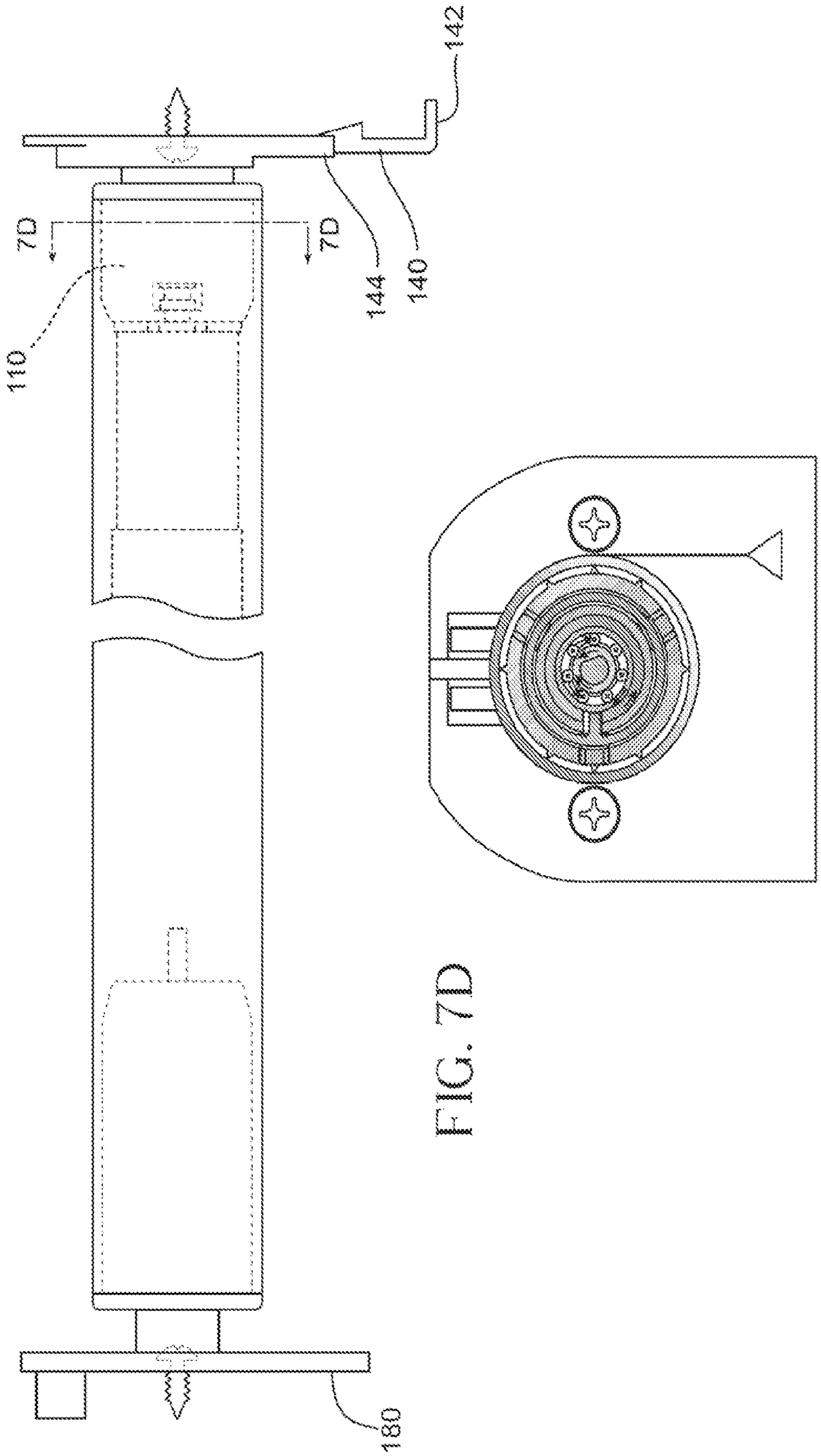



FIG. 7C

FIG. 7D

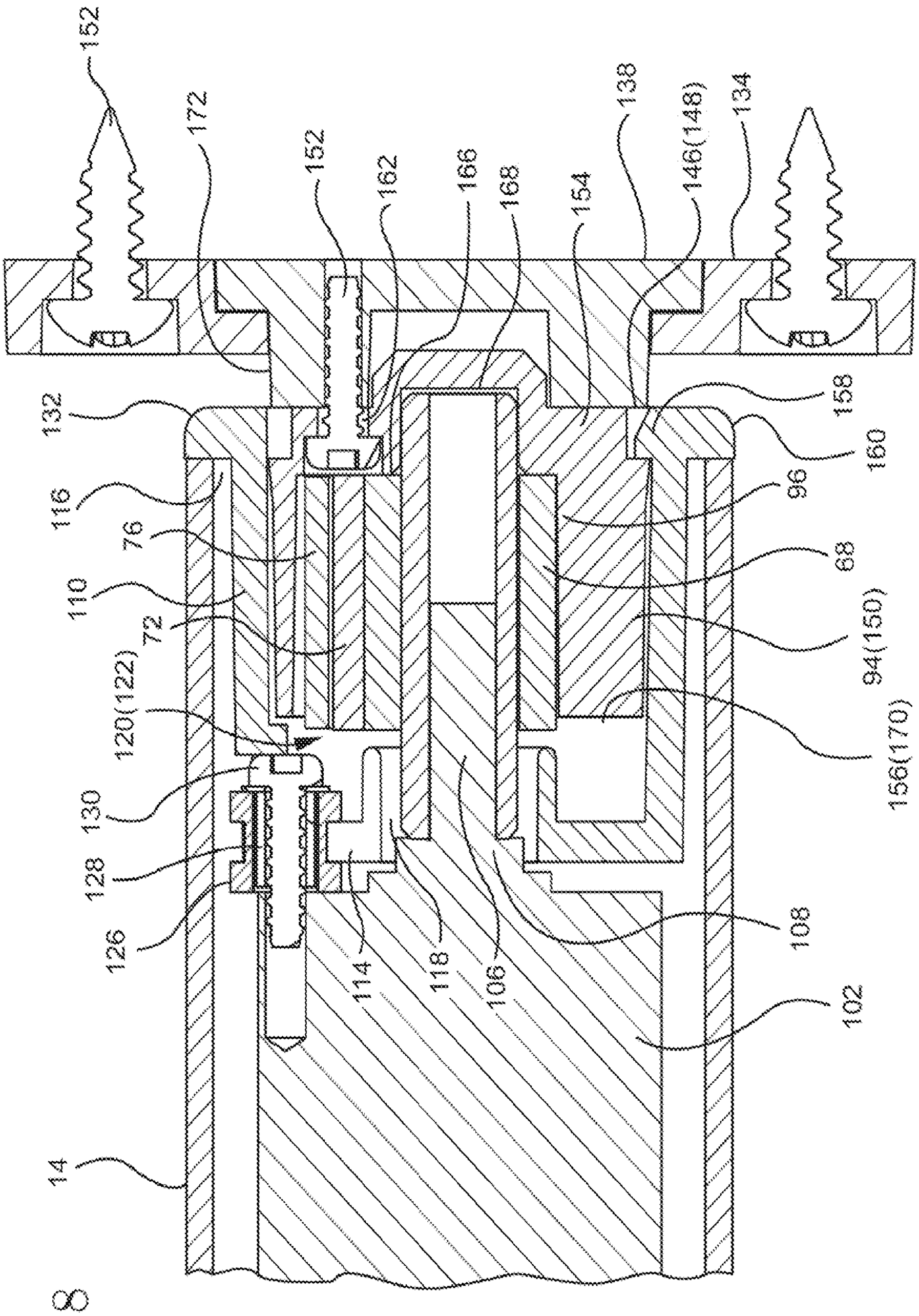
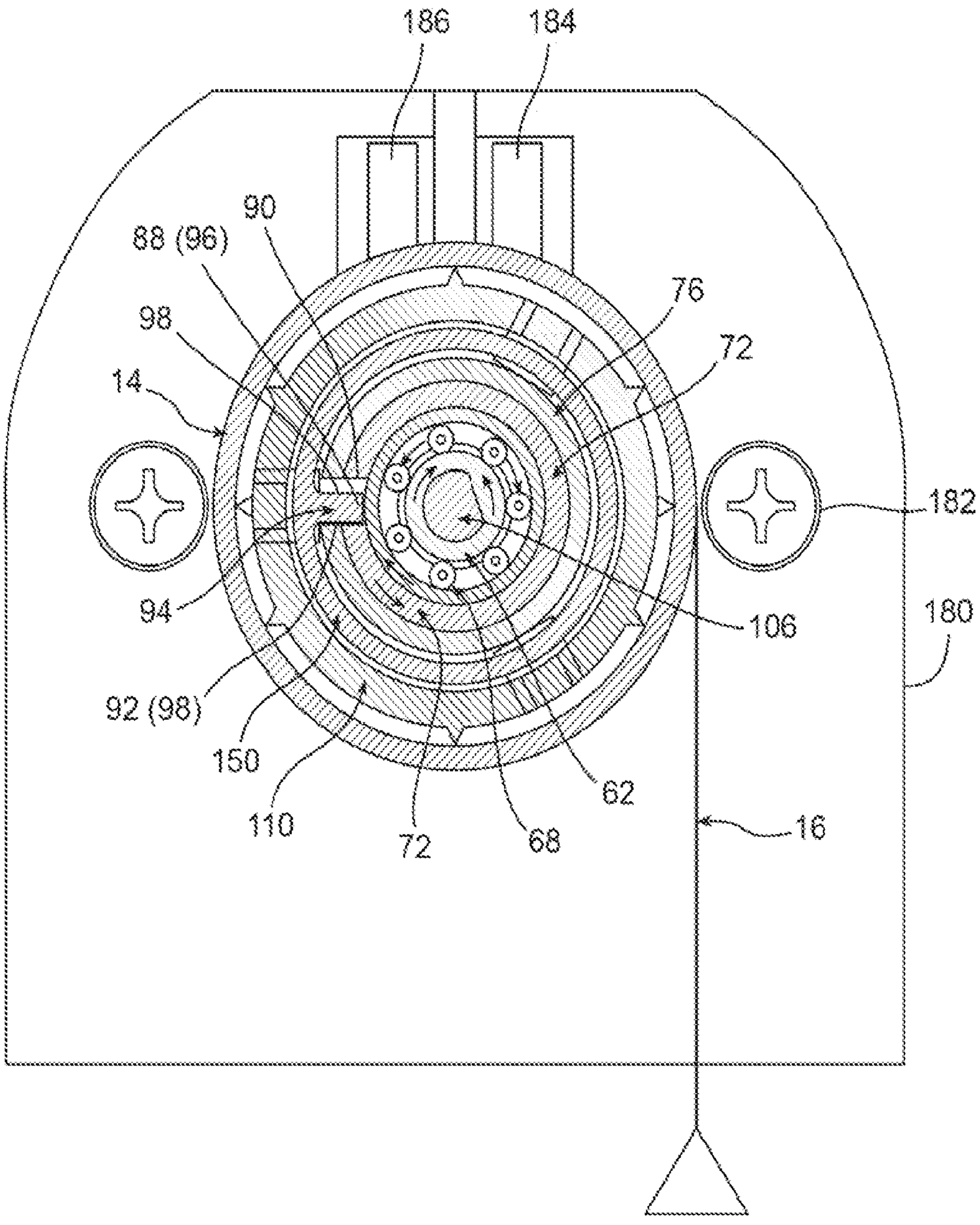

152
172
152
162
166
168
154
138
146(148)
134
132
158
160
116
96
76
68
110
72
94(150)
120(122)
156(170)
130
128
126
114
118
106
108
102
14

FIG. 8

FIG. 9



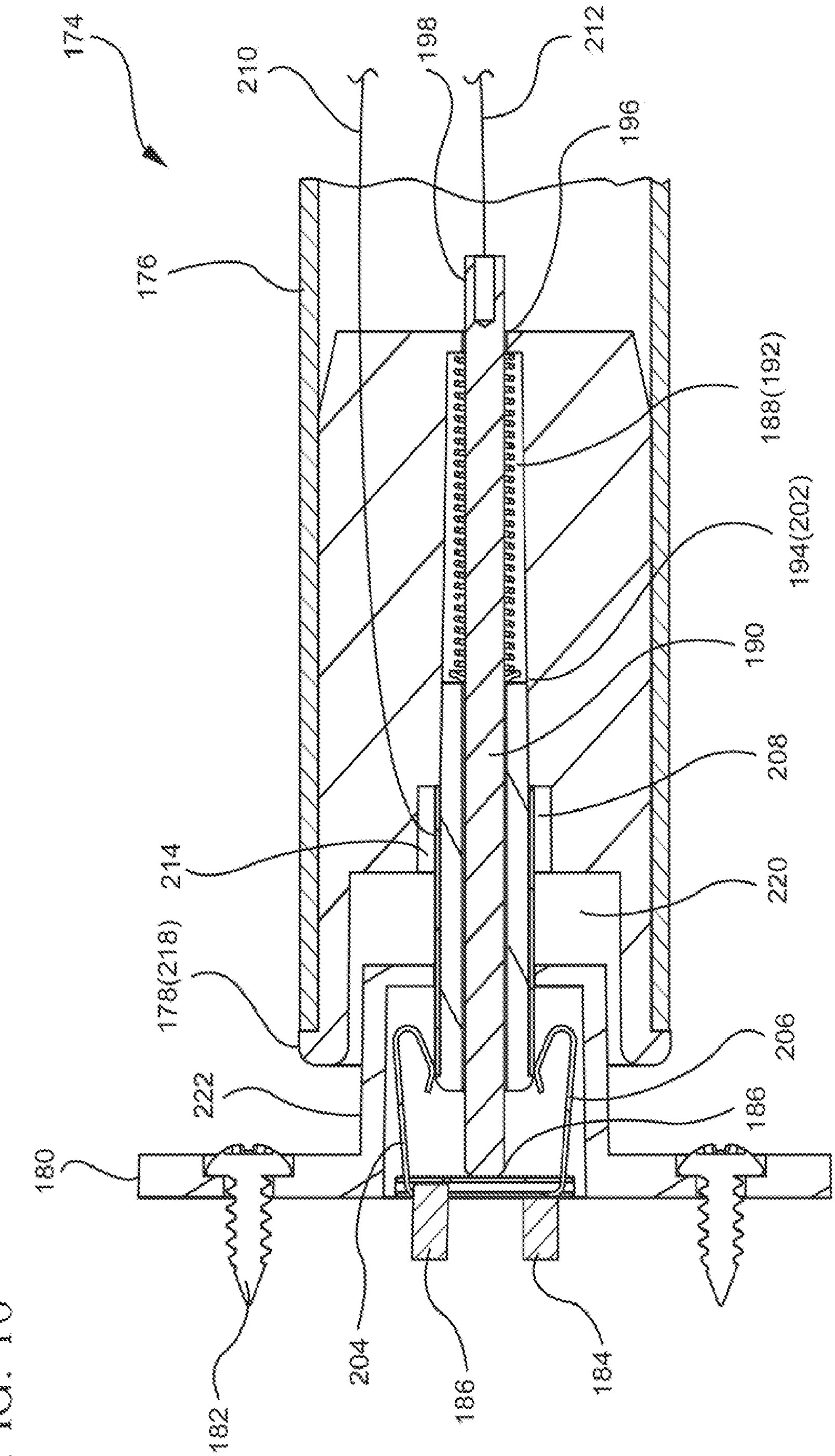

174
210
198
212
196
176
188(192)
194(202)
190
208
214
220
178(218)
222
206
186
180
182
204
186
184

FIG. 10

FIG. 11

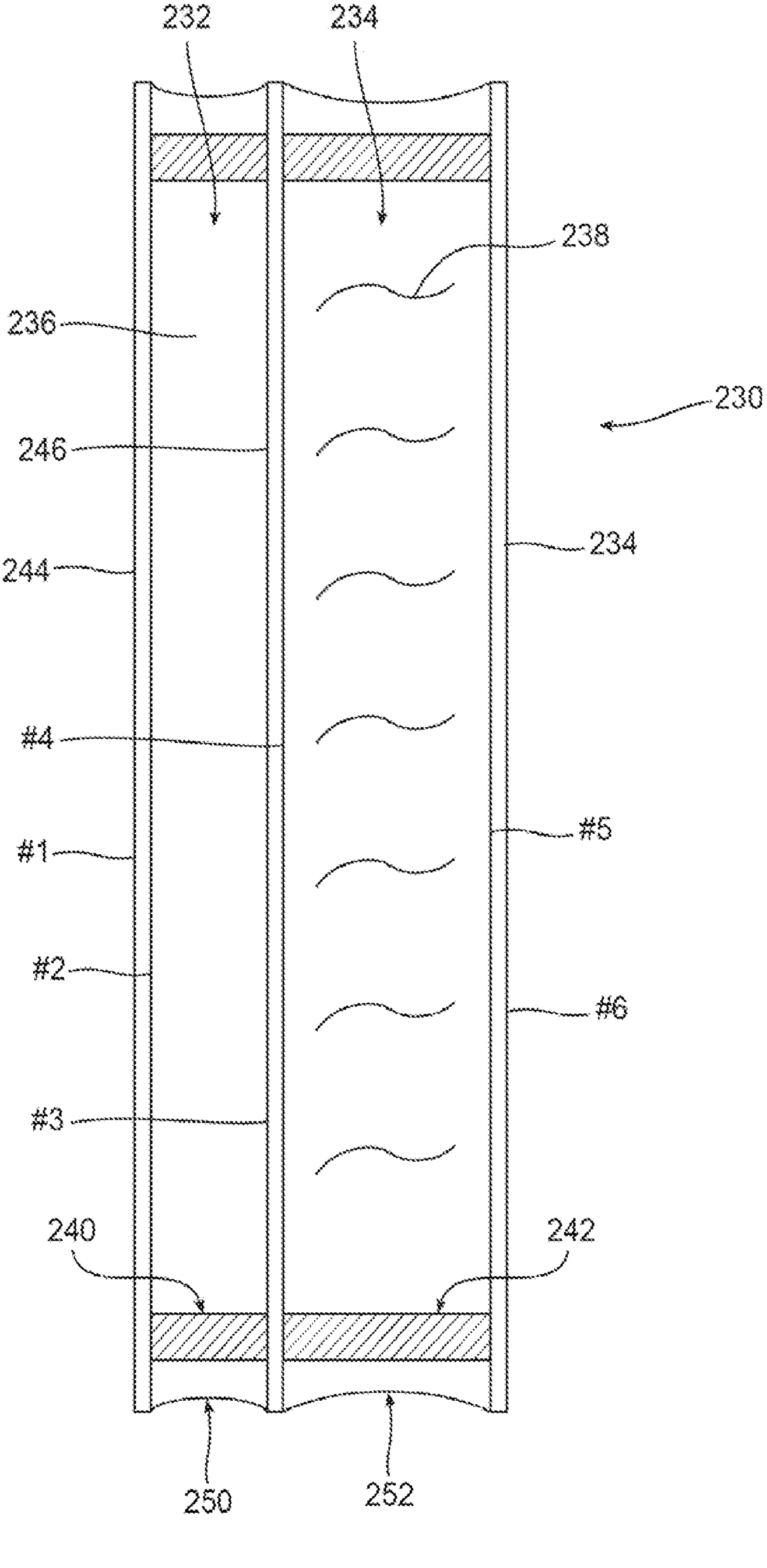


FIG. 12

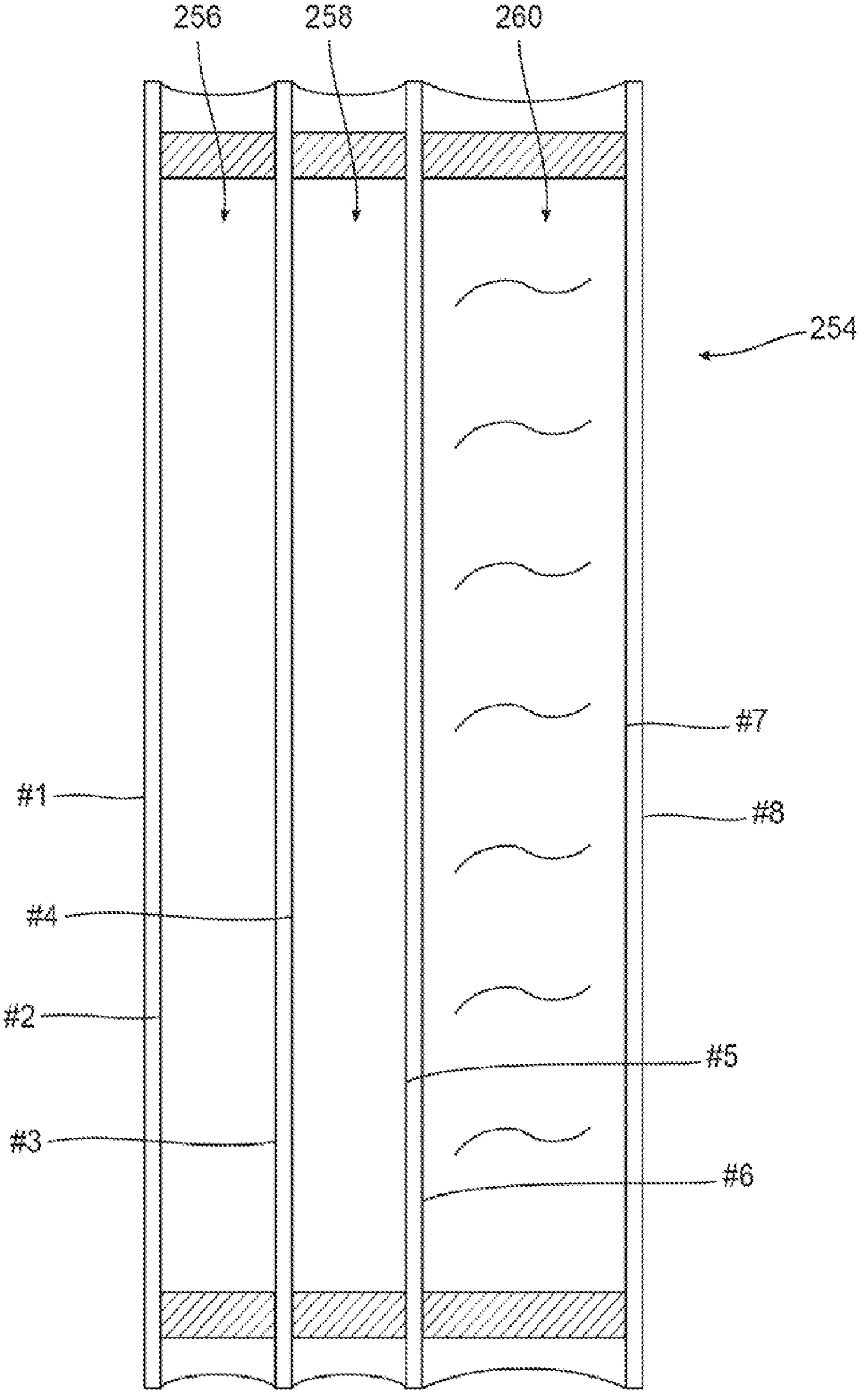


FIG. 13A

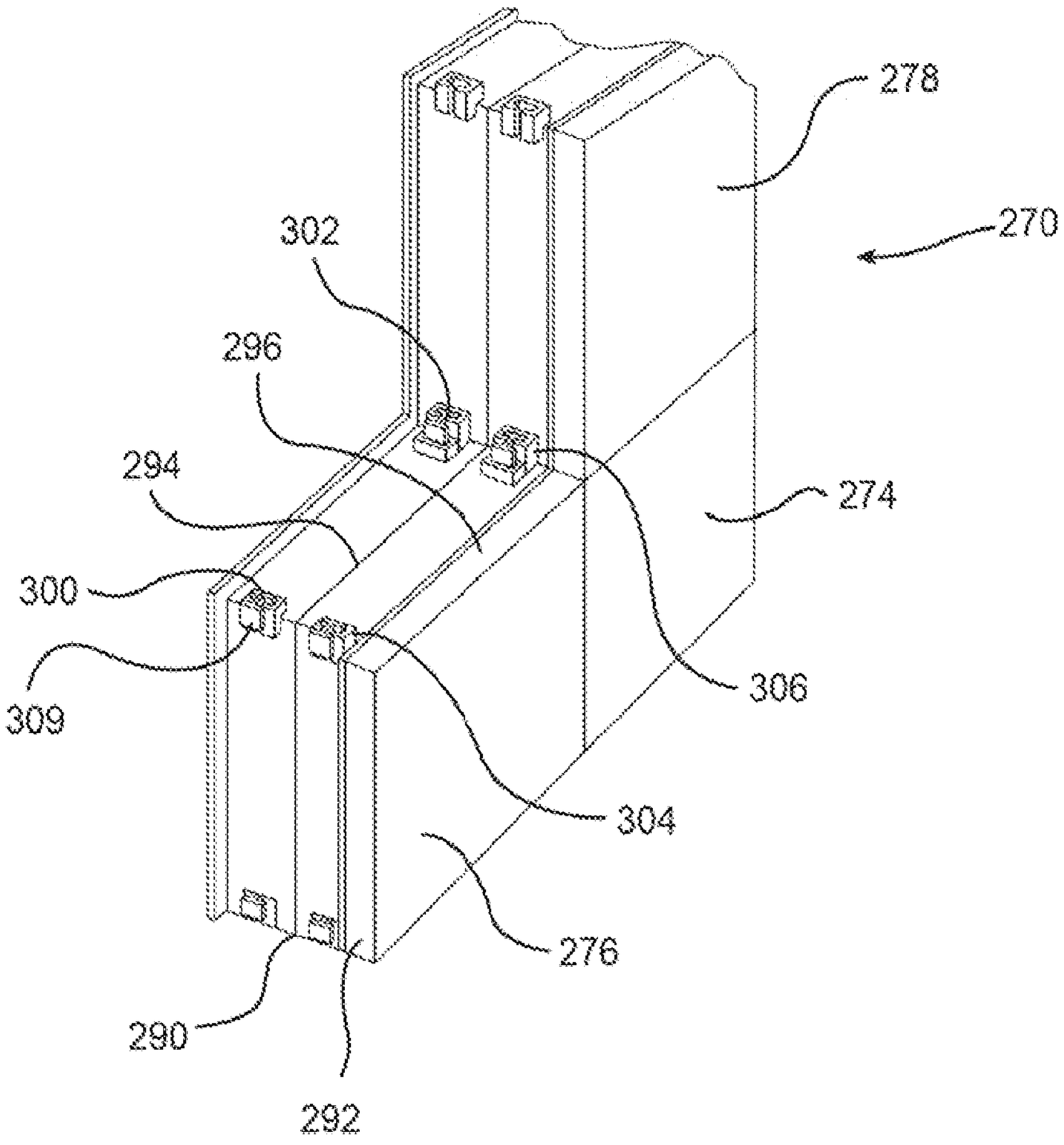
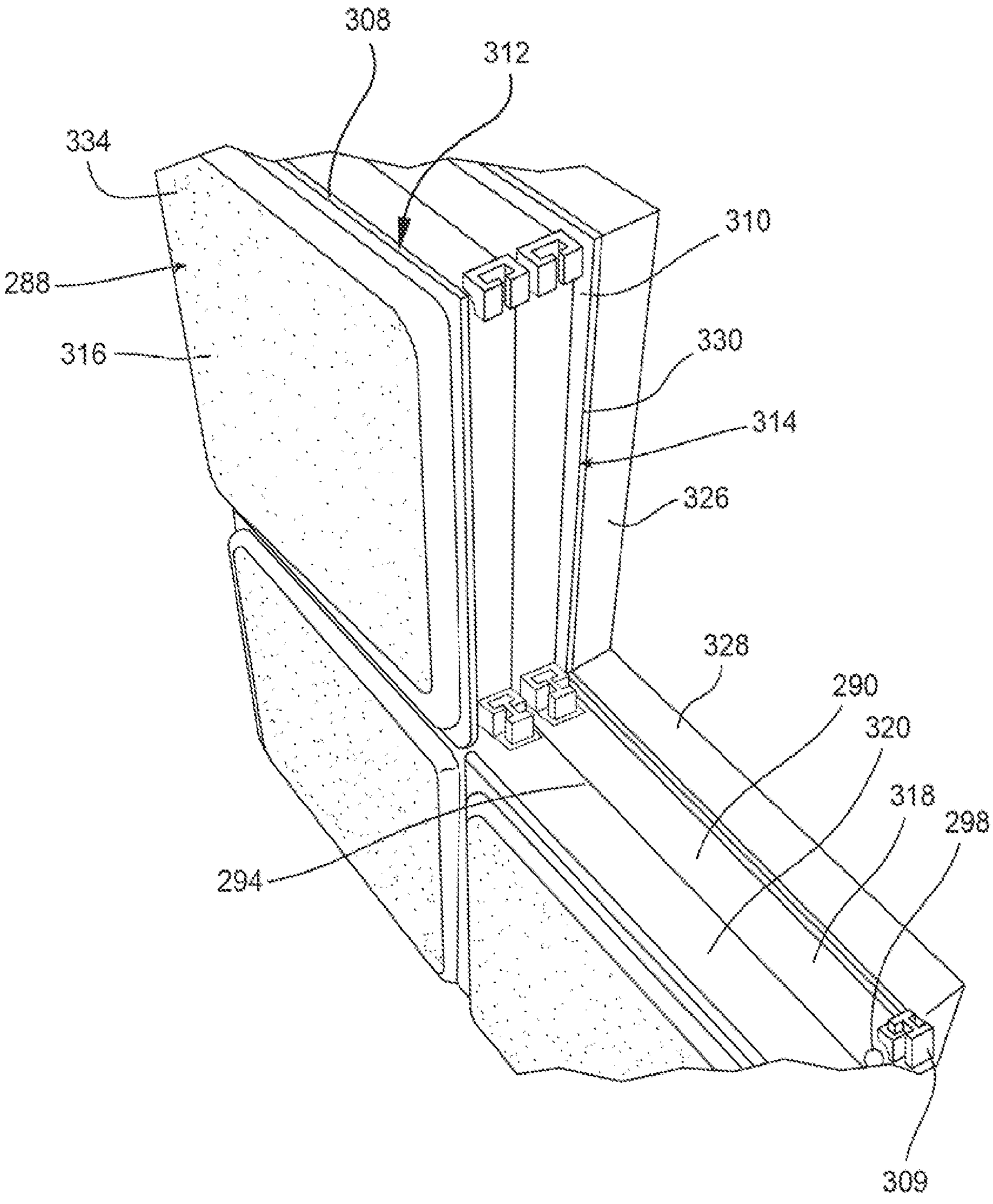


FIG. 13B



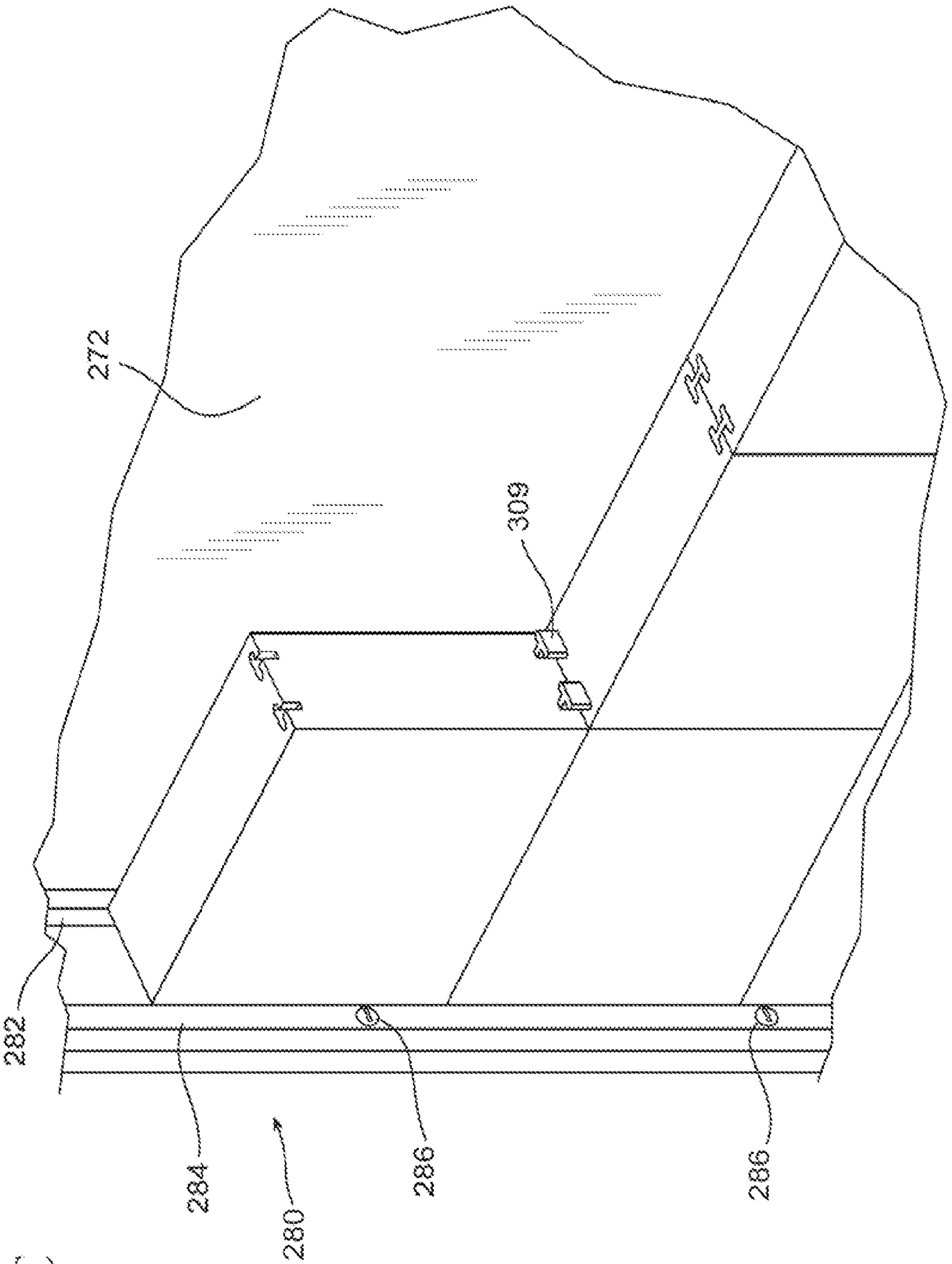



FIG. 13C

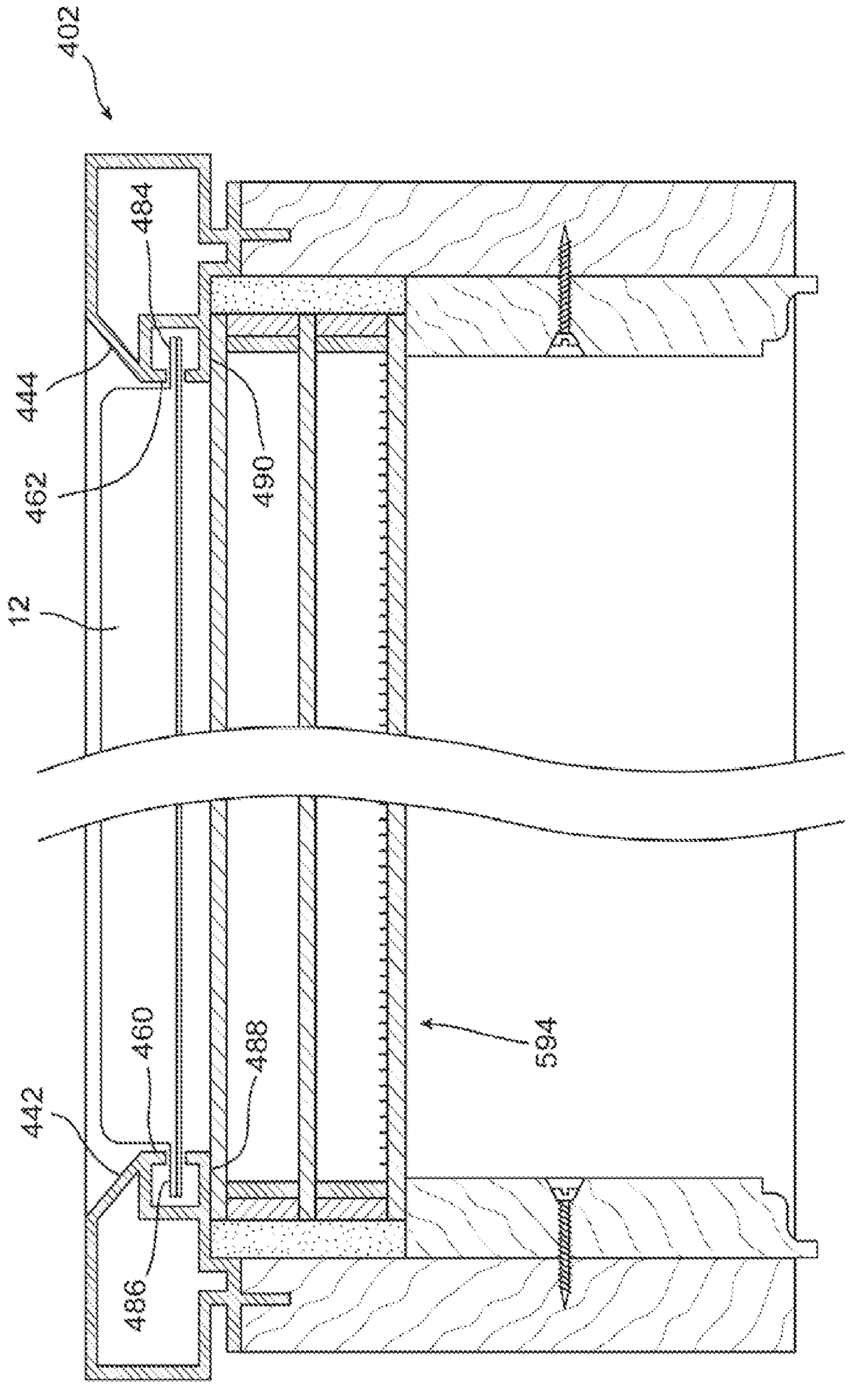
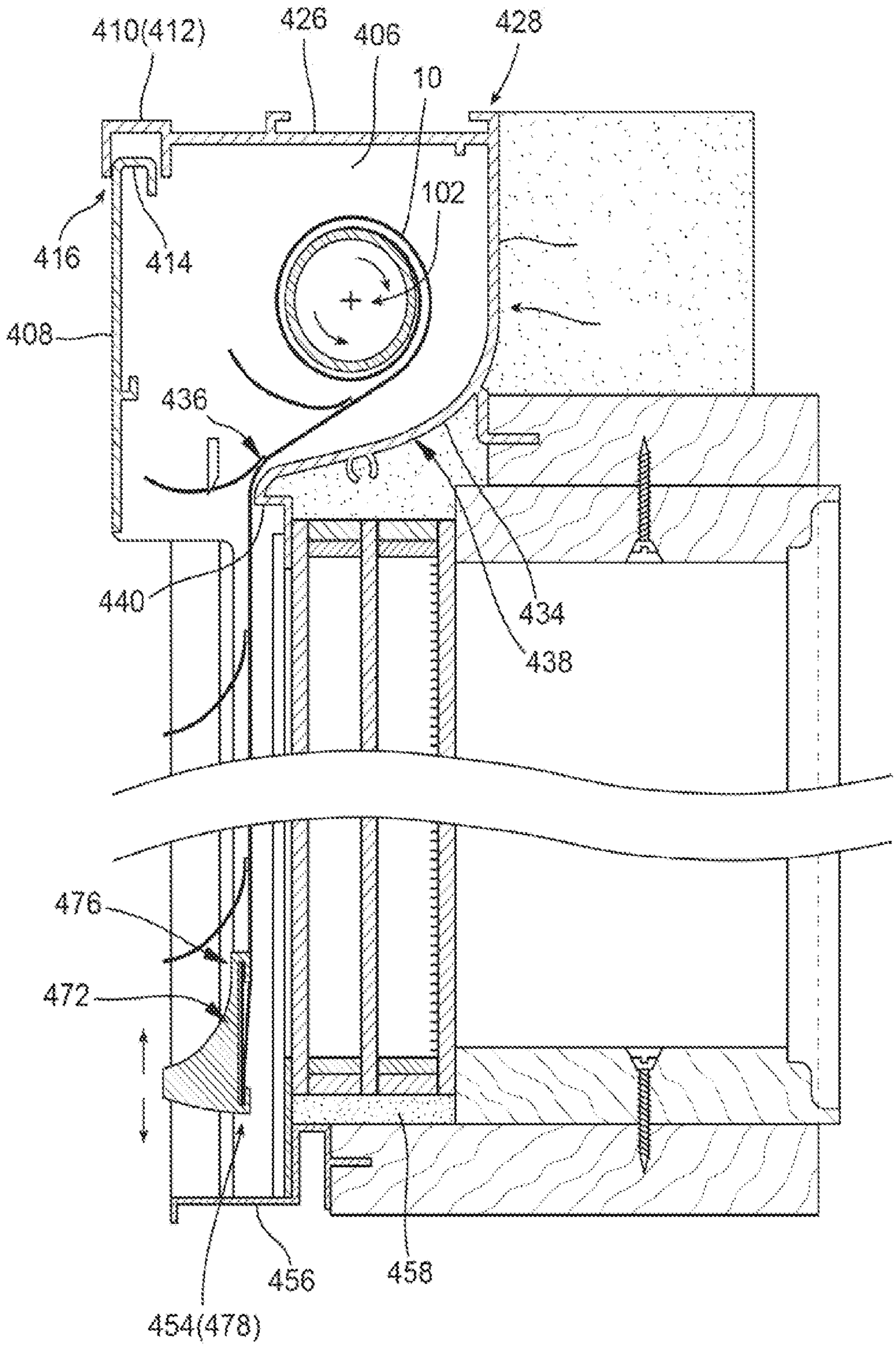



FIG. 14

FIG. 15


410(412)
426
406
428
10
102
416
414
408
436
440
434
438
476
472
456
458
454(478)

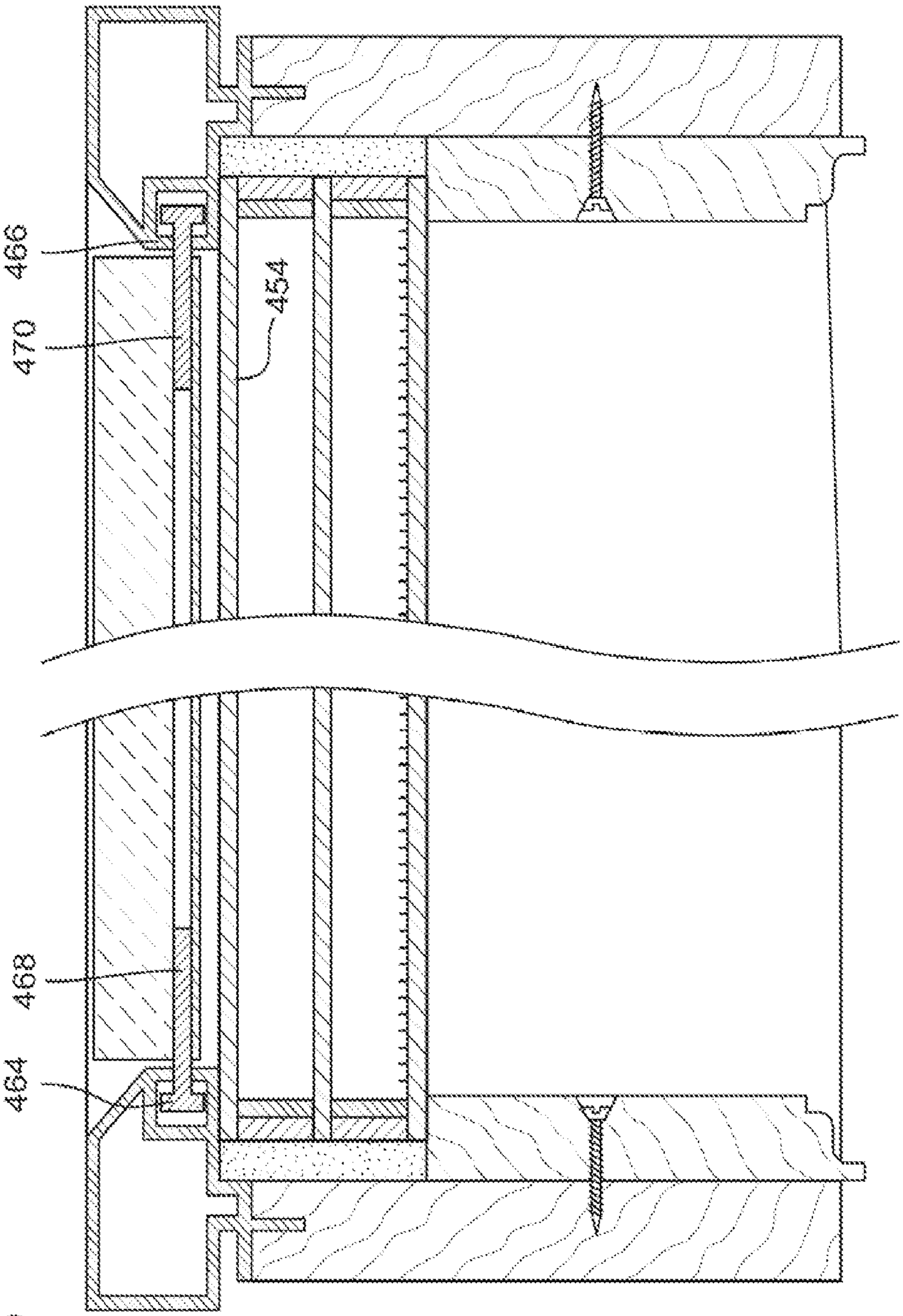



FIG. 16

FIG. 17

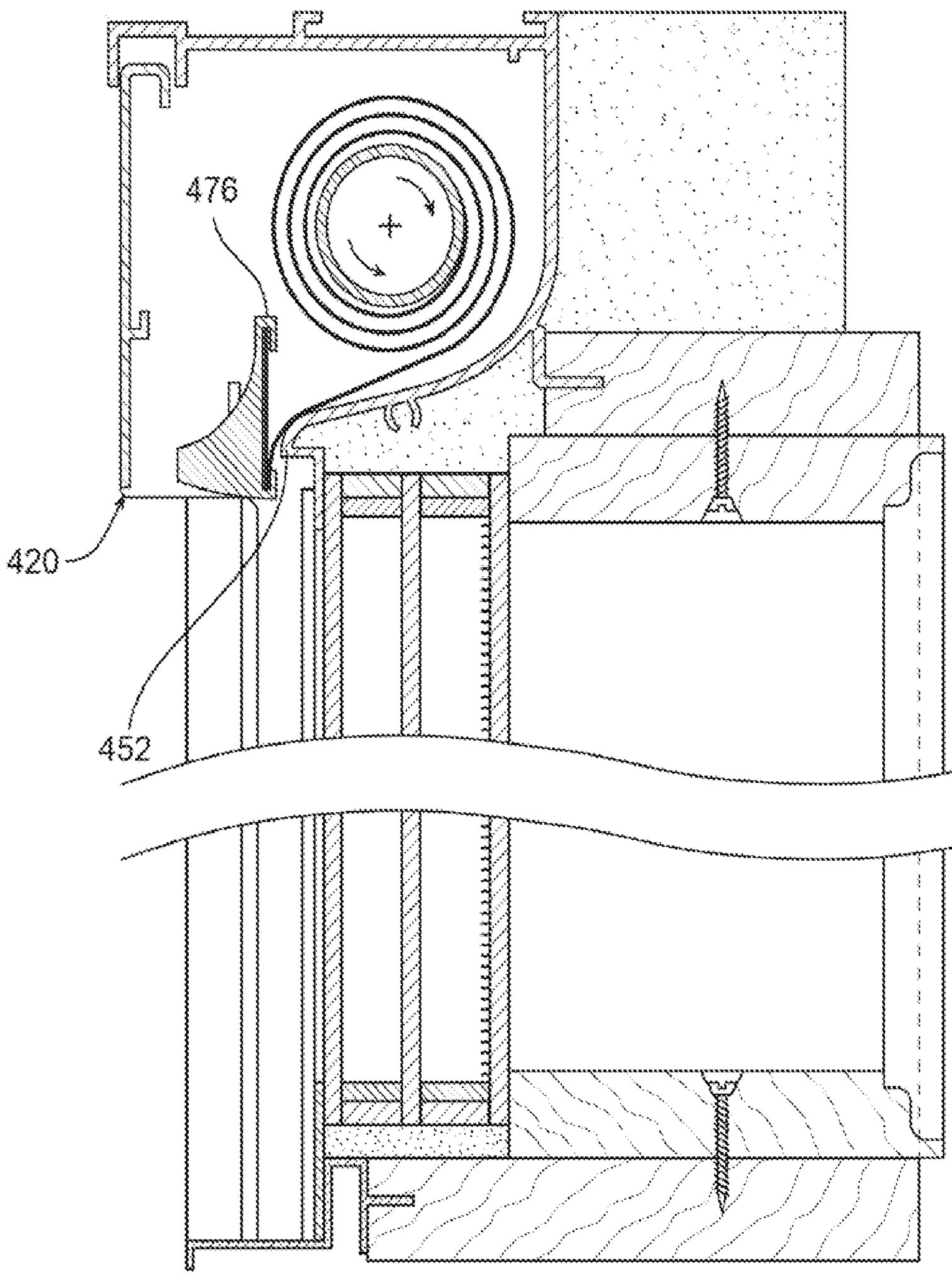


FIG. 18

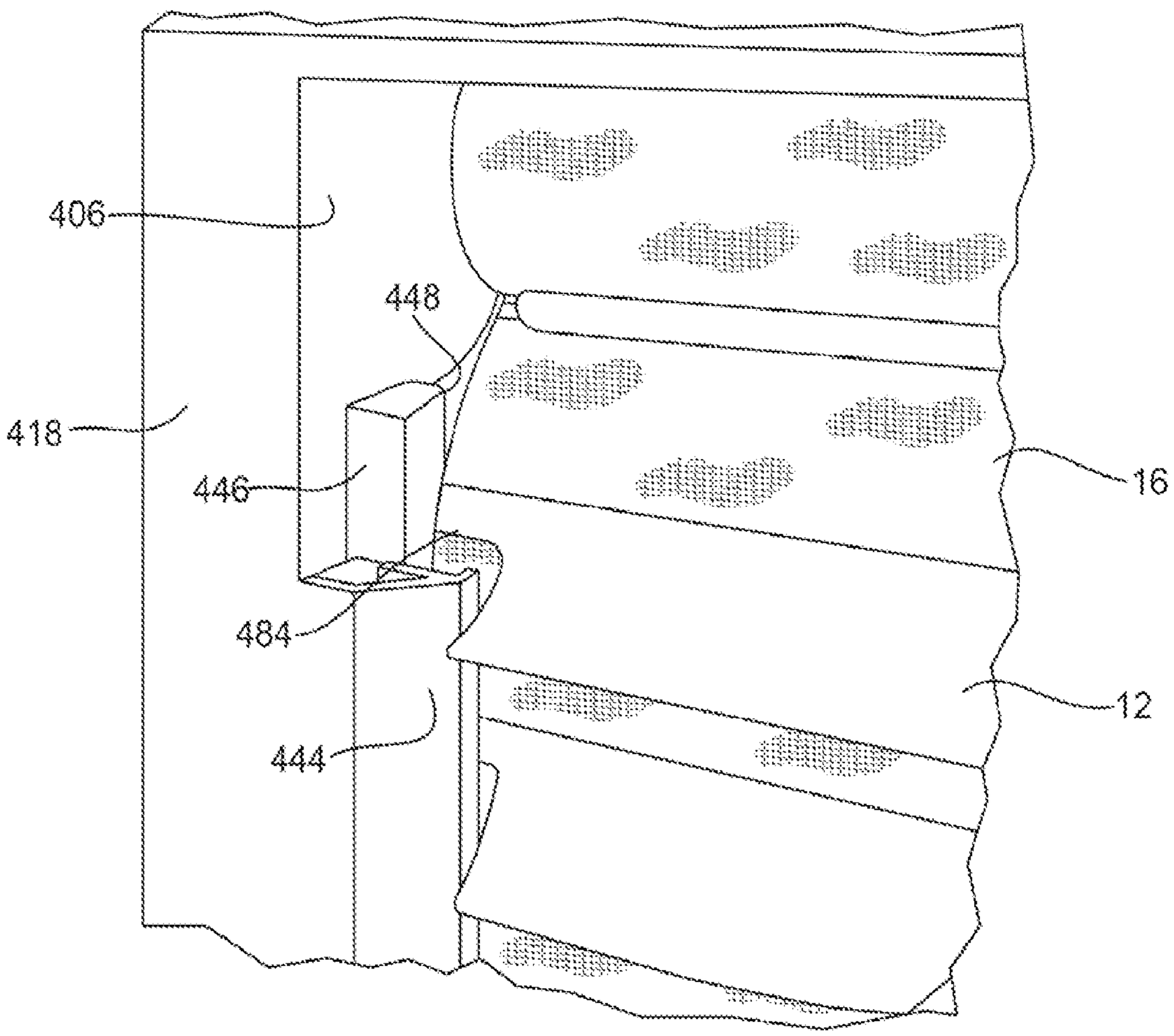


FIG. 19

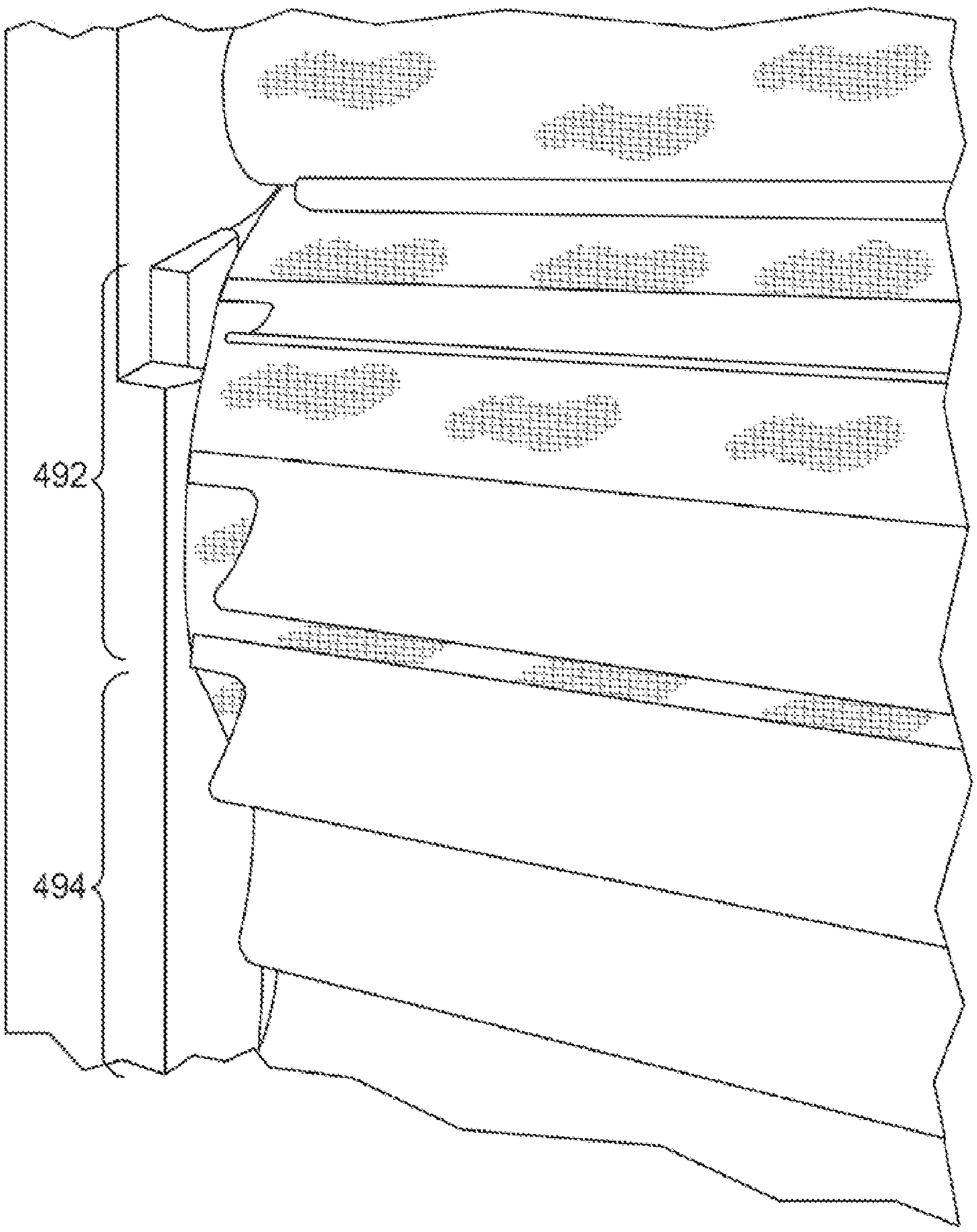


FIG. 20

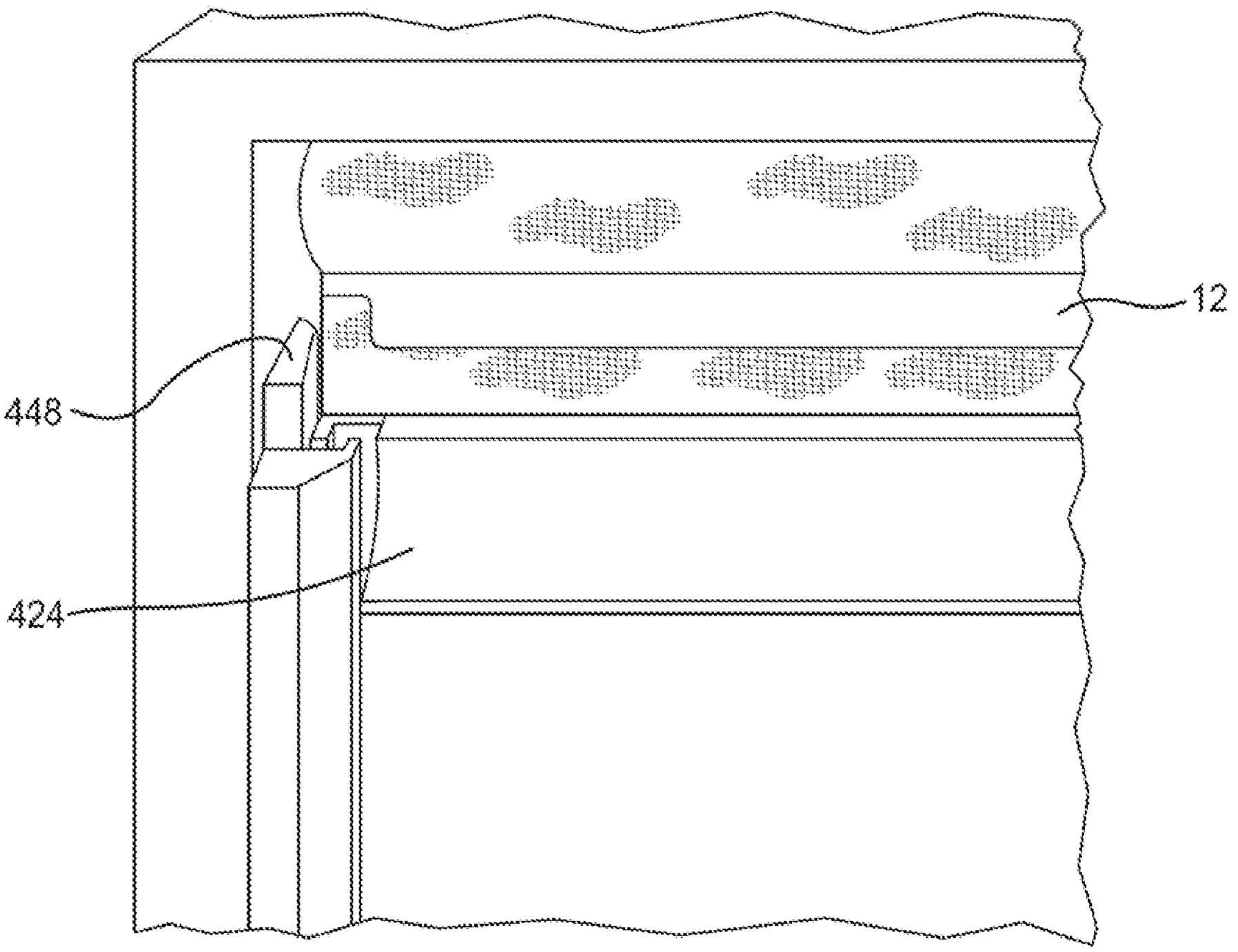
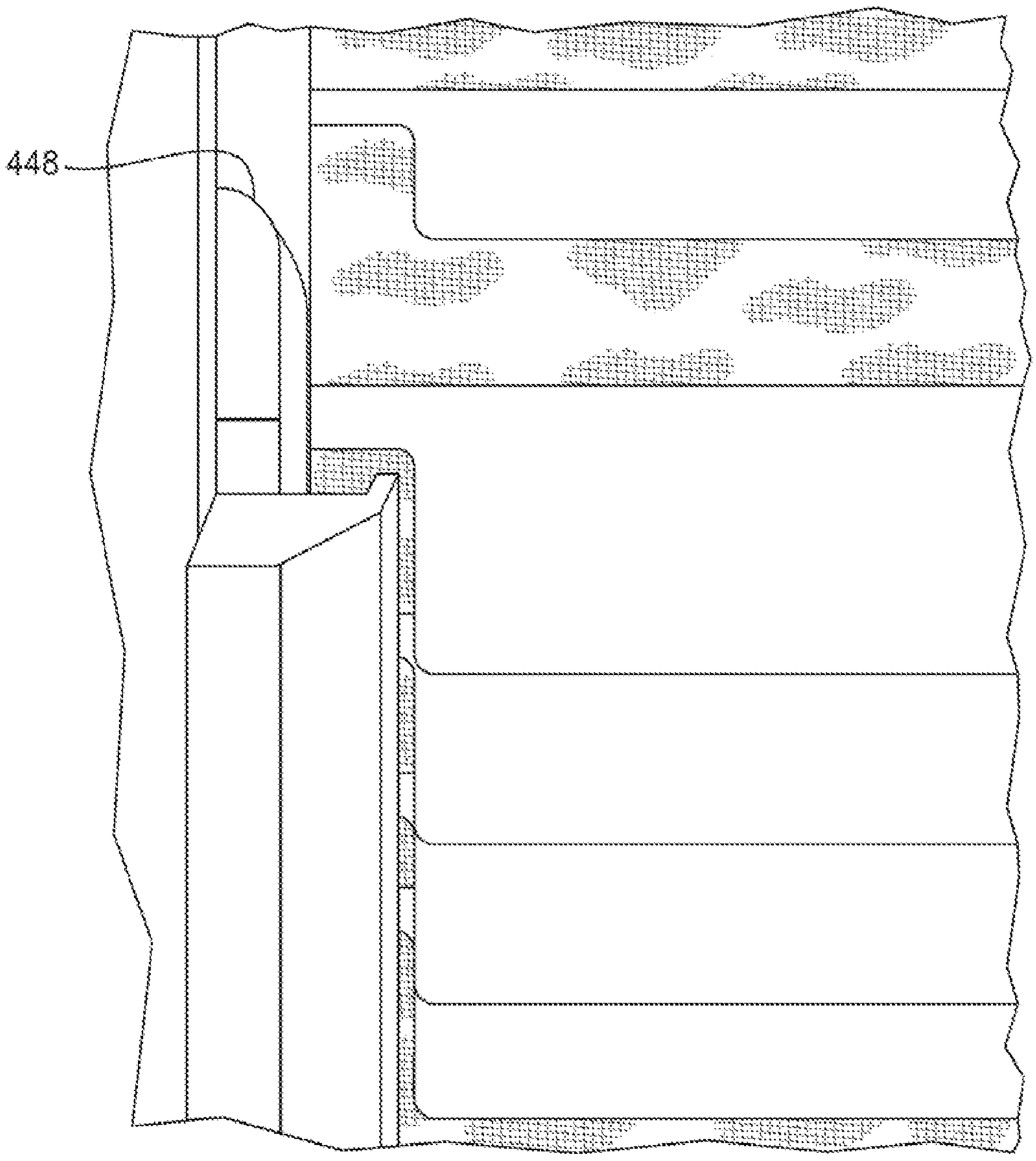


FIG. 21



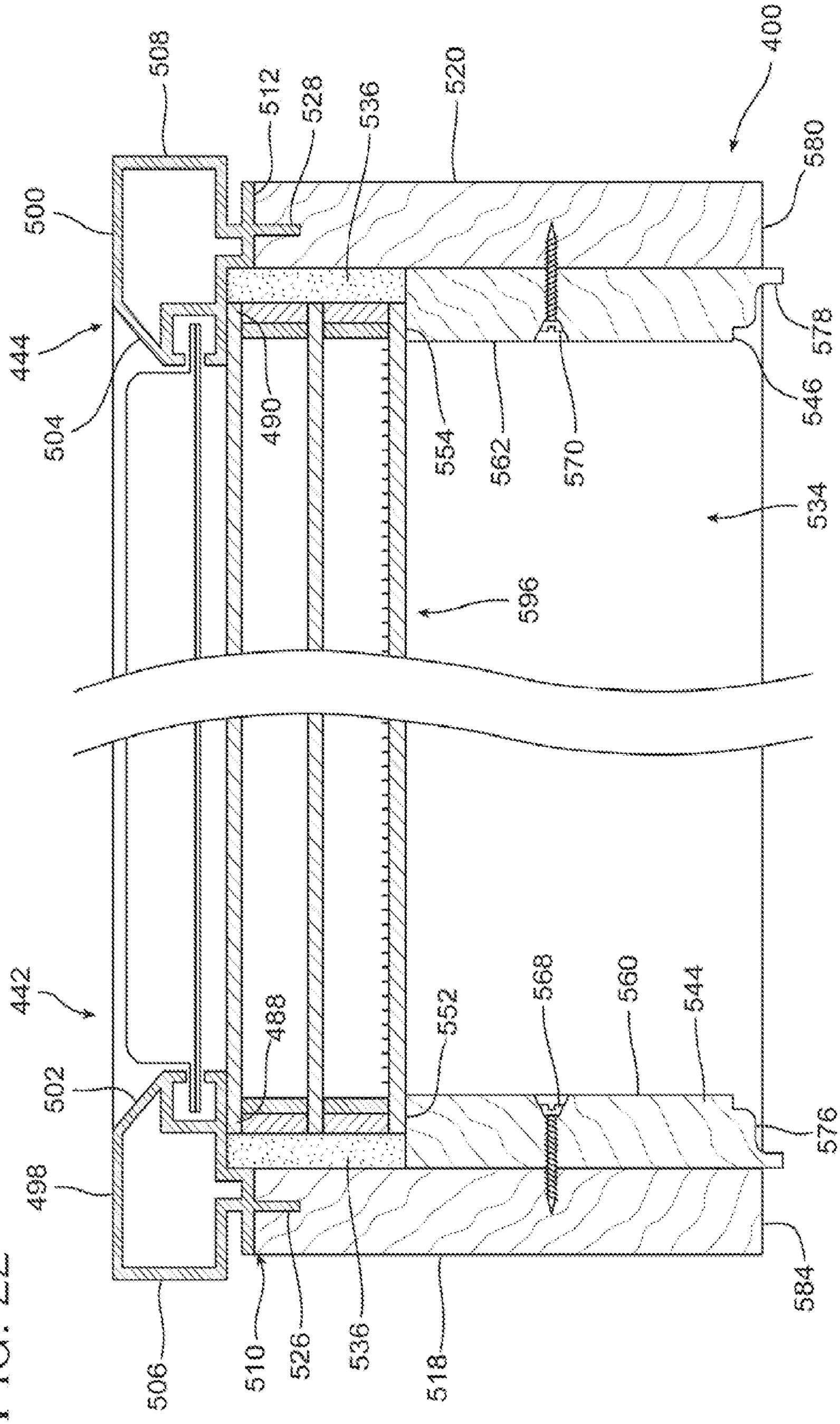
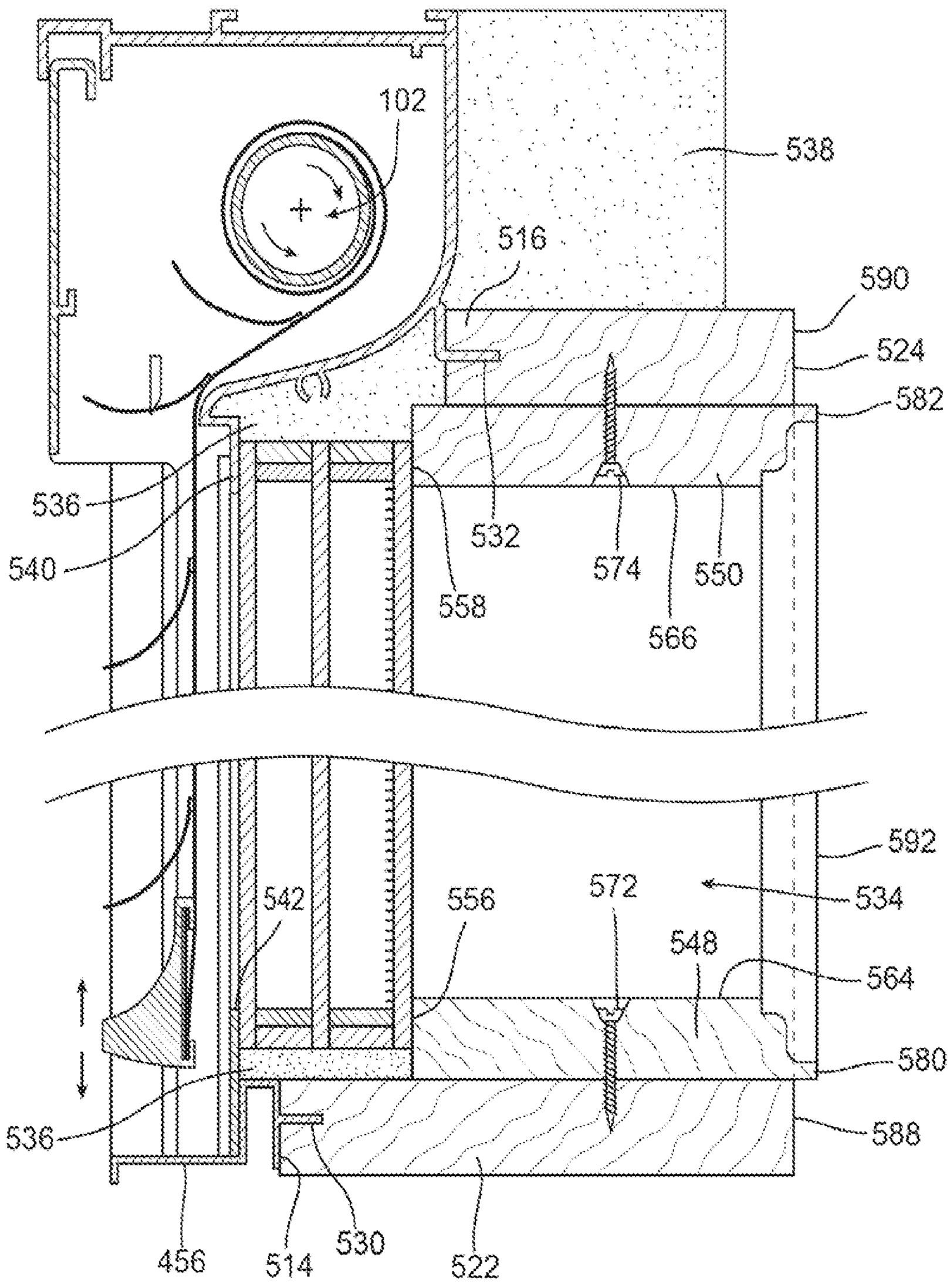

400
580
578
546
534
596
444
504
490
554
562
570
500
512
528
536
520
508
442
502
498
488
552
568
560
544
576
584
506
510
526
536
518

FIG. 22

FIG. 23


102
538
516
590
524
582
536
540
532
574
550
558
566
592
572
534
542
556
548
564
580
536
588
456
514
530
522

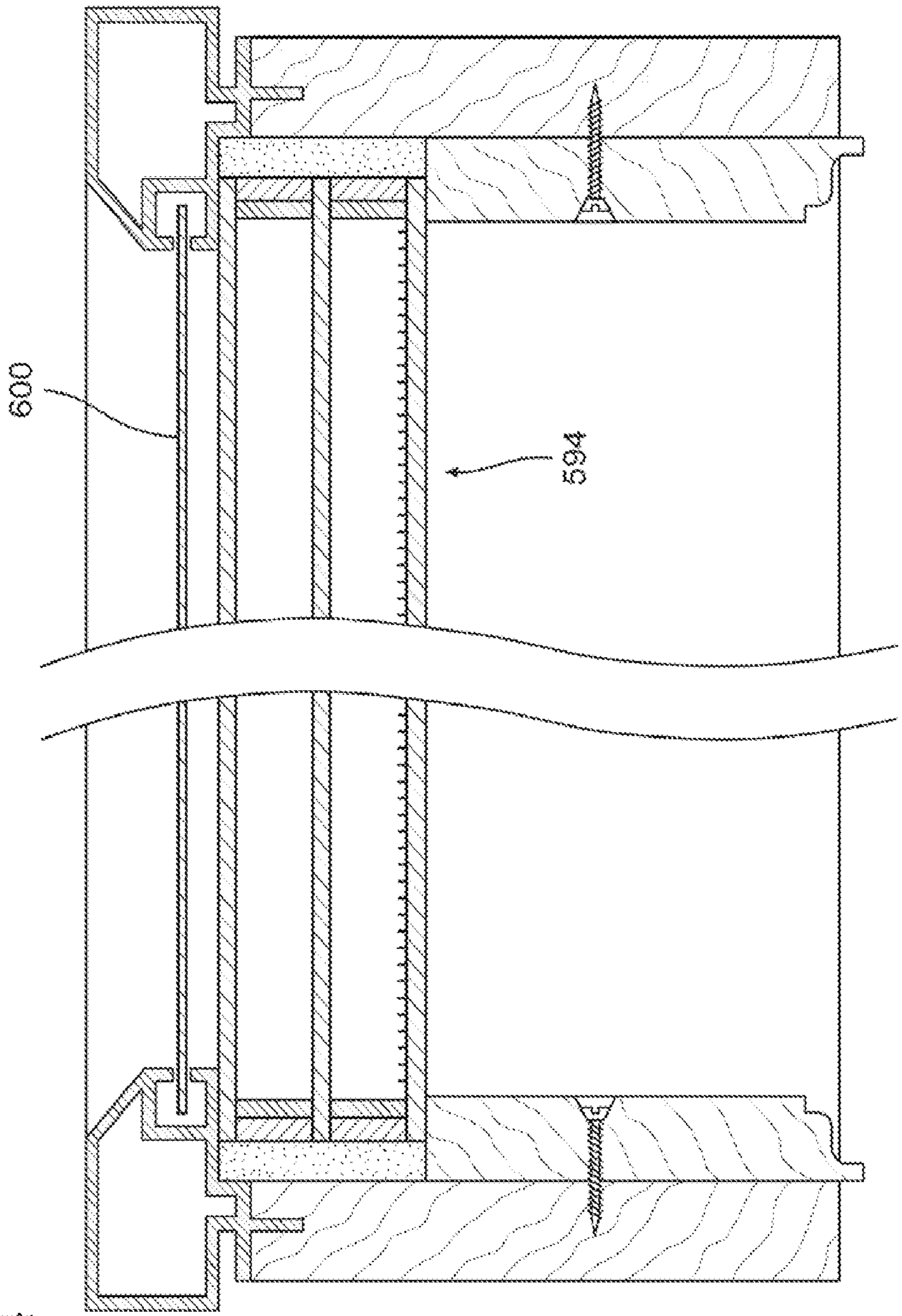
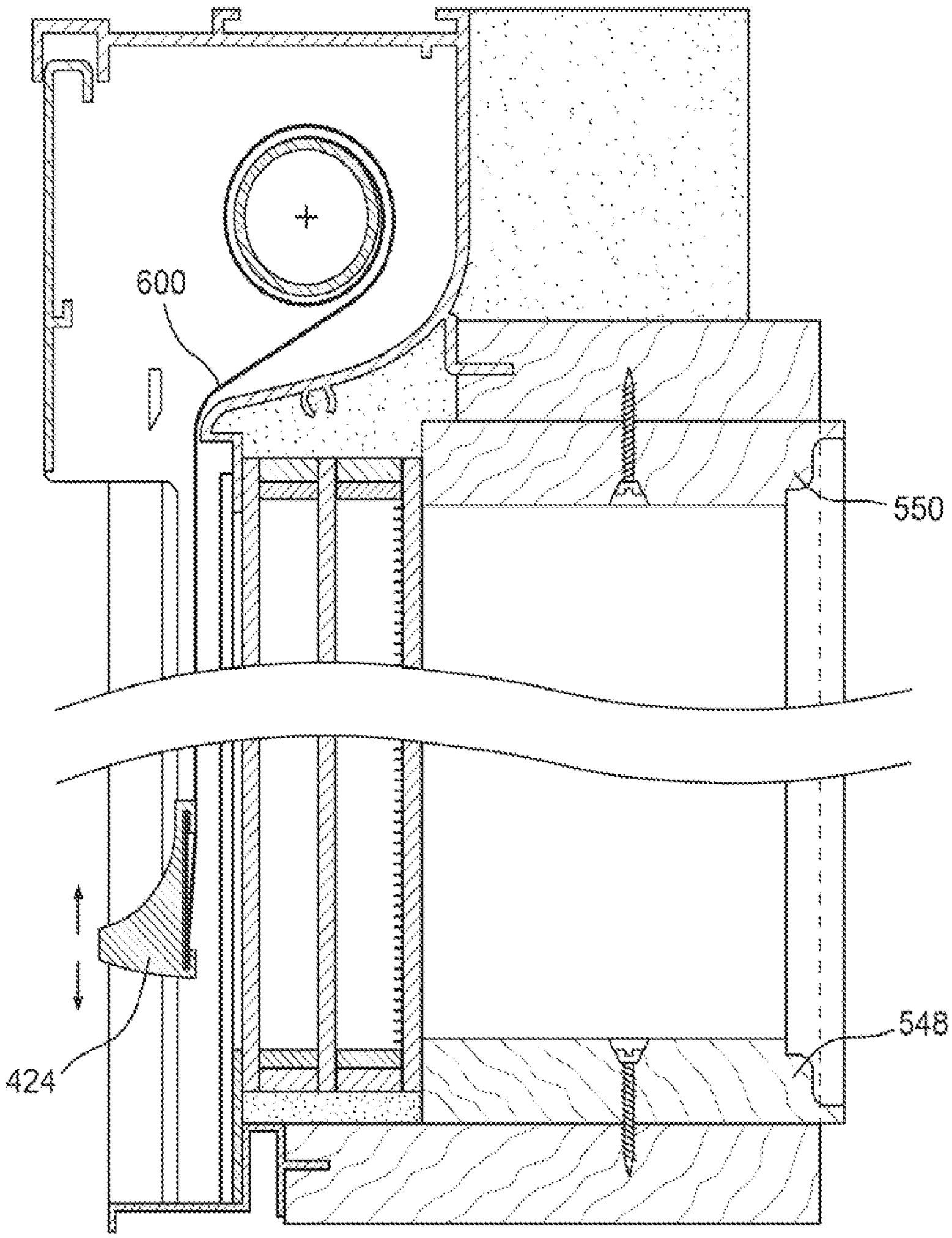



FIG. 24

FIG. 25



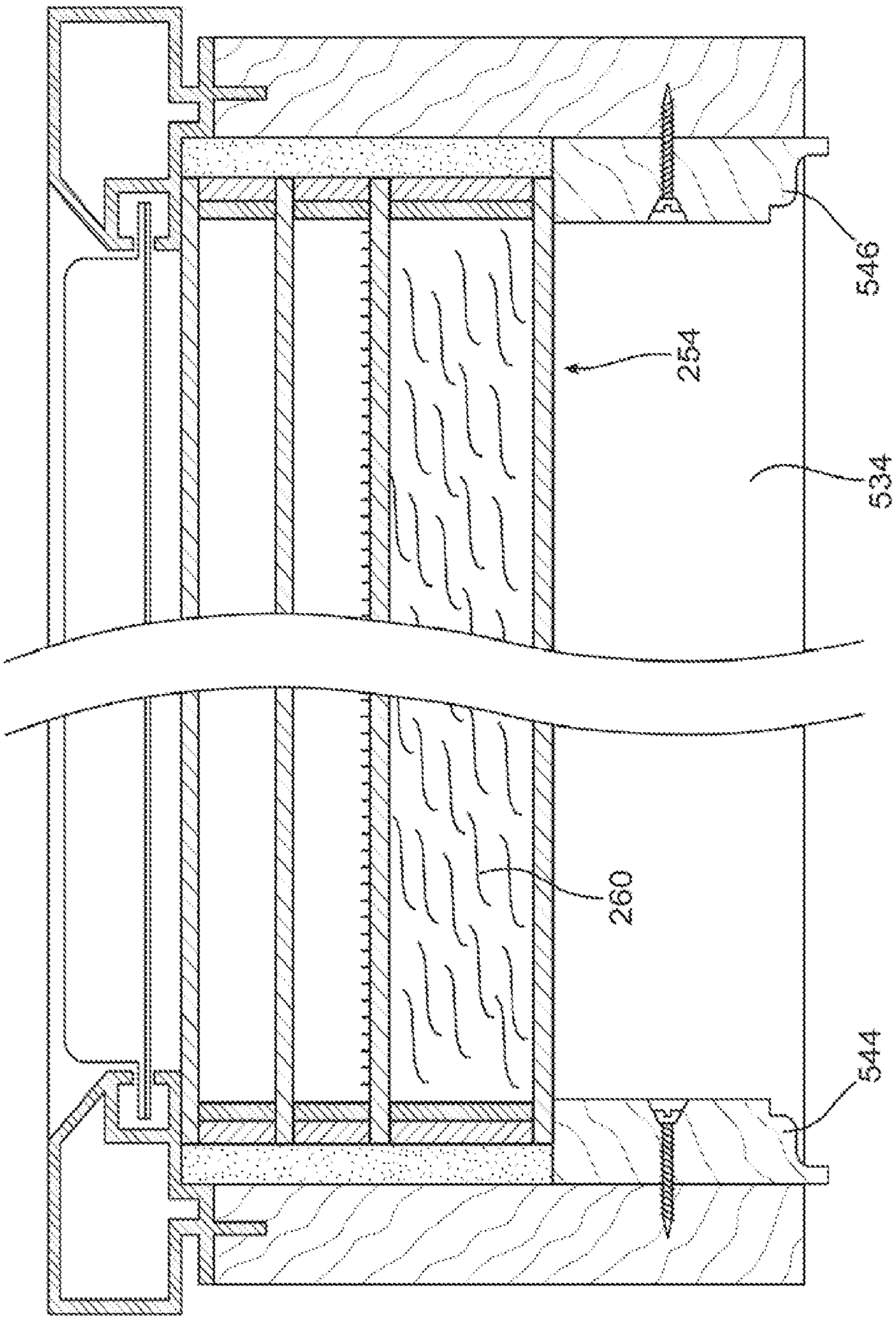
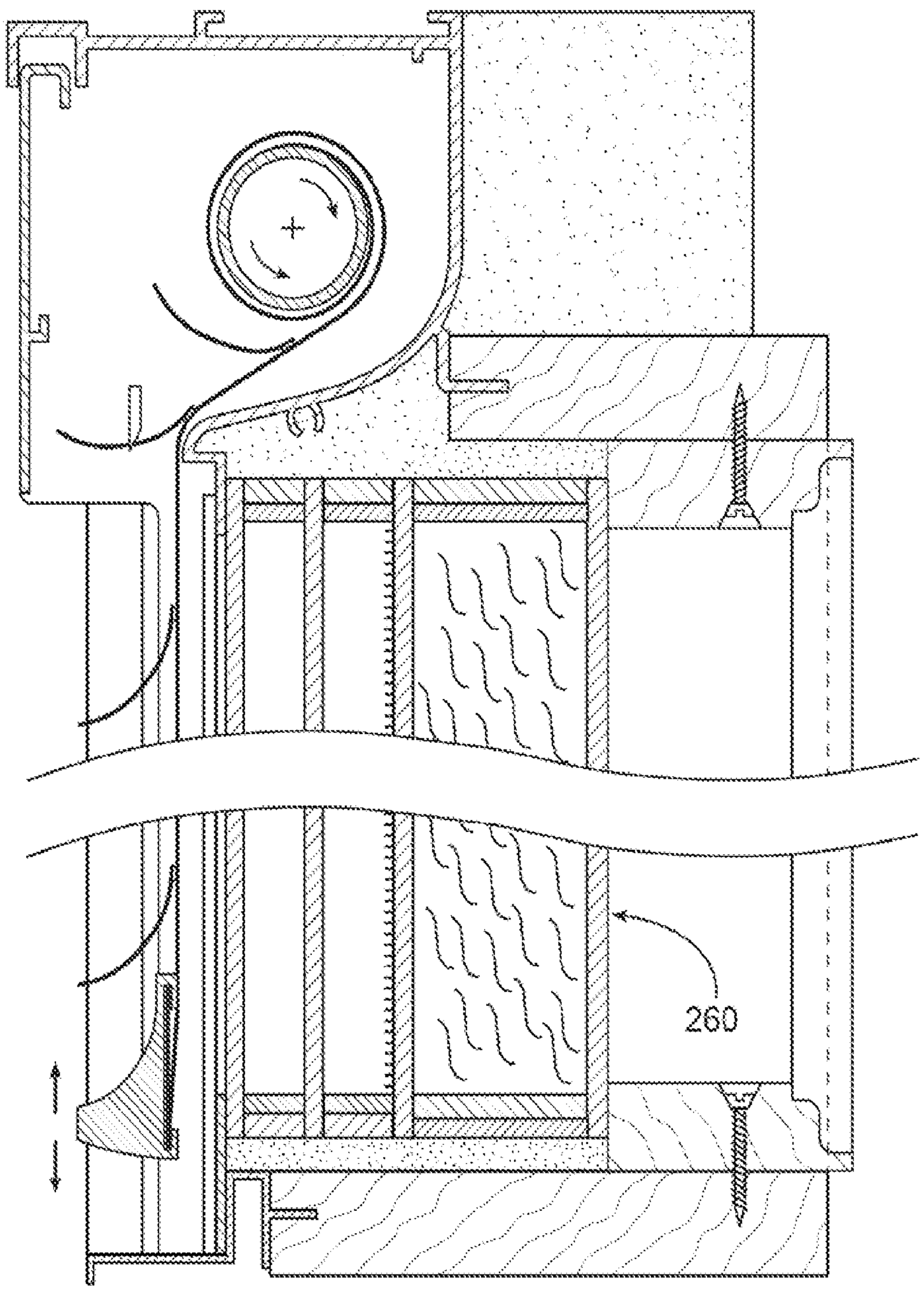



FIG. 26

FIG. 27



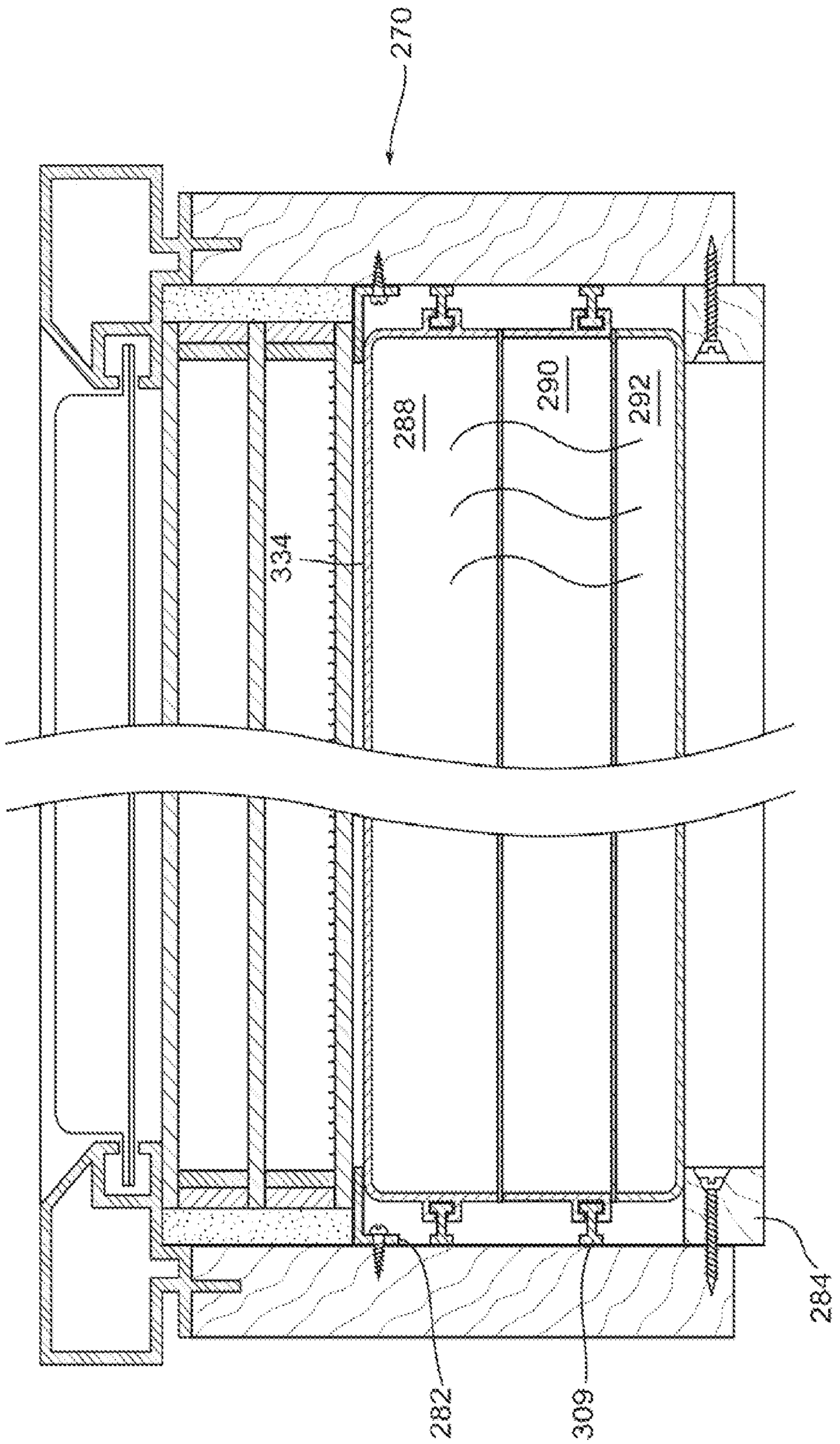
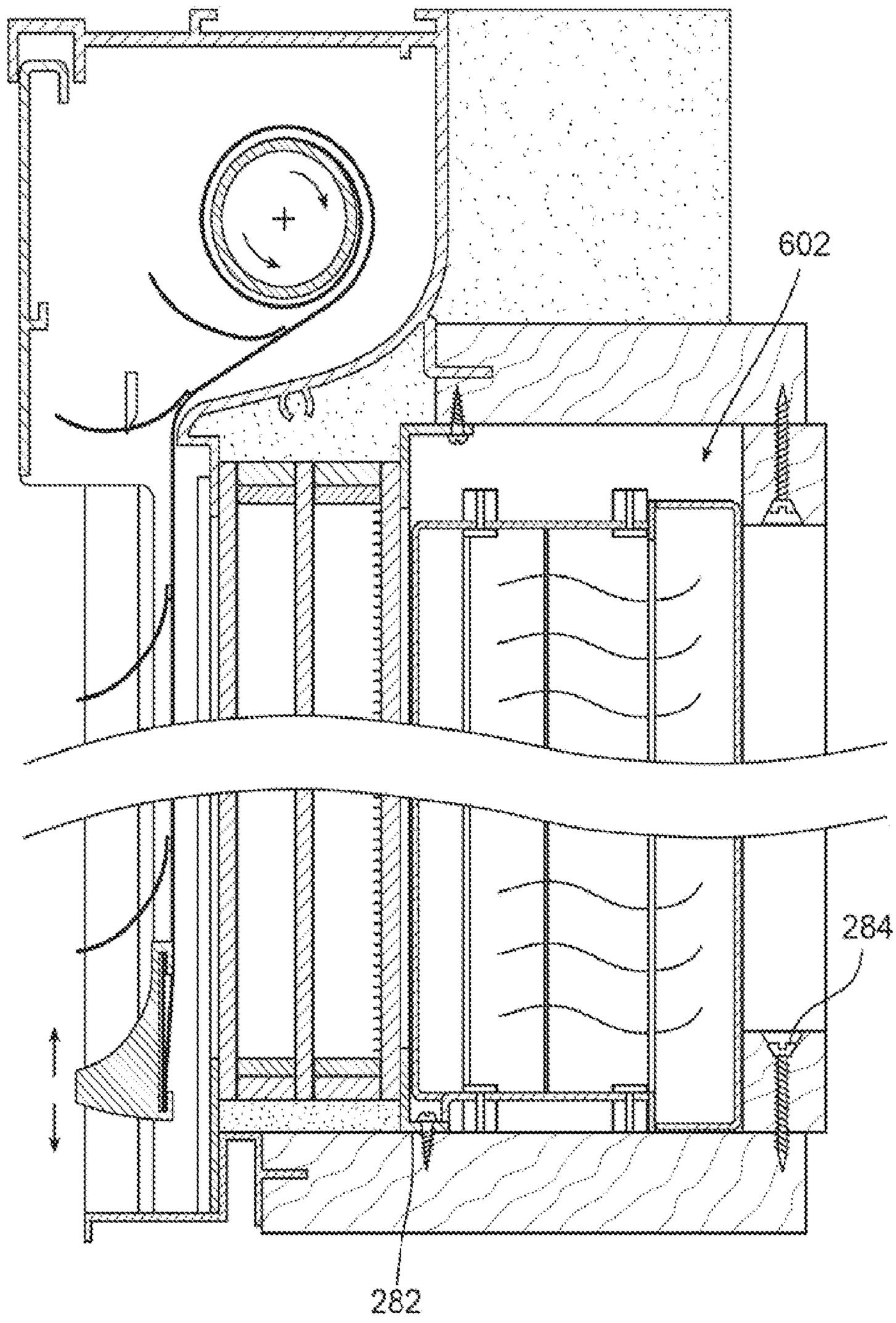



FIG. 28

FIG. 29



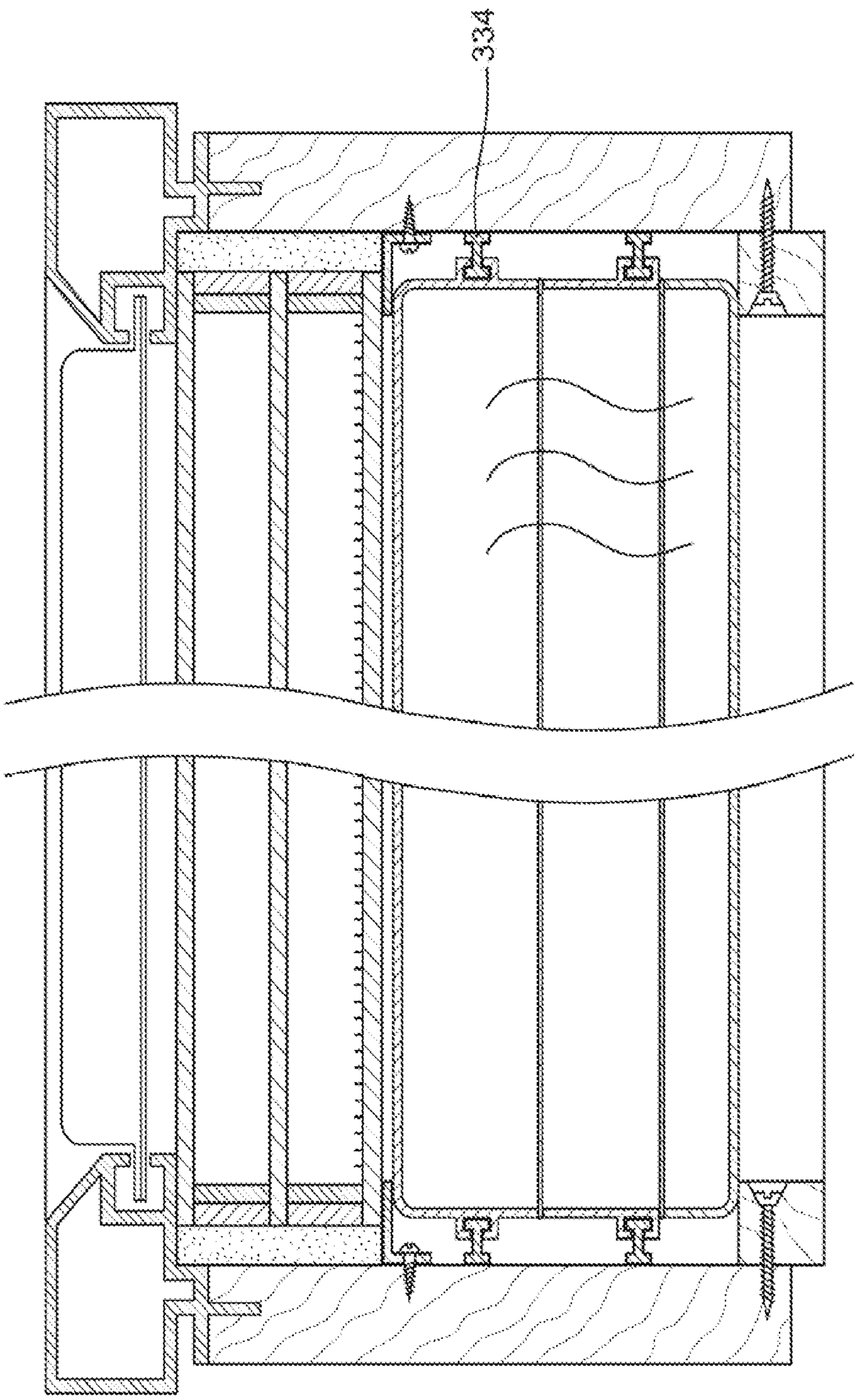
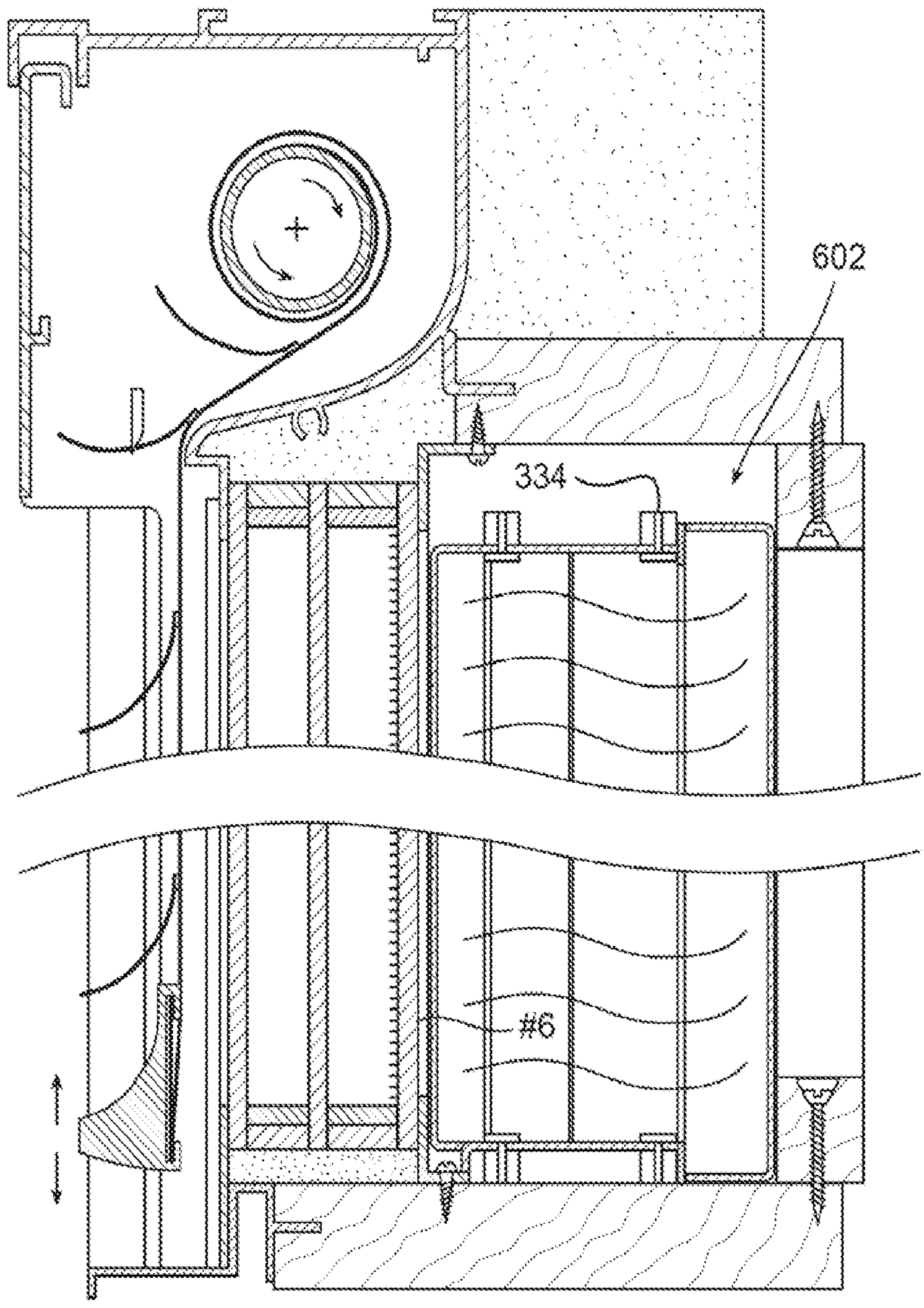
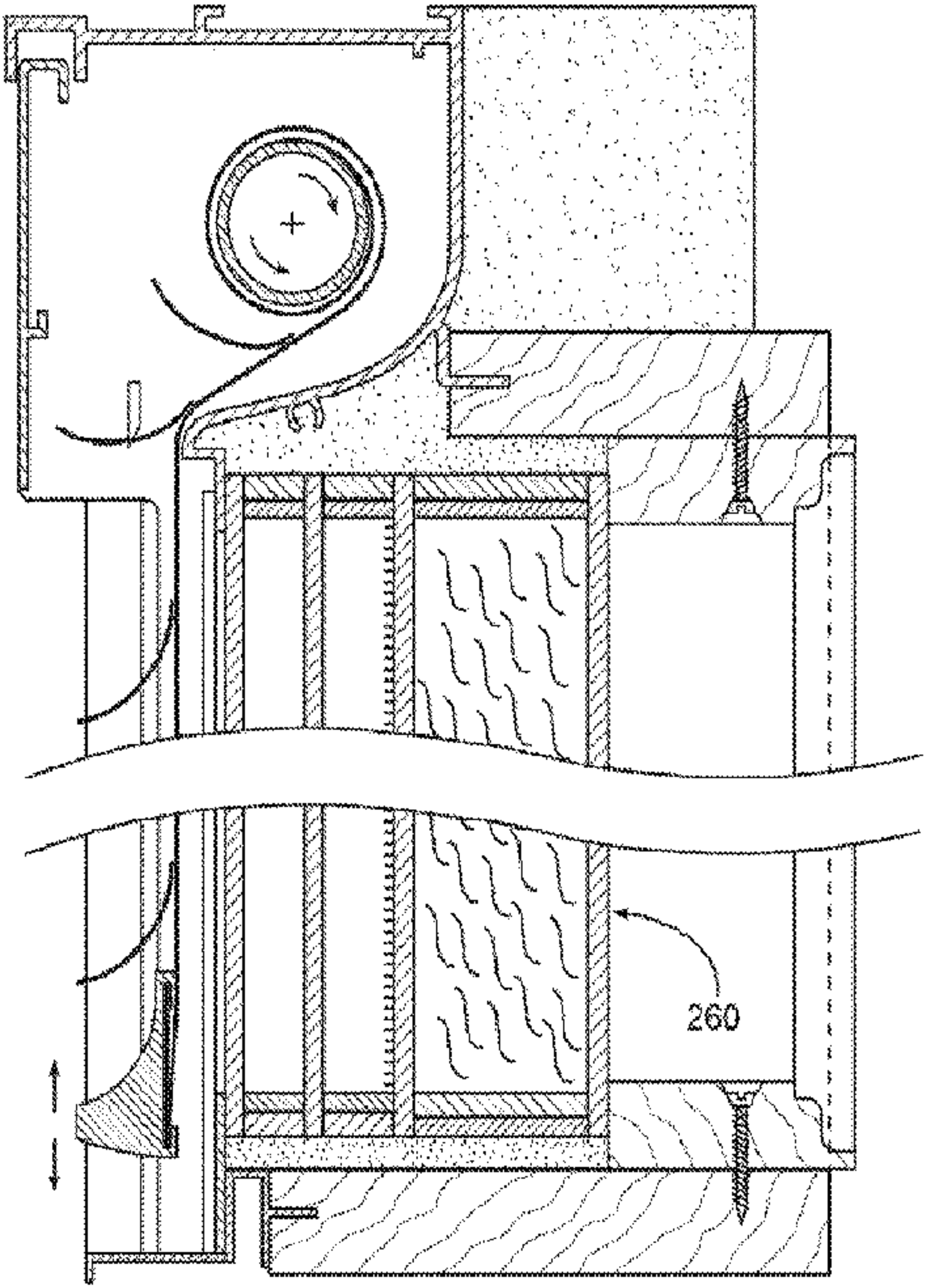


FIG. 30

FIG. 31




260