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(54) Title: RIGID MEDIA SUPPORT & REMOVAL

(57) Abstract: A support system for rigid media of an evaporative cooler includes a water distribution pipe, a bottom support including at least one sidewall extending from a bottom surface of the bottom support, and a rigid media block having a bottom end at least partially supported by the bottom surface of the bottom support, the rigid media block including a slot formed across a top surface thereof and having the water distribution pipe running through the slot, the slot having a depth selected such that a gap is formed below the water distribution pipe when the water distribution pipe is disposed within the slot and the bottom end of the rigid media block is engaged with the bottom surface of the bottom support.

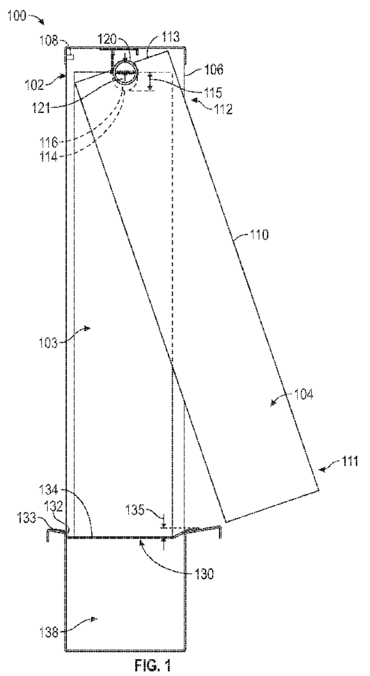

FIG. 1

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[Continued on next page]

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RIGID MEDIA SUPPORT & REMOVAL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 62/627,637 filed on February 7, 2018, the entire content of which is hereby incorporated by reference.

FIELD

[0002] The present disclosure generally relates to devices, systems, and methods for rigid media support and removal, e.g., for evaporative coolers.

BACKGROUND

[0003] Evaporative coolers are often used to cool buildings or to augment the cooling of buildings and processes, e.g., in dry and moderately dry climates. In commercial applications, evaporative pre-coolers are increasingly used to improve the efficiency of vapor-compression cooling systems through their placement upstream of the condensing coil(s). Newer, more cost-effective evaporative coolers may use “rigid media” instead of (the more traditional) woven wood fiber evaporative media. The rigid media may be produced as rectangular blocks built up from glued, cross-corrugated sheets of treated paper. The media blocks are typically 12-inches to 24-inches wide, by 4-inches to 12-inches thick, by 36-inches to 84-inches high. In use, airflow may proceed through the thickness of the media block in a repeated “up and down” path, directed by opposed corrugations. Media blocks may be easily cut to desired dimensions for a particular cooler.

[0004] Evaporative cooling may be accomplished as water distributed on top of the media blocks flows gravitationally downward to wet the media. Air flowing on its extended course through the media may pick up moisture such that, in typical operation, the airstream is nearly saturated when it exits the media.

[0005] The media blocks may be arranged side-by-side and may be held in position in a frame, e.g., sheet metal or plastic frames. In most aspects, the media blocks should be held relatively securely in position for optimal performance and durability. If the media blocks are out of position, they may allow air and/or water to stray from its intended path and degrade performance. Also, wind or seismic forces should generally not be able to dislodge the media blocks from the enclosure. However, the media blocks may need to be removed and re-installed for routine service and occasional replacement. Typical evaporative cooler enclosures, and pre-cooler frames, may be designed with media removal from the top, as seen for example in U.S. Patent No. 7,021,078, which is hereby incorporated by reference in its entirety. In this design, the media housing tilts out, the top (with its water feed system) is removed, and the media can then be lifted out for cleaning or replacement.

[0006] In some relatively large pre-cooler designs (e.g., used as accessories to packaged cooling units), media blocks can be removed from the front by first removing a top restraining rail or angle held in place by screws. Such designs usually require a fixed back rail that keeps the blocks from moving inward in the direction of airflow, but these front and back rails can add cost and block some of the media airflow. This approach may also require a taller frame, which can add cost. Moreover, these and other commonly-implemented designs often use other fastening devices. In summary, there is a need for an improved technique that retains the media blocks while facilitating their rapid removal and replacement, e.g., with limited (or absent) tools and fasteners.

SUMMARY

[0007] In an aspect, a support system for rigid media of an evaporative cooler includes a water distribution pipe, a bottom support including at least one sidewall extending from a bottom surface of the bottom support, and a rigid media block having a bottom end at least partially supported by the bottom surface of the bottom support, the rigid media block including a slot formed across a top surface thereof and having the water distribution pipe running through the slot, the slot having a depth selected such that a gap is formed below the water distribution pipe when the water distribution pipe is disposed within the slot and the bottom end of the rigid media block is engaged with the bottom surface of the bottom support.

[0008] These and other features, aspects, and advantages of the present teachings will become better understood with reference to the following description, examples, and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The foregoing and other objects, features and advantages of the devices, systems, and methods described herein will be apparent from the following description of particular embodiments thereof, as illustrated in the accompanying drawings. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the devices, systems, and methods described herein. In the drawings, like reference numerals generally identify corresponding elements.

[0010] Fig. 1 illustrates a full-height cross-sectional view of a support system for rigid media of an evaporative cooler, in accordance with a representative embodiment.

[0011] Fig. 2 illustrates an enlarged cross-sectional view of a top portion of a support system for rigid media of an evaporative cooler, in accordance with a representative embodiment.

[0012] Fig. 3 illustrates an enlarged cross-sectional view of a bottom portion of a support system for rigid media of an evaporative cooler, in accordance with a representative embodiment.

[0013] Fig. 4 is a flow chart of a method for support and removal of rigid media of an evaporative cooler, in accordance with a representative embodiment.

DETAILED DESCRIPTION

[0014] The embodiments will now be described more fully hereinafter with reference to the accompanying figures, in which preferred embodiments are shown. The foregoing may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these illustrated embodiments are provided so that this disclosure will convey the scope to those skilled in the art.

[0015] All documents mentioned herein are hereby incorporated by reference in their entirety. References to items in the singular should be understood to include items in the plural, and vice versa, unless explicitly stated otherwise or clear from the text. Grammatical conjunctions are intended to express any and all disjunctive and conjunctive combinations of conjoined clauses, sentences, words, and the like, unless otherwise stated or clear from the context. Thus, the term “or” should generally be understood to mean “and/or” and so forth.

[0016] Recitation of ranges of values herein are not intended to be limiting, referring instead individually to any and all values falling within the range, unless otherwise indicated herein, and each separate value within such a range is incorporated into the specification as if it were individually recited herein. The words “about,” “approximately” or the like, when accompanying a numerical value, are to be construed as indicating a deviation as would be appreciated by one of ordinary skill in the art to operate satisfactorily for an intended purpose. Similarly, words of approximation such as "about," "approximately," or "substantially" when used in reference to physical characteristics, should be understood to contemplate a range of deviations that would be appreciated by one of ordinary skill in the art to operate satisfactorily for a corresponding use, function, purpose, or the like. Ranges of values and/or numeric values are provided herein as examples only, and do not constitute a limitation on the scope of the described embodiments. Where ranges of values are provided, they are also intended to include each value within the range as if set forth individually, unless expressly stated to the contrary. The use of any and all examples, or exemplary language ("e.g.," "such as," or the like) provided herein, is intended merely to better illuminate the embodiments and does not pose a limitation on the scope of the embodiments. No language in the specification should be construed as indicating any unclaimed element as essential to the practice of the embodiments.

[0017] In the following description, it is understood that terms such as "first," "second," "top," "bottom," "up," "down," and the like, are words of convenience and are not to be construed as limiting terms unless specifically stated to the contrary.

[0018] The present disclosure generally relates to devices, systems, and methods for rigid media support and removal, e.g., for evaporative coolers. As such, the present teachings may respond to a need for more easily serviced rigid-media evaporative cooling components. Specifically, the present teachings may provide relatively simple techniques that facilitate the removal of evaporative rigid media blocks from an evaporative cooler (e.g., without tools), while also providing retention adequate to resist wind or other forces that might dislodge the media blocks.

[0019] The present teachings may include devices and systems that support and retain the bottoms of the media blocks in a shallow tray or similar, and that retain the tops of the media blocks using an existing portion of an evaporative cooler, e.g., a water-feed pipe inserted (at least partially) into a slot in the tops of the media blocks. This configuration can allow media blocks to be lifted upward to clear the top edge of the tray, and to then be pulled outward at the bottom, rotating about the pipe to free the media blocks from the cooler, i.e., until the media block is free at the bottom and can be dropped downward from the pipe and thus freed from an enclosure.

[0020] The present teachings may thus facilitate a relatively simple removal and replacement process for rigid media in evaporative coolers. Some advantages of the present teachings may include: labor time savings; elimination of tools needed for removal and replacement; minimization of air bypassing the top of media; and easier access to components below (and around) evaporative media (such as a sump disposed below the media).

[0021] Fig. 1 illustrates a full-height cross-sectional view of a support system 100 for rigid media 110 of an evaporative cooler 102, in accordance with a representative embodiment; Fig. 2 illustrates an enlarged cross-sectional view of a top portion 200 of a support system (e.g., the same or similar support system 100 of Fig. 1) for rigid media 110 of an evaporative cooler 102, in accordance with a representative embodiment; and Fig. 3 illustrates an enlarged cross-sectional view of a bottom portion 300 of a support system (e.g., the same or similar support system 100 of Fig. 1) for rigid media 110 of an evaporative cooler 102, in accordance with a representative embodiment. Thus, the following description generally refers to Fig. 1, a full-height cross-sectional view showing a media enclosure 106 and the rigid media 110 in operating and removal positions, and Figs. 2 and 3, which show enlarged cross-sectional views featuring a top portion 200 and a bottom portion 300, respectively, of a support system 100 for rigid media 110 of an evaporative cooler 102. The enlarged views show enhanced detail to improve understanding of the media removal and replacement techniques described herein.

[0022] Generally, as shown in Fig. 1, a support system 100 for rigid media 110 of an evaporative cooler 102 may include a pipe 120 (e.g., for water distribution in the evaporative cooler 102 or a cooler system), a bottom support 130, and the rigid media 110, which may be in block form as described herein.

[0023] In many instances, the pipe 120 may include a water distribution pipe or the like. However, other types of pipes are also or instead possible for the pipe 120 as described and shown herein. For example, the pipe 120 may be used as a conduit for another fluid, such as a coolant, a fuel, and so on. The pipe 120 as described and shown herein may also or instead be replaced by, or supplemented with, another fixture of the evaporative cooler 102, including without limitation one or more of a support structure, a frame, a housing, wiring or a conduit for wiring, a heating or cooling element, and so forth. Thus, in general, the pipe 120 as described and shown herein may generally include or define a structure or element of the evaporative cooler 102 that can support a top end 112 of the rigid media 110 as described and shown herein.

[0024] The bottom support 130 may be sized and shaped to accommodate a bottom end 111 of the rigid media 110. To this end, a bottom surface 134 of the bottom support 130 may include a width that is greater than or equal to a width of the block of rigid media 110 (i.e., a width of the bottom end 111 of the rigid media 110). This is because, in general, the bottom support 130 as described and shown herein may generally include or define a structure or element of the evaporative cooler 102 that can support the bottom end 111 of the rigid media 110 as described and shown herein.

[0025] The bottom support 130 may include at least one sidewall 132 extending from the bottom surface 134 thereof. As best shown in Fig. 3, the bottom support 130 may include one or more perforations 336, e.g., in the bottom surface 134 thereof or on the side wall 132. The perforations 336 may provide a fluid pathway from above the bottom surface 134 to below the bottom surface 134, which can be advantageous when a reservoir 138 or the like is disposed below the bottom support 130 or is integral with the bottom support 130. To this end, such a reservoir 138 may be present in the support system 100. The reservoir 138 may define a structure or include an attribute that holds the bottom support 130 in place, such as the flanges 339 best shown in Fig. 3. Also, or instead, another portion of the evaporative cooler 102 may work to support the bottom support 130 and hold it in place within the evaporative cooler 102. In certain implementations, the bottom support 130 itself may act as a reservoir, a sump, or a portion thereof. Also, in certain implementations, at least a portion of the bottom support 130 is removable. In other implementations, at least a portion of the bottom support 130 is permanently attached to an enclosure 106, a reservoir 138, or another portion of the evaporative cooler 102.

[0026] As shown in Fig. 1, the rigid media 110 may be formed into a block, and thus may be referred to herein as a "rigid media block" or the like. That is, the rigid media 110 may define a substantially rectangular block, where this block may be built up from glued, cross-corrugated sheets of treated paper or the like. In certain implementations, the rigid media 110 may be formed of a block that is about 12-inches to about 24-inches wide, by about 4-inches to about 12-inches thick, by about 36-inches to about 84-inches high. Other sizes are also or instead possible. In use in the evaporative cooler 102, airflow may proceed through the thickness of the block of rigid media 110, e.g., in a repeated up-and-down path, which can be at least partially be directed by opposed corrugations.

[0027] The block of rigid media 110 may have a bottom end 111, which is at least partially supported by the bottom surface 134 of the bottom support 130 when the rigid media 110 is disposed within an operational position within the evaporative cooler 102. This operational position is shown in Fig. 1 by the rigid media 110 designated by the first arrow 103, as opposed to a removal position shown in Fig. 1 by the rigid media 110 designated by the second arrow 104.

[0028] The block of rigid media 110 may include a slot 114 formed across a top surface 113 thereof. In operation and use of the evaporative cooler 102 (e.g., when the rigid media 110 is disposed within an operational position within the evaporative cooler 102) the pipe 120 may be disposed through the slot 114 (i.e., at least partially through the slot 114). In other words, the pipe 120 may be running through the slot 114 of the rigid media 110 (e.g., a plurality of blocks of rigid media 110) within the evaporative cooler 102. To this end, the slot 114 may be sized and shaped to accommodate the pipe 120 or a portion thereof. For example, a width of the slot 114 may be substantially equal to a diameter of the pipe 120. Further, and as best shown in Fig. 2, the slot 114 may have a depth 215 selected such that a gap 216 is formed below the pipe 120 when the pipe 120 is disposed within the slot 114. More particularly, the slot 114 may have a depth 215 selected such that this gap 216 is formed below the pipe 120 when the pipe 120 is disposed within the slot 114 and, as shown in Fig. 1, when the bottom end 111 of the rigid media 110 is engaged with the bottom surface 134 of the bottom support 130. Even more specifically, the depth 215 of the slot 114 in the block of rigid media 110 may be greater than a combination of (i) a depth 135 of the bottom surface 134 of the bottom support 130 relative to a top edge 133 of a sidewall 132, and (ii) a radius 121 of the pipe 120.

[0029] Thus, the present teachings may include a slot 114 in each of the blocks of rigid media 110. The slot 114 may be shaped by straight vertical cuts that extend downward to meet an upward-facing cylindrical cut of approximately the same diameter as the distributor pipe 120. In practice, the slot 114 can be cut in a single pass using a shaper or router with a custom blade. The slot 114 can also, without adversely affecting performance, be shaped with a flat bottom rather than the cylindrical bottom that is shown in the figures. In an operating position, the top edges of the blocks of rigid media 110 may align approximately at the centerline of the distributor pipe 120, leaving a gap 216 between the bottom of the pipe 120 and the bottom of the slot 114. Fig. 1 shows a block of rigid media 110 both in its vertical operating position, with front and rear faces substantially parallel to the edges of sides of an enclosure 106 (e.g., disposed in side channels in the enclosure 106 that contain or support at least a part of the rigid media 110), and a block of rigid media 110 in its lifted removal position, with the underside of its slot 114 in contact with the distributor pipe 120, and rotated so that the bottom end 111 of the block of rigid media 110 clears the enclosure 106 while the top end 112 of the block of rigid media 110 nearly contacts the underside of the top of the enclosure 106. As will be further described, from this rotated position, the blocks of rigid media 110 may be dropped downward and removed from the enclosure 106.

[0030] In use, i.e., when the rigid media 110 is disposed within an operational position within the evaporative cooler 102, the block of rigid media 110 may be supported on its bottom end 111 only by the bottom support 130, and supported on its top end 112 only by the pipe 120. In this manner, otherwise functional aspects of the evaporative cooler 102 may be used to support the rigid media 110, where a combination of these features may promote easy removal as well as a relatively simplified support system 100 as described herein.

[0031] Turning back to the bottom support 130, which is best shown in Fig. 3, the sidewall 132 may include one or more sidewall surfaces 340 disposed at an obtuse angle 341 relative to the bottom surface 134 of the bottom support 130. In this manner, the sidewall surfaces 340 may form a ramp, incline, or the like, which can direct water or other liquid toward the bottom surface 134—e.g., toward perforations 336 in the bottom surface 134, which in turn direct liquid to a reservoir 138. Further, the sidewall surfaces 340 forming a ramp or the like may provide a sliding surface for removal of the rigid media 110 from the evaporative cooler 102. Stated otherwise, one or more of the sidewall surfaces 340 may promote water collection on the bottom surface 134 of the bottom support 130, and/or one or more of the sidewall surfaces 340 may provide a sliding surface for removal of the block of rigid media 110 from the evaporative cooler 102.

[0032] The support system 100 may include one or more additional features that promote relatively easy removal of the rigid media 110 therefrom. For example, as shown in Fig. 3, the support system 100 may include a handle 350 coupled to the rigid media 110. By way of example, the handle 350 may be engaged with a rod 352 that is disposed through an opening 354 in a block of the rigid media 110. For example, the opening 354 in the block of the rigid media 110 may be a flute opening of corrugated media used to form the block of rigid media 110. Additionally, or alternatively, the handle 350 may be coupled around the rigid media 110, such as by being tied or clasped around a block of rigid media 110. The handle 350 may also or instead be otherwise affixed to the block of rigid media 110, such as through a screw, nail, rivet, pin, snap, latch, hook and loop, tie, and the like. The handle 350 may also or instead be integral with the rigid media 110, such as being formed on the rigid media 110 and made from the same or similar materials, e.g., a strip of corrugated material.

[0033] Thus, another detail appearing in Fig. 3 is a removal rod or rods 352 connected to a removal handle 350. This removal rod 352 and handle 350 can, for example, use either a single rod 352 connected to an in-line or opposed handle 350, or a pair of rods 352 spaced apart by a predetermined width and joined by a handle 350. In a simple form, the latter "u-shaped" design may be bent from a single rod 352. The rod 352 may include a dimension or a diameter slightly larger than the downward, backward flute openings of corrugated media used for the blocks of rigid media 110. Thus, using an integral handle 350, the rod 352 may be forcefully inserted along corrugations, e.g., near the bottom end 111 of the blocks of rigid media 110 and centered on the width of the blocks of rigid media 110. The rod 352 can be retained permanently in the blocks of rigid media 110, for example, using an adhesive or an "arrow-head" retention, so that the rod 352 inserts with modest effort but cannot easily be pulled out from the rigid media 110. In this configuration, the handle 350 can be a bent extension of the rod 352 or it can be a separate piece secured to the rod 352. Both the rod 352 and the handle 350 may be fabricated from corrosion-proof materials. Alternatively, the retention rod 352 can be long enough to extend completely through the blocks of rigid media 110, e.g., with a 90-degree bend at its back, lower end; in this configuration, the rod 352 may be inserted from the back side, and with blocks of rigid media 110 removed from the enclosure 106; also, the handle 350 may be attached to the rod 352 after the rod 352 is inserted fully through the blocks of rigid media 110. In a pre-cooler assembly with multiple blocks of rigid media 110, only one of the blocks may be equipped with the rod 352 and handle 350, where, after removal of the first block, the others may be slid sideways along the bottom support 130, e.g., so that service workers or the like can insert their hands along both sides of the remaining blocks, thus negating a need for a handle 350 on each block.

[0034] Turning back to Fig. 1, the support system 100, or more particularly the evaporative cooler 102, may include an enclosure 106 containing at least a portion of the pipe 120, the bottom support 130, and the rigid media 110. The enclosure 106 may form a housing for the evaporative cooler 102. In this manner, the enclosure 106 may include a cooler feature 108 disposed thereon, adjacent thereto, or otherwise in communication with the evaporative cooler 102. For example, the enclosure 106 may include a surface having a cooler feature 108 such as one or more of a spray reflector and a pipe support disposed thereon. As best shown in Fig. 3, the enclosure 106 may also or instead include a plurality of channels structurally configured to secure and hold the blocks of rigid media 110 when they are disposed within the evaporative cooler 102. That is, the enclosure 106 may include one or more vertical side channels, which may act as vertical elements that connect the bottom support 130 with a top channel similarly formed in the enclosure 106. Thus, the enclosure 106 and further support for the rigid media 110 of the evaporative cooler 102 may be formed by the bottom support 130, the symmetrical left and right side channels, and the top channel of the enclosure 106.

[0035] The media enclosure 106 may be structurally configured to accommodate a total width of the blocks of rigid media 110, which may be about six feet. Similarly, a middle (e.g., welded-in) section of the bottom support 130 may be about four feet wide, with 12-inches wide removable sections of the bottom support 130 adjacent to side channels on each side. A welded-in center section may add significant rigidity to the media enclosure 106 by linking the upper edges of the reservoir 138 to maintain uniform spacing of its opposed top edges.

[0036] The enclosure 106 may vary depending on the material of the enclosure 106, e.g., whether the enclosure 106 is fabricated of metal or plastic. For example, at the top of the enclosure 106 of a stainless-steel embodiment, a top channel 260 can be welded at its ends to side channels. In this design, a small "legs-down," substantially continuous spray reflector channel 262 may be welded to the underside of the top channel 260. The pipe 120, which may have an outer diameter approximately equal to the width of the spray reflector channel 262, may be supported below the spray reflector channel 262 by one or more pipe supports 264 (typically about 0.75-inches wide) distributed along the length of the spray reflector channel 262. The pipe supports 264 may be welded to the underside of the top channel 260. By way of example, an enclosure 106 that is about six feet wide may have three pipe supports 264—one at the substantial center and two others located between the center and sides. In an aspect, the pipe supports 264 hold the pipe 120 in position about 0.75-inches below the underside of the enclosure 106 or a portion thereof such as the spray reflector channel 262.

[0037] In implementations with a "once-through" water feed instead of a re-circulation pump disposed in the reservoir 138, the reservoir 138 may be absent. Instead, the bottom support 130 may lack perforations 336, and the rigid media 110 can rest on a closed bottom surface 134. Such designs may rely on intelligent controls that cycle water flow on and off, keeping the rigid media 110 wet enough for effective evaporation, while avoiding wasting water by overflowing the bottom area (e.g., a tray or the like formed by the bottom support 130). It will be understood that the media removal design of the present teachings may be equally valuable in these "once-through" water flow designs.

[0038] Thus, as described above, Figs. 1–3 show the support system 100 with rigid media 110 in both an operating position (as shown by the first arrow 103) and in the removal position (as shown by the second arrow 104). In certain implementations, the support system 100 may include a water-containing bottom reservoir 138 (or sump) with a perforated or screened top plate/surface that forms at least part of the bottom support 130, which supports blocks of rigid media 110 when the blocks are disposed in the operating position.

[0039] As discussed above, the blocks of rigid media 110 may be shaped as substantially rectangular solids with a predetermined height, width, and thickness. For example, all of the blocks of rigid media 110 may have the same height and thickness, and may typically include a standardized modular width except that one or more may be cut to a modified width so that the total width of their side-by-side arrangement fits the enclosure 106 without significant gaps, yet is not so tight as to prevent removal of the blocks of rigid media 110 one at a time.

[0040] The reservoir 138 may include an open-top shape that can be formed from, e.g., sheet metal or plastic. The bottom support 130 may rest on the top edges of the reservoir 138 such that its horizontal portion has width equal to, or slightly greater than, the thickness of the blocks of rigid media 110, thus providing a resting surface for the level underside of the blocks of rigid media 110, with minimal front-to-back movement of the blocks of rigid media 110 while they rest on the bottom surface 134. In certain implementations, with a reservoir 138 formed from sheet stainless steel or the like, the bottom support 130 may be fabricated in multiple sections (width-wise), with one majority section secured to the top edges of the reservoir 138 to properly space its vertical faces, and also to strengthen the assembly.

[0041] As stated previously, the bottom surface 134 may include a screened design, which can allow water draining downward through the rigid media 110 to enter the reservoir 138, while excluding large debris that could clog a circulating pump, a drain, or the like. The bottom surface 134 may include multiple sections, and may (collectively) extend the full width of the reservoir 138. In certain implementations, at least one small section of the bottom surface 134, typically near a side channels of the enclosure 106, may be removably and replaceably attached, such that it can be removed for access to equipment such as the reservoir 138 itself, or a pump, a water refill component, or the like, depending on the water flow design of the evaporative cooler 102.

[0042] As discussed herein, Fig. 2 shows additional details of the top end 112 of an embodiment, again showing rigid media 110 in both its vertical operating position and its removal position. This more-detailed view shows the upward-oriented distributor pipe 120 with holes 222 that may discharge water against the underside of a spray reflector channel 262 or the like. The reflected water may then spread and drip downward, e.g., around the distributor pipe 120, to uniformly wet the rigid media 110. The holes 222 may be aligned along the length of the pipe 120 and uniformly spaced (e.g., about 1.5-inches to about 2.5-inches apart). The pipe 120 may be held in place by a screw 224 or the like, which can be driven from the front through the pipe 120 and into the pipe supports 264. This enlarged view also shows more clearly, in both the vertical operating position and in an angled removal position, the shape of the slot 114, which may include substantially straight sides and a rounded bottom portion.

[0043] As discussed herein, Fig. 3 shows additional details at the bottom end 111 of an embodiment, again showing rigid media 110 in both its vertical operating position and its removal position. This enlarged view shows in more detail how the bottom support 130 may cooperate with a sump, e.g., the reservoir 138. As shown in the figure, the reservoir 138 may include an upward-angled back splash ledge 370 extending from the top back edge 371, which is structurally configured to catch drips off of the evaporative rigid media 110 and return any captured droplets back to the reservoir 138. The top back edge 371 may provide a corner that supports an edge of the bottom support 130, which may include an about 0.5-inch depression with an outward bend that is slightly angled to follow the slope of the back splash ledge 370 of the reservoir 138. However, the outward angled bend on the bottom support 130 can be much shorter than the back splash ledge 370, as its function may be simply to support the rigid media 110, rather than to catch drips. Thus, the function of the depression at the top back edge 371 may be to retain the rigid media 110 from backward movement when the rigid media 110 is in its vertical operating position. At the top front of the reservoir 138, a front splash ledge 372 may extend outward, e.g., again to catch and return droplets that fall off of the rigid media 110. At the front, the bottom support 130 may provide less positive retention of the rigid media 110 than does the vertical back edge, to facilitate removal. The obtuse angle 341 of the bottom support 130 may allow the rigid media 110 to slide upward as it is pulled outward for removal. A second bend may be disposed at the front of the bottom support 130, which is structurally configured to allow the bottom support 130 sidewall 132 to follow the slope of the front splash ledge 372 of the reservoir 138. Thus, in the vertical operating position, the block of rigid media 110 may rest on the horizontal bottom surface 134 of the bottom support 130, which is supported on the reservoir 138 by its short rear outward angled bend and its short front support ledge. These two short extensions may match the angles of the longer back and front splash ledges 370 and 372, respectively.

[0044] Fig. 4 is a flow chart of a method 400 for support and removal of rigid media of an evaporative cooler, in accordance with a representative embodiment. The method 400 may be performed using any of the devices, systems, and techniques described herein. Specifically, and as described throughout this disclosure, the present teachings may provide a technique for retaining media blocks in place during operation while facilitating removal and replacement without tools, using the following configuration: a shallow bottom tray whose horizontal bottom supports the media blocks, where the short back wall of the tray prevents backward movement of the blocks, and a sloping front plane extending forward from the bottom of the tray allows the bottoms of the blocks to slide upward and outward for removal; and a cylindrical horizontal top pipe supported below the top enclosure that fits snugly into co-linear slots in the tops of the side-by-side media blocks, where in an operating position the slots are deep enough to provide a gap between the pipe and the bottom of the slot; where the gap is equal to or greater than the depth of the bottom tray. This configuration may allow for easy removal of each block by pulling upward and outward on its lower portion, thus lifting the block and gradually closing the vertical gap between the pipe and the "over-deep" slot. As the block rotates forward about the pipe, the back bottom edge of the block may ultimately be freed from the enclosure and the block can be dropped downward to free it from the pipe. At this point, the top and remainder of the block can easily be removed from the enclosure. Replacement may simply reverse the removal process.

[0045] As shown in step 402, the method 400 may include lifting a rigid media block toward a water distribution pipe that extends through a slot formed across a top surface of the rigid media block. The slot may have a depth selected such that a gap is formed below the water distribution pipe when the water distribution pipe is disposed within the slot and a bottom end of the rigid media block is engaged with the bottom surface of the bottom support. The gap may thereby permit lifting of the rigid media block toward the water distribution pipe.

[0046] As shown in step 404, the method 400 may include moving the rigid media block—while the rigid media block is lifted toward the water distribution pipe—

over a sidewall of a bottom support and away from a bottom surface of the bottom support. Moving the rigid media block may include rotating the rigid media block about the water distribution pipe.

[0047] As shown in step 406, the method 400 may include pulling the rigid media block away from the water distribution pipe thereby removing the rigid media block from the support system.

[0048] One aspect of the present teachings includes a rigid media block structurally configured for removal from an evaporative cooler. That is, a rigid media block for an evaporative cooler may include a first material substantially shaped into a block-shaped structure. For example, the rigid media block may include a cross-section that is substantially rectangular, where the first material includes a plurality of cross-corrugated sheets of treated paper. The rigid media block may further include a slot formed through a top surface of the block-shaped structure. The slot may have a width selected to accommodate a water feed pipe of the evaporative cooler within the slot. The slot may further have a depth selected such that a gap is formed below a water distribution pipe when the water distribution pipe is disposed within the slot and a bottom end of the rigid media block is engaged with a bottom surface of a bottom support in the evaporative cooler.

[0049] Another aspect of the present teachings includes a support system for one or more side-by-side rectangular blocks of rigid evaporative media, that includes top and bottom supports, where for each block: (a) the top support is a water distribution pipe inserted in a continuous width-wise slot along the block's top surface, where the breadth of the slot closely fits the pipe diameter; (b) the bottom support is a shallow tray with horizontal bottom plane of breadth approximately equal to the breadth of the block; and (c) the depth of the slot below the pipe is greater than the depth of the tray.

[0050] Implementations may include one or more of the following features. The tray may be perforated and supported above a water-collection sump. The bottom support may include an upward-sloping drip-catching sheet extending outward from the front edge of the tray's bottom plane, where the sheet provides a sliding surface for block removal and replacement. At least one block may include a lower front handle for lifting and pulling the block for removal. The handle may extend from at least one rod inserted from the front and permanently secured into open flutes of a cross-corrugated rigid media. The tray may be segmented width-wise with at least one tray segment that is removable from the sump and is secured to the bottom of a block, where the removable tray segment includes an integral front handle for lifting and pulling the block.

[0051] Another aspect of the present teachings includes a method for removing rigid evaporative media blocks from a support system including lifting each block upward to free it from a shallow close-fitting bottom tray, then rotating it outward at the bottom, about a top support pipe in a close-fitting slot in the top of the block, until the bottom is clear of the tray, then dropping the block downward to clear the slot from the pipe, then pulling the block outward to remove it from the support system.

[0052] Another aspect of the present teachings includes a support system, including top and bottom supports, for one or more side-by-side rectangular blocks of rigid evaporative media, where the blocks have identical height and thickness, and where: (a) the top support is a perforated water-distribution pipe inserted in a continuous width-wise slot along the top surface of the one or more blocks, where the breadth of the slot closely fits the pipe diameter, and in normal operating position the slot has excess depth below the pipe; (b) the bottom support is a shallow tray with horizontal bottom plane of breadth matched to the thickness of the block; and (c) in normal operating position the depth of the slot below the pipe is greater than the depth of the tray.

[0053] Implementations may include one or more of the following features. The tray may be perforated and supported above a water-collection sump. The bottom support may include an upward-sloping sheet extending outward from the front edge of the tray's bottom plane, where the sheet provides a sliding surface that aids block removal and replacement. At least one block may include a lower front handle for lifting and pulling the block for removal. The handle may extend from at least one rod inserted and permanently secured into open flutes of a cross-corrugated rigid media. The tray may be segmented width-wise with at least one tray segment that is secured to the bottom of a block and is removable from the sump, where the removable tray segment includes an integral front handle for lifting and pulling the block.

[0054] Another aspect of the present teachings includes a method for removing one or more rigid evaporative media blocks from a support system, where the support system includes an upper support pipe in a close-fitting slot along the top of each block, and a bottom tray in which the bottom surface of each block is closely confined. The method may include lifting each block upward and outward to free it from the tray, dropping the block downward to clear the block from the pipe, and pulling the block downward and/or outward to remove it from the support system.

[0055] The above systems, devices, methods, processes, and the like may be realized in hardware, software, or any combination of these suitable for a particular application. The hardware may include a general-purpose computer and/or dedicated computing device. This includes realization in one or more microprocessors, microcontrollers, embedded microcontrollers, programmable digital signal processors or other programmable devices or processing circuitry, along with internal and/or external memory. This may also, or instead, include one or more application specific integrated circuits, programmable gate arrays, programmable array logic components, or any other device or devices that may be configured to process electronic signals. It will further be appreciated that a realization of the processes or devices described above may include computer-executable code created using a structured programming language such as C, an object oriented programming language such as C++, or any other high-level or low-level programming language (including assembly languages, hardware description languages, and database programming languages and technologies) that may be stored, compiled or interpreted to run on one of the above devices, as well as heterogeneous combinations of processors, processor architectures, or combinations of different hardware and software. In another aspect, the methods may be embodied in systems that perform the steps thereof, and may be distributed across devices in a number of ways. At the same time, processing may be distributed across devices such as the various systems described above, or all of the functionality may be integrated into a dedicated, standalone device or other hardware. In another aspect, means for performing the steps associated with the processes described above may include any of the hardware and/or software described above. All such permutations and combinations are intended to fall within the scope of the present disclosure.

[0056] Embodiments disclosed herein may include computer program products comprising computer-executable code or computer-usable code that, when executing on one or more computing devices, performs any and/or all of the steps thereof. The code may be stored in a non-transitory fashion in a computer memory, which may be a memory from which the program executes (such as random-access memory associated with a processor), or a storage device such as a disk drive, flash memory or any other optical, electromagnetic, magnetic, infrared, or other device or combination of devices. In another aspect, any of the systems and methods described above may be embodied in any suitable transmission or propagation medium carrying computer-executable code and/or any inputs or outputs from same.

[0057] The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the disclosure to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings.

[0058] Unless the context clearly requires otherwise, throughout the description, the words "comprise," "comprising," "include," "including," and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in a sense of "including, but not limited to." Additionally, the words "herein," "hereunder," "above," "below," and words of similar import refer to this application as a whole and not to any particular portions of this application.

[0059] It will be appreciated that the devices, systems, and methods described above are set forth by way of example and not of limitation. For example, regarding the methods provided above, absent an explicit indication to the contrary, the disclosed steps may be modified, supplemented, omitted, and/or re-ordered without departing from the scope of this disclosure. Numerous variations, additions, omissions, and other modifications will be apparent to one of ordinary skill in the art. In addition, the order or presentation of method steps in the description and drawings above is not intended to require this order of performing the recited steps unless a particular order is expressly required or otherwise clear from the context.

[0060] The method steps of the implementations described herein are intended to include any suitable method of causing such method steps to be performed, consistent with the patentability of the following claims, unless a different meaning is expressly provided or otherwise clear from the context. So, for example performing the step of X includes any suitable method for causing another party such as a remote user, a remote processing resource (e.g., a server or cloud computer) or a machine to perform the step of X. Similarly, performing steps X, Y and Z may include any method of directing or controlling any combination of such other individuals or resources to perform steps X, Y and Z to obtain the benefit of such steps. Thus, method steps of the implementations described herein are intended to include any suitable method of causing one or more other parties or entities to perform the steps, consistent with the patentability of the following claims, unless a different meaning is expressly provided or otherwise clear from the context. Such parties or entities need not be under the direction or control of any other party or entity, and need not be located within a particular jurisdiction.

[0061] It will be appreciated that the methods and systems described above are set forth by way of example and not of limitation. Numerous variations, additions, omissions, and other modifications will be apparent to one of ordinary skill in the art. In addition, the order or presentation of method steps in the description and drawings above is not intended to require this order of performing the recited steps unless a particular order is expressly required or otherwise clear from the context. Thus, while particular embodiments have been shown and described, it will be apparent to those skilled in the art that various changes and modifications in form and details may be made therein without departing from the spirit and scope of this disclosure and are intended to form a part of the invention as defined by the following claims, which are to be interpreted in the broadest sense allowable by law.

CLAIMS

What is claimed is:

1. A support system for rigid media of an evaporative cooler, the support system comprising:

a water distribution pipe;

a bottom support including at least one sidewall extending from a bottom surface of the bottom support; and

a rigid media block having a bottom end at least partially supported by the bottom surface of the bottom support, the rigid media block including a slot formed across a top surface thereof and having the water distribution pipe running through the slot, the slot having a depth selected such that a gap is formed below the water distribution pipe when the water distribution pipe is disposed within the slot and the bottom end of the rigid media block is engaged with the bottom surface of the bottom support.

2. The support system of claim 1, wherein the depth of the slot in the rigid media block is greater than a combination of (i) a depth of the bottom surface of the bottom support relative to a top edge of the at least one sidewall and (ii) a radius of the water distribution pipe.

3. The support system of claim 1, wherein the rigid media block is supported on its bottom end only by the bottom support, and supported on its top end only by the water distribution pipe.

4. The support system of claim 1, wherein the bottom support includes one or more perforations in the bottom surface.

5. The support system of claim 4, further comprising a reservoir disposed below the bottom support.

6. The support system of claim 5, wherein the reservoir includes a structure that holds the bottom support in place.

7. The support system of claim 1, wherein the at least one sidewall includes one or more surfaces disposed at an obtuse angle relative to the bottom surface of the bottom support.

8. The support system of claim 7, wherein the one or more surfaces promote water collection on the bottom surface of the bottom support, and wherein the one or more surfaces provide a sliding surface for removal of the rigid media block from the evaporative cooler.

9. The support system of claim 1, wherein at least a portion of the bottom support is removable.

10. The support system of claim 1, wherein the bottom surface of the bottom support includes a width that is greater than or equal to a width of the rigid media block.

11. The support system of claim 1, further comprising a handle coupled to the rigid media block.

12. The support system of claim 11, wherein the handle is engaged with a rod disposed through an opening in the rigid media block.

13. The support system of claim 12, wherein the opening in the rigid media block includes a flute opening of corrugated media used to form the rigid media block.

14. The support system of claim 1, further comprising an enclosure containing at least a portion of the water distribution pipe, the bottom support, and the rigid media block.

15. The support system of claim 14, wherein the enclosure includes a surface having one or more of a spray reflector and a pipe support disposed thereon.

16. The support system of claim 1, wherein a width of the slot is substantially equal to a diameter of the water distribution pipe.

17. A method for removing a rigid media block from a support system of an evaporative cooler, the method comprising:

lifting the rigid media block toward a water distribution pipe that extends through a slot formed across a top surface of the rigid media block;

moving the rigid media block, while the rigid media block is lifted toward the water distribution pipe, over a sidewall of a bottom support and away from a bottom surface of the bottom support; and

pulling the rigid media block away from the water distribution pipe thereby removing the rigid media block from the support system.

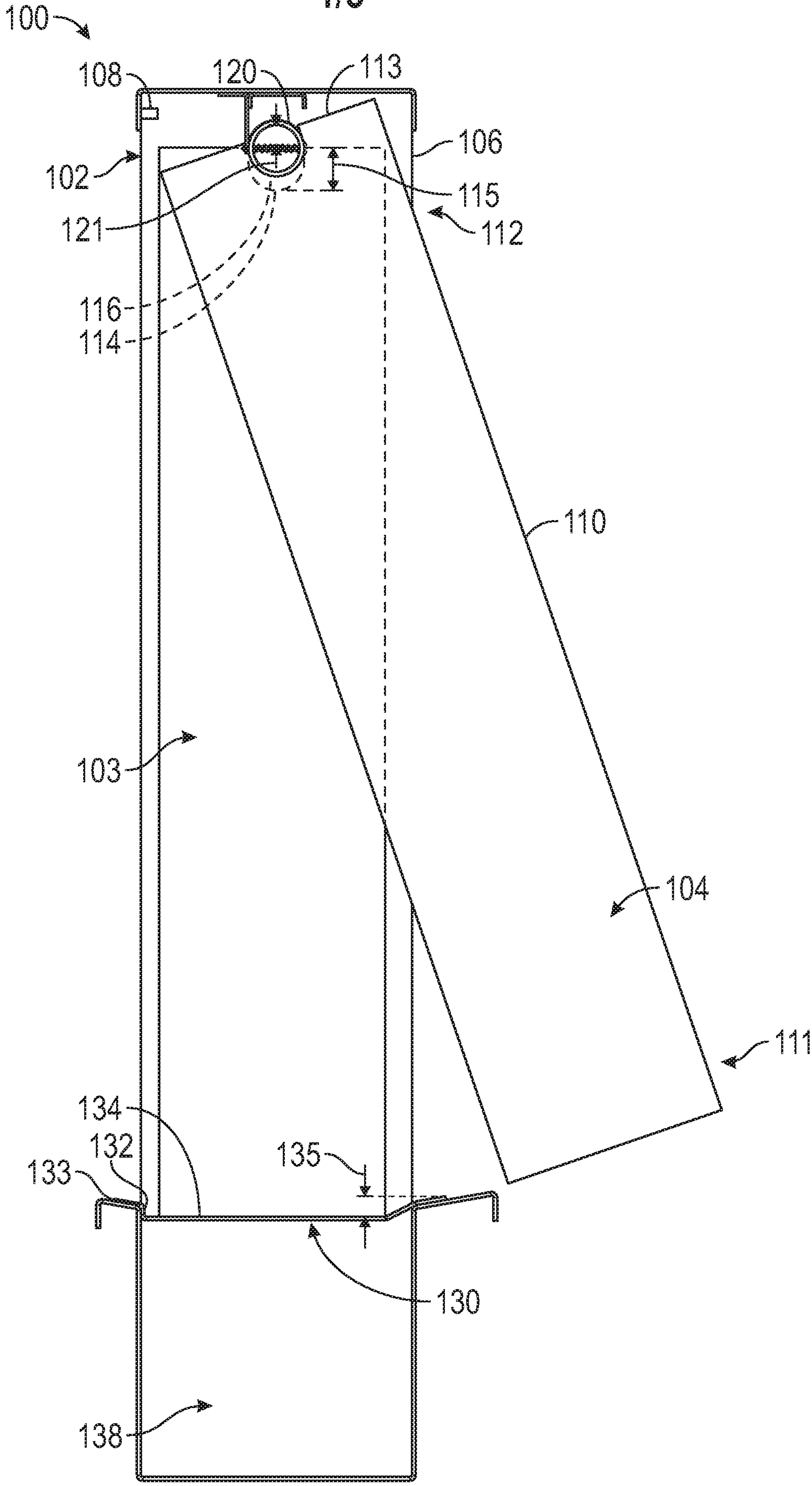
18. The method of claim 17, wherein the slot has a depth selected such that a gap is formed below the water distribution pipe when the water distribution pipe is disposed within the slot and a bottom end of the rigid media block is engaged with the bottom surface of the bottom support, the gap thereby permitting the lifting of the rigid media block toward the water distribution pipe.

19. The method of claim 17, wherein moving the rigid media block includes rotating the rigid media block about the water distribution pipe.

20. A rigid media block for an evaporative cooler, comprising:

a first material substantially shaped into a block-shaped structure; and

a slot formed through a top surface of the block-shaped structure, the slot having a width selected to accommodate a water feed pipe of the evaporative cooler within the slot, and the slot having a depth selected such that a gap is formed below a water distribution pipe when the water distribution pipe is disposed within the slot and a bottom end of the rigid media block is engaged with a bottom surface of a bottom support in the evaporative cooler.


100
108
120
113
106
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112
121
116
114
110
103
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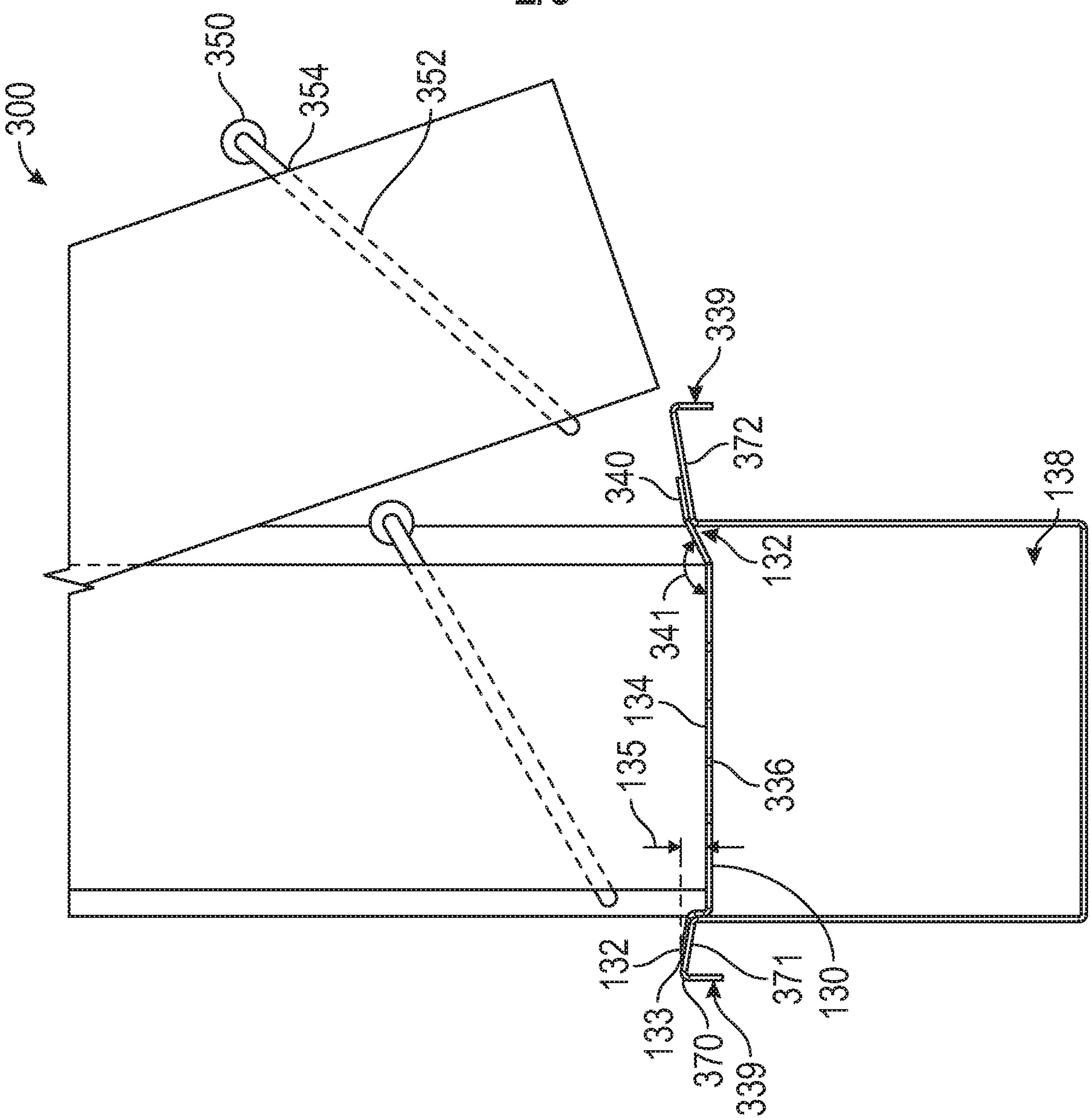
134
132
133
135
130
138

FIG. 1


300
350
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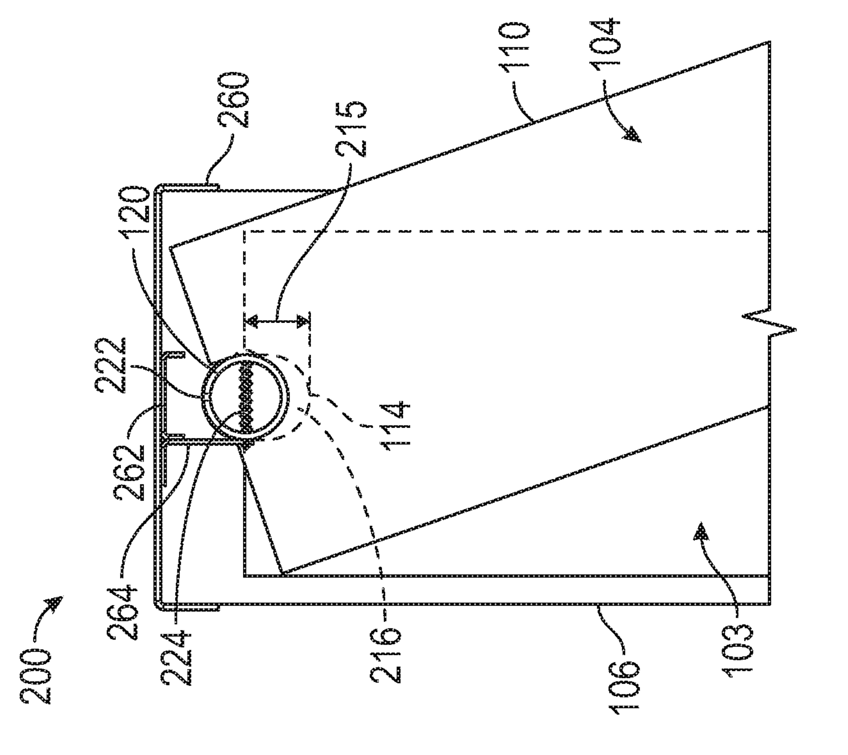
133
371
370
339

FIG. 3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260
215
120
222
114
262
264
224
216
200
106
103

FIG. 2

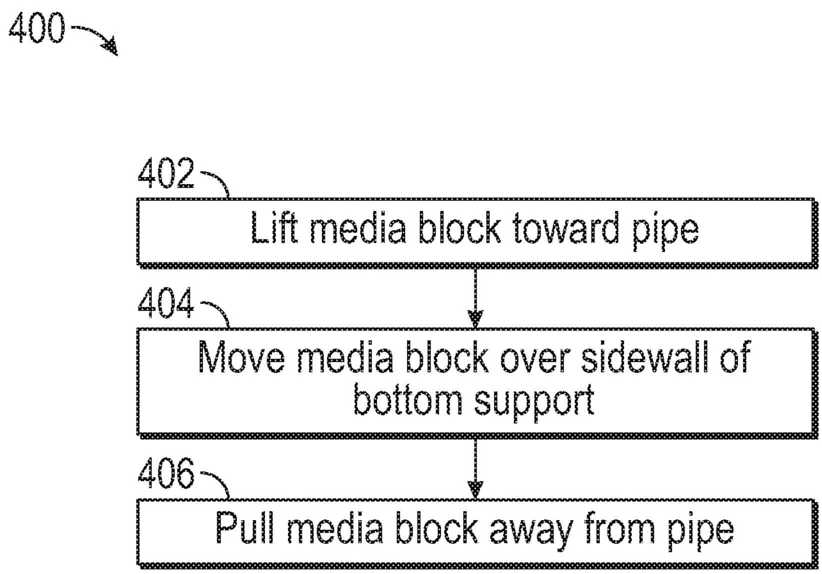
400
402
Lift media block toward pipe
404
Move media block over sidewall of bottom support
406
Pull media block away from pipe

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 19/16855

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B01D 1/22, F24F 6/04, F24F 6/14, F25B 39/02, F25D 23/12, F28C 3/08, F28D 5/02 (2019.01)
CPC - A47F 3/04, B01D 1/22, B01D 1/30, B01D 29/19, B01D 2201/44, B01D 2275/406, B01F 3/04, B05B 1/14, B23P 15/26, F24F 1/0007, F24F 5/0021, F24F 5/0035, F24F 6/04, F24F 6/14, F24F 2006/046, F24F 2006/146, F25B 39/02, F25B 39/028, F25B 2339/02, F25B 2339/021, F25B 2700/21173, F25D 23/06, F25D 23/12, F25D 23/126, F25D 23/069, F28C 3/06, F28D 1/0246, F28D 5/02, F28D 2001/0293, Y02B 30/545

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2017/0276386 A1 (GENERAL ELECTRIC COMPANY) 28 September 2017 (28.09.2017), Figs. 1, 2; para [0006], [0019], [0024]-[0026]	1-20
A	US 2005/0029371 A1 (KUCERA) 10 February 2005 (10.02.2005), Figs. 9, 10; para [0009], [0025], [0026], [0030], [0031]	1-20
A	US 2005/0262864 A1 (DES CHAMPS) 01 December 2005 (01.12.2005), Figs. 2-4; para [0008], [0030], [0037]	1-20
A	US 4,461,733 A (OTTERBEIN) 24 July 1984 (24.07.1984), Fig. 5; col 2, ln 49-64; col 3, ln 43-53; col 4, ln 15-61	1-20
A	US 4,200,599 A (GOETTL) 29 April 1980 (29.04.1980), Fig. 1; col 1, ln 56-64; col 2, ln 62-68; col 3, ln 30-51	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 April 2019	24 APR 2019

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774