

DESCRIPTION

WASHING MACHINE

TECHNICAL FIELD

[0001]

The present invention relates to a washing machine for washing clothes.

BACKGROUND ART

[0002]

A conventional washing machine includes a detergent case that includes a storage chamber in which a detergent is stored, and a channel structure through which water drops to the detergent case (see PTLs 1 to 3). The detergent is dissolved in water within the storage chamber. As a result, a detergent solution is produced. The detergent solution is foamed within the storage chamber (see PTL 4).

[0003]

The storage chamber of the conventional detergent case has both a function of producing a detergent solution, and a function of foaming the solution. Both production and foaming of the solution take place within the common storage chamber. According to this structure, the solution easily flows out from the detergent case before being sufficiently foamed.

Citation List

Patent Literatures

[0004]

PTL 1: Unexamined Japanese Patent Publication No. 2008-99920

PTL 2: Unexamined Japanese Patent Publication No. 2-1091

PTL 3: Unexamined Japanese Patent Publication No. 2000-342894

PTL 4: Unexamined Japanese Patent Publication No. 2008-99919

SUMMARY

[0005]

Embodiments provide a washing machine capable of supplying a sufficiently foamed detergent solution for washing clothes.

[0005a]

A washing machine according to an aspect comprises: a detergent case that includes a storage chamber in which a detergent is stored; and a water supply box that includes a holding part that forms a storage space in which the detergent case is stored, and a channel structure part that defines a channel through which water is supplied to the detergent case, wherein the holding part holds the detergent case such that the detergent case is movable between an exposed position where the storage chamber is exposed from the holding part, and a storage position where the storage chamber is stored within the storage space, the water supply box is disposed between the holding part and the channel structure part, and includes a support wall that supports the water flowing along the channel, the support wall includes a dropping hole and a leak hole, the dropping hole and the leak hole being formed between the holding part and the channel structure part, the dropping hole defining a dropping path of the water toward the detergent case disposed at the storage position, and the leak hole being a hole through which the water from the channel leaks when the storage chamber is disposed at the exposed position, and the detergent case closes the leak hole when the detergent case is disposed at the storage position.

[0006]

A washing machine according to an embodiment includes a detergent case that is provided with a first storage chamber in which a detergent is stored, and a channel structure part that forms a channel above the detergent case. The channel structure part is provided with a plurality of dropping holes that direct water from the channel toward the detergent case. The detergent case includes a separation wall that separates the first storage chamber into a mixing chamber where the detergent and the water are mixed to produce a solution of the detergent, and a foaming chamber where the solution flowing from the mixing chamber is foamed. The plurality of dropping holes include a first dropping hole that directs the water toward the mixing chamber, and a second dropping hole that directs the water toward the foaming chamber.

[0007]

The washing machine according to the present disclosure is capable of washing clothes by using a sufficiently foamed detergent solution.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

FIG. 1 is a schematic block diagram of an exemplary washing

machine.

FIG. 2 is a schematic perspective view of a water supply unit of the washing machine illustrated in FIG. 1.

FIG. 3A is a schematic perspective view of a water supply box of the water supply unit illustrated in FIG. 2.

FIG. 3B is a schematic side view of the water supply box illustrated in FIG. 3A.

FIG. 4 is a schematic perspective view of the water supply box illustrated in FIG. 3B.

FIG. 5 is a schematic cross-sectional view of a dam wall of the water supply box illustrated in FIG. 4.

FIG. 6 is a schematic perspective view of a detergent case of the washing machine illustrated in FIG. 1.

FIG. 7 is a schematic plan view of the water supply box illustrated in FIG. 5.

FIG. 8 is a schematic exploded perspective view of the detergent case illustrated in FIG. 6.

FIG. 9A is a schematic cross-sectional view of the water supply box illustrated in FIG. 7.

FIG. 9B is a schematic cross-sectional view of the water supply box illustrated in FIG. 7.

FIG. 10 is a schematic perspective view of the washing machine illustrated in FIG. 1.

FIG. 11 is a schematic perspective view of the washing machine illustrated in FIG. 10.

FIG. 12 is a schematic cross-sectional view of the washing machine illustrated in FIG. 10.

FIG. 13 is a schematic perspective view of a lid of the water supply

box illustrated in FIG. 3B.

FIG. 14A is a schematic perspective view of the washing machine illustrated in FIG. 1.

FIG. 14B is a schematic cross-sectional view of the washing machine illustrated in FIG. 14A.

FIG. 15A is a schematic cross-sectional view of the detergent case illustrated in FIG. 6.

FIG. 15B is a schematic cross-sectional view of the detergent case illustrated in FIG. 6.

FIG. 16A is a schematic plan view of another detergent case including a rib structure.

FIG. 16B is a schematic plan view of another detergent case including a rib structure.

DESCRIPTION OF EMBODIMENT

[0009]

An exemplary washing machine is hereinafter described with reference to the accompanying drawings. The description provided herein helps clear and sufficient understanding of the washing machine. Terms expressing directions, such as “up”, “down”, “left”, and “right”, are given only for clarification of the description. Accordingly, these terms should not be interpreted as limiting in any sense. The washing machine may have a drying function as well as a washing function for washing clothes. Various functions associated with the washing function do not limit the principle of the following embodiment.

[0010]

<Water Supply Structure>

FIG. 1 is a schematic block diagram of exemplary washing machine

100. Washing machine 100 is described with reference to FIG. 1.

[0011]

Washing machine 100 includes water supply port 200, water supply unit 300, detergent case 400, and washing tub 500. A user can supply water from water supply port 200 to washing machine 100. The water sequentially passes through water supply unit 300 and detergent case 400, and reaches washing tub 500. Washing tub 500 performs washing operation for washing clothes. The washing operation may be operation performed by any one of washing tubs of conventional washing machines. The principle of this embodiment is not limited to a particular washing operation executed by washing tub 500.

[0012]

Detergent case 400 includes first chamber 410, second chamber 420, and third chamber 430. The user can store a powder detergent in first chamber 410. The user can store a liquid detergent in second chamber 420. The user can store a finishing agent in third chamber 430, such as a softener or other types of finishing agents acting on fabrics of clothes. Third chamber 430 provided herein may be eliminated. The principle of this embodiment is not limited in any way by third chamber 430. According to this embodiment, first chamber 410 is an example of a first storage chamber. Second chamber 420 is an example of a second storage chamber. The powder detergent stored in first chamber 410 is an example of a first detergent. The liquid detergent stored in second chamber 420 is an example of a second detergent.

[0013]

Water supply unit 300 includes water supply valve 310 and channel structure part 320. Water supply valve 310 switches a path of water between first path FP reaching first chamber 410 and second chamber

420, and second path SP reaching third chamber 430. Second path SP provided herein may be eliminated. The principle of this embodiment is not limited in any way by second path SP.

[0014]

Channel structure part 320 defines a channel above detergent case 400. This channel supplies water to first chamber 410 and second chamber 420. When water supply valve 310 opens first path FP, water is supplied to first chamber 410 and second chamber 420 through channel structure part 320. As a result, each of the powder detergent contained in first chamber 410, and the liquid detergent contained in second chamber 420 is mixed with water. Each of the powder detergent and the liquid detergent is supplied to washing tub 500 with water. Washing tub 500 agitates clothes in each of the solution of the powder detergent, and the solution of the liquid detergent to wash the clothes.

[0015]

When water supply valve 310 opens second path SP, water is supplied to third chamber 430. The finishing agent contained in third chamber 430 is mixed with water. The finishing agent is supplied to washing tub 500 with water. Washing tub 500 rinses clothes in the solution of the finishing agent to give desired characteristics (such as softness) to the clothes.

[0016]

FIG. 2 is a schematic perspective view of water supply unit 300. Water supply unit 300 is described with reference to FIGS. 1 and 2.

[0017]

Water supply unit 300 includes water supply valve 310 described with reference to FIG. 1, water supply box 330, and lid 340. Detergent case 400 described with reference to FIG. 1 is stored in water supply box

330. The user can take out detergent case 400 from water supply box 330. Channel structure part 320 described with reference to FIG. 1 is formed integrally with water supply box 330. A channel of channel structure part 320 is disposed below lid 340.

[0018]

FIG. 3A is a schematic perspective view of water supply box 330. FIG. 3B is a schematic side view of water supply box 330. Water supply box 330 is described with reference to FIGS. 1, 3A, and 3B.

[0019]

Water supply box 330 includes holding box 350 and channel box 360. Detergent case 400 described with reference to FIG. 1 is stored in holding box 350. Channel structure part 320 described with reference to FIG. 1 forms a channel within channel box 360.

[0020]

Water supply box 330 includes shared wall 331 shared by holding box 350 and channel box 360. Shared wall 331 supports water flowing along the channel formed within channel box 360. According to this embodiment, shared wall 331 is an example of a support wall.

[0021]

Channel box 360 includes first water guide cylinder 361, second water guide cylinder 362, and peripheral wall part 363. First water guide cylinder 361 may be an upstream end of first path FP described with reference to FIG. 1. Second water guide cylinder 362 may be an upstream end of second path SP described with reference to FIG. 1. Water supply valve 310 described with reference to FIG. 1 is attached to first water guide cylinder 361 and second water guide cylinder 362. Second water guide cylinder 362 is closed when water supply valve 310 opens first water guide cylinder 361. First water guide cylinder 361 is closed when water

supply valve 310 opens second water guide cylinder 362.

[0022]

Lid 340 faces shared wall 331. Peripheral wall part 363 stands between lid 340 and shared wall 331 to define a substantially rectangular area forming the channel. Peripheral wall part 363 includes right wall 364 from which first water guide cylinder 361 and second water guide cylinder 362 protrude. Channel structure part 320 described with reference to FIG. 1 includes shared wall 331, lid 340, channel box 360, first water guide cylinder 361, and second water guide cylinder 362.

[0023]

FIG. 4 is a schematic perspective view of water supply box 330. Water supply box 330 is described with reference to FIGS. 1, 3B, and 4. Note that detergent case 400 and lid 340 are removed from water supply box 330 illustrated in FIG. 4.

[0024]

Holding box 350 includes a substantially U-shaped storage wall 351 formed integrally with shared wall 331. Storage wall 351 and shared wall 331 are configured to define storage space 352 in which detergent case 400 is stored. According to this embodiment, storage wall 351 is an example of a holding part.

[0025]

Storage wall 351 includes lower wall 353, left wall 354, and right wall 355. Lower wall 353 extends below detergent case 400. Lower wall 353 receives water below detergent case 400 when water leaks from first chamber 410, second chamber 420, and third chamber 430. Left wall 354 stands between a left edge of lower wall 353 and a left edge of shared wall 331. Right wall 355 stands between a right edge of lower wall 353 and a right edge of shared wall 331.

[0026]

Storage wall 351 includes left holding shoulder 356 and right holding shoulder 357. Left holding shoulder 356 is provided along a corner formed by left wall 354 and lower wall 353. Right holding shoulder 357 is provided along a corner formed by right wall 355 and lower wall 353. Left holding shoulder 356 and right holding shoulder 357 extend in an insertion direction of detergent case 400. Detergent case 400 is held on left holding shoulder 356 and right holding shoulder 357 within storage space 352.

[0027]

Storage wall 351 includes substantially U-shaped front edge 358. Front edge 358 and shared wall 331 are configured to define insertion port 391. Detergent case 400 is inserted from insertion port 391 into storage space 352.

[0028]

Storage wall 351 includes rear wall 359 on the side opposite to front edge 358. Rear wall 359 closes storage space 352.

[0029]

As illustrated in FIG. 3B, shared wall 331 is horizontally disposed between storage wall 351 and channel box 360, while lower wall 353 is inclined downward in a direction from rear wall 359 toward front edge 358. Accordingly, a designer can increase a height of right wall 364 of channel box 360 in the vicinity of rear wall 359 without excessively increasing a height of water supply box 330. Right wall 364 narrows from rear wall 359 toward front edge 358. Accordingly, lid 340 is disposed substantially horizontally.

[0030]

First water guide cylinder 361 and second water guide cylinder 362

are disposed closer to rear wall 359 than to front edge 358, and protrude to the outside from right wall 364 of channel box 360. Since right wall 364 has a wide area in the vicinity of rear wall 359, the designer can increase sizes of inner diameters of first water guide cylinder 361 and second water guide cylinder 362. Increase in the diameters of first water guide cylinder 361 and second water guide cylinder 362 reduces flow resistances of the respective cylinders.

[0031]

As illustrated in FIG. 4, channel box 360 includes first partitioning wall 371, second partitioning wall 372, and third partitioning wall 373. First partitioning wall 371 stands from shared wall 331 in an area surrounded by peripheral wall part 363. Second partitioning wall 372 stands from shared wall 331 in an area between first partitioning wall 371 and right wall 364 of peripheral wall part 363. Third partitioning wall 373 stands from shared wall 331 in an area between second partitioning wall 372 and right wall 364.

[0032]

A space surrounding second partitioning wall 372 forms first channel 381 through which water flows from first water guide cylinder 361. A space surrounded by third partitioning wall 373 and right wall 364 forms second channel 382 through which water flows from second water guide cylinder 362. First channel 381 corresponds to first path FP described with reference to FIG. 1. Second channel 382 corresponds to second path SP described with reference to FIG. 1. The designer may design first channel 381 and second channel 382 in such shapes as to match with a shape of detergent case 400. The principle of this embodiment is not limited by the particular shapes of first channel 381 and second channel 382.

[0033]

Dropping holes 383 and 384 are formed in shared wall 331 inside first channel 381. Dropping hole 384 is formed at a position different from a position of dropping hole 383. Water flowing from first water guide cylinder 361 enters first chamber 410 described with reference to FIG. 1 through dropping hole 383. Water flowing from first water guide cylinder 361 enters second chamber 420 described with reference to FIG. 1 through dropping hole 384. Accordingly, dropping holes 383 and 384 define dropping paths of water into first chamber 410 and second chamber 420 in an area between storage wall 351 and channel box 360.

[0034]

Upper edges of peripheral wall part 363, first partitioning wall 371, second partitioning wall 372, and third partitioning wall 373 may be welded to a lower surface of lid 340. If water supply box 330 and lid 340 are made of resin, the upper edges of peripheral wall part 363, first partitioning wall 371, second partitioning wall 372, and third partitioning wall 373 are easily welded to lid 340 by an ultrasonic technique. The principle of this embodiment is not limited in any way to a particular connecting structure between lid 340 and peripheral wall part 363, first partitioning wall 371, second partitioning wall 372, and third partitioning wall 373.

[0035]

The user can supply water from first water guide cylinder 361 and fill first channel 381 with water. When third partitioning wall 373 is water-tightly connected to lid 340, water from first channel 381 is supplied to first chamber 410 and second chamber 420 through dropping holes 383 and 384 without entering second channel 382.

[0036]

The user can supply water from second water guide cylinder 362 and fill second channel 382 with water. When third partitioning wall 373 is water-tightly connected to lid 340, water from second channel 382 is supplied to third chamber 430 without entering first channel 381. Accordingly, the flow path of water is appropriately selectable in accordance with switching operation of water supply valve 310.

[0037]

Channel box 360 includes substantially C-shaped dam wall 374. Both ends of dam wall 374 are connected to second partitioning wall 372. Dropping hole 384 is surrounded by second partitioning wall 372 and dam wall 374. An upper edge of dam wall 374 is separated from lid 340 unlike first partitioning wall 371, second partitioning wall 372, and third partitioning wall 373. Accordingly, when first channel 381 is filled with water, water is allowed to flow through a clearance between dam wall 374 and lid 340, and enter second chamber 420 from dropping hole 384. According to this embodiment, each of first partitioning wall 371, second partitioning wall 372, third partitioning wall 373, and dam wall 374 is an example of a wall part. Each of second partitioning wall 372 and dam wall 374 is an example of a surrounding wall part.

[0038]

FIG. 5 is a schematic cross-sectional view of dam wall 374. A function of dam wall 374 is described with reference to FIGS. 4 and 5.

[0039]

When flow of water from first water guide cylinder 361 is stopped, a water level within first channel 381 gradually lowers with dropping of water from dropping holes 383 and 384. When the water level within first channel 381 becomes lower than a height of dam wall 374, a liquid layer within a space surrounded by dam wall 374 and second partitioning wall

372 is separated from a liquid layer surrounding dam wall 374. As a result, water within the space surrounded by dam wall 374 and second partitioning wall 372 disappears faster than water in other areas. Thereafter, air is allowed to flow into first channel 381 through dropping hole 384. Accordingly, discharge of water through dropping hole 383 is accelerated.

[0040]

FIG. 6 is a schematic perspective view of detergent case 400. Detergent case 400 is described with reference to FIGS. 4 and 6.

[0041]

Detergent case 400 includes handle 440, first sectioning wall 411, second sectioning wall 421, and third sectioning wall 431. First sectioning wall 411, second sectioning wall 421, and third sectioning wall 431 are connected to handle 440. The user can hold handle 440 and take out detergent case 400 from storage space 352. First sectioning wall 411 sections first chamber 410 opened upward. Second sectioning wall 421 sections second chamber 420 opened upward. Third sectioning wall 431 sections third chamber 430 opened upward. The user can take out detergent case 400 from storage space 352, and supply the powder detergent to first chamber 410 sectioned by first sectioning wall 411. The user can take out detergent case 400 from storage space 352, and supply the liquid detergent to second chamber 420 sectioned by second sectioning wall 421. The user can take out detergent case 400 from storage space 352, and supply the finishing agent to third chamber 430 sectioned by third sectioning wall 431. According to this embodiment, at least one of first sectioning wall 411 and second sectioning wall 421 is an example of a sectioning wall.

[0042]

Detergent case 400 includes intermediate wall 414 which separates first chamber 410 into mixing chamber 412 and foaming chamber 413. Mixing chamber 412 is formed between handle 440 and foaming chamber 413. The user can supply the powder detergent to mixing chamber 412. Mixing chamber 412 is mainly used for mixing the powder detergent with water. Foaming chamber 413 is mainly used for foaming a detergent solution. According to this embodiment, intermediate wall 414 is an example of a separation wall.

[0043]

FIG. 7 is a schematic plan view of water supply box 330. A water supply technique from channel box 360 to detergent case 400 is described with reference to FIGS. 6 and 7.

[0044]

As described above, dropping holes 383 and 384 are formed in shared wall 331. Dropping hole 385 is further formed in shared wall 331. Each of dropping holes 383, 384, and 385 directs the water supplied to first channel 381 toward detergent case 400. The water supplied to first channel 381 through first water guide cylinder 361 is directed toward mixing chamber 412 by dropping hole 383. More specifically, the water supplied to first channel 381 through first water guide cylinder 361 drops toward mixing chamber 412 through dropping hole 383. Accordingly, the powder detergent is allowed to efficiently mix with water within mixing chamber 412. Water supplied to first channel 381 through first water guide cylinder 361 is directed toward second chamber 420 by dropping hole 384. More specifically, water supplied to first channel 381 through first water guide cylinder 361 drops toward second chamber 420 through dropping hole 384. Accordingly, the liquid detergent is allowed to efficiently mix with water within second chamber 420. According to this

embodiment, dropping hole 383 is an example of a first dropping hole. Dropping hole 384 is an example of a third dropping hole.

[0045]

Intermediate wall 414 is provided with notch 415. The detergent solution within mixing chamber 412 is allowed to flow into foaming chamber 413 through notch 415. Water supplied to first channel 381 through first water guide cylinder 361 is directed toward foaming chamber 413 by dropping hole 385. More specifically, water supplied to first channel 381 through first water guide cylinder 361 drops toward foaming chamber 413 through dropping hole 385. Accordingly, the detergent solution within foaming chamber 413 can be efficiently foamed. According to this embodiment, dropping hole 385 is an example of a second dropping hole. Notch 415 is an example of a first notch.

[0046]

First sectioning wall 411 includes upstream wall 418 and downstream wall 419. Upstream wall 418 and intermediate wall 414 are configured to section mixing chamber 412. Downstream wall 419 and intermediate wall 414 are configured to section foaming chamber 413. According to this embodiment, downstream wall 419 is an example of a first wall part. According to this embodiment, upstream wall 418 is an example of a second wall section.

[0047]

Upstream wall 418 includes upper edge 451 facing shared wall 331. Upper edge 451 is disposed in the vicinity of a lower surface of shared wall 331. Water within mixing chamber 412 is enclosed by upstream wall 418 and shared wall 331, and therefore intensively flows into foaming chamber 413 through notch 415.

[0048]

Downstream wall 419 includes upper edge 452 facing shared wall 331. Unlike upper edge 451 of upstream wall 418, a majority of upper edge 452 of downstream wall 419 is disposed apart from shared wall 331 by 5 mm or more. Accordingly, a liquid surface of a solution formed within foaming chamber 413 is also disposed apart from shared wall 331. In this case, an air layer is formed between shared wall 331 and the liquid surface of the solution formed within foaming chamber 413. Water ejected from dropping hole 385 reaches the solution within foaming chamber 413 while introducing air from the air layer. Accordingly, the solution within foaming chamber 413 is efficiently foamed. According to this embodiment, upper edge 452 of downstream wall 419 is an example of a first upper edge. Upper edge 451 of upstream wall 418 is an example of a second upper edge.

[0049]

Downstream wall 419 may be expressed as detergent case rear wall 416 formed on the side opposite to handle 440 in the front-rear direction. Notch 417 is formed in detergent case rear wall 416. The detergent solution within foaming chamber 413 flows out from detergent case 400 through notch 417.

[0050]

FIG. 8 is a schematic exploded perspective view of detergent case 400. Detergent case 400 is described with reference to FIGS. 7 and 8.

[0051]

Detergent case 400 includes first siphon lid 422 and second siphon lid 432. First siphon lid 422 is used for discharge of water from second chamber 420. Second siphon lid 432 is used for discharge of water from third chamber 430.

[0052]

First siphon lid 422 includes lid plate 423 and outer cylinder 424. Lid plate 423 includes opening 425. Water dropping from dropping hole 384 flows into second chamber 420 through opening 425. Outer cylinder 424 protrudes downward from lid plate 423.

[0053]

Second sectioning wall 421 which sections second chamber 420 disposed adjacent to mixing chamber 412 and foaming chamber 413 includes bottom wall 426 and inner cylinder 427. Bottom wall 426 faces lid plate 423 of first siphon lid 422. Inner cylinder 427 protrudes upward from bottom wall 426. When first siphon lid 422 closes a part of second chamber 420, inner cylinder 427 is inserted into outer cylinder 424 to constitute a siphon structure. Liquid within second chamber 420 flows into a clearance between inner cylinder 427 and outer cylinder 424 based on the principle of siphon. Thereafter, the liquid flows downward within inner cylinder 427, and is discharged from detergent case 400.

[0054]

Second siphon lid 432 includes lid plate 433 and an outer cylinder (not illustrated). Lid plate 433 includes opening 434. Water supplied from second water guide cylinder 362 to second channel 382 flows into third chamber 430 through opening 434. Third sectioning wall 431 includes bottom wall 435 and inner cylinder 436. When second siphon lid 432 closes a part of third chamber 430, inner cylinder 436 is inserted into the outer cylinder of second siphon lid 432 to constitute a siphon structure. Liquid within third chamber 430 flows into a clearance between inner cylinder 436 and the outer cylinder based on the principle of siphon. Thereafter, the liquid flows downward within inner cylinder 436, and is discharged from detergent case 400.

[0055]

Detergent case 400 includes boundary wall 401 forming a boundary between first chamber 410 (mixing chamber 412 and foaming chamber 413), and second chamber 420. Boundary wall 401 is provided with notch 402. Liquid within second chamber 420 is allowed to flow from second chamber 420 to mixing chamber 412 through notch 402. According to this embodiment, notch 402 is an example of a second notch.

[0056]

Detergent case 400 includes rib structure 460 protruding within mixing chamber 412. Rib structure 460 extends, from notch 402 formed in boundary wall 401, in a direction crossing a flow line of water flowing toward notch 415 formed in intermediate wall 414. Rib structure 460 prevents a flow of the powder detergent into foaming chamber 413 before the powder detergent is sufficiently dissolved within mixing chamber 412.

[0057]

Rib structure 460 includes left rib 461 and right rib 462. Right rib 462 is disposed apart from left rib 461. In this case, a complicated water flow pattern is produced within mixing chamber 412. Accordingly, the powder detergent is efficiently dissolved within mixing chamber 412. According to this embodiment, one of left rib 461 and right rib 462 is an example of a first rib. The other of left rib 461 and right rib 462 is an example of a second rib.

[0058]

FIG. 9A is a schematic cross-sectional view of water supply box 330. FIG. 9B is a schematic perspective view of water supply box 330. A water discharge technique from water supply box 330 is described with reference to FIGS. 9A and 9B.

[0059]

As illustrated in FIG. 9A, lower wall 353 of holding box 350 is

disposed apart from detergent case 400. Accordingly, lower space 392 is formed between lower wall 353 and detergent case 400. The water and detergent discharged from detergent case 400 flow through lower space 392.

[0060]

FIG. 9B illustrates virtual plane PP defined by an upper surface of left holding shoulder 356 and an upper surface of right holding shoulder 357. A space below plane PP corresponds to lower space 392 described above. A space above plane PP corresponds to upper space 393. Detergent case 400 is stored in upper space 393. Accordingly, front edge 358 of lower wall 353 is disposed apart from detergent case 400, and forms dropping port 394 (opening formed between plane PP and front edge 358 of lower wall 353).

[0061]

As described above, lower wall 353 is inclined downward toward insertion port 391. Accordingly, the water and detergent supplied to lower space 392 is allowed to drop from dropping port 394 formed between plane PP and lower wall 353.

[0062]

FIG. 10 is a schematic perspective view of washing machine 100. Washing machine 100 is described with reference to FIGS. 1 and 10.

[0063]

Washing machine 100 includes housing 600 and lid part 700. Housing 600 includes lower housing 610 and upper housing 620. Washing tub 500 described with reference to FIG. 1 is stored in lower housing 610. Lower housing 610 is provided with discharge port 611 through which water is discharged from washing tub 500. Lid part 700 is attached to upper housing 620. Lid part 700 swings upward and downward on an

upper part of upper housing 620. Upper housing 620 is provided with water supply port 200 described with reference to FIG. 1. Water supply unit 300 and detergent case 400 described with reference to FIG. 1 are assembled in upper housing 620.

[0064]

FIG. 11 is a schematic perspective view of washing machine 100. Washing machine 100 is further described with reference to FIG. 11.

[0065]

As illustrated in FIG. 11, the user can swing lid part 700 upward. Upper housing 620 is provided with loading port 621. When the user swings lid part 700 upward, washing tub 500 is exposed through loading port 621. The user can load clothes into washing tub 500 through loading port 621.

[0066]

Handle 440 of detergent case 400 faces loading port 621. Accordingly, the user can swing lid part 700 upward and access handle 440 of detergent case 400 exposed from housing 600.

[0067]

FIG. 12 is a schematic cross-sectional view of washing machine 100. Washing machine 100 is further described with reference to FIGS. 10 to 12.

[0068]

Washing machine 100 further includes operation panel 800. Operation panel 800 is disposed between water supply port 200 and lid part 700. The user can set various operations of washing tub 500 by operating operation panel 800.

[0069]

Water supply box 330 is disposed inside upper housing 620 and

below operation panel 800 and water supply port 200. Water supplied from water supply port 200 flows downward and enters water supply box 330. As described above, dropping port 394 is formed between lower wall 353 of holding box 350 and detergent case 400. Handle 440 of detergent case 400 does not close dropping port 394, while dropping port 394 is open in an area above washing tub 500. Accordingly, the detergent solution directly drops from water supply box 330 toward washing tub 500 through dropping port 394.

[0070]

<Design of Lid>

The lid may have a function of adjusting a flow resistance inside the channel box, and a function of preventing separation of the detergent case, in accordance with various shapes designed by the designer. A lid designing technique is hereinafter described.

[0071]

FIG. 13 is a schematic perspective view of lid 340. Lid 340 is described with reference to FIGS. 3B, 4, 7, and 13.

[0072]

Lid 340 includes lid plate 341, L-shaped ridge 342, left engaging plate 343, and right engaging plate 344. Lid plate 341 closes first channel 381 and second channel 382. A lower surface of lid plate 341 may be welded to upper edges of peripheral wall part 363, first partitioning wall 371, second partitioning wall 372, and third partitioning wall 373 by an ultrasonic technique.

[0073]

Ridge 342 protrudes downward from lid plate 341. Ridge 342 comes into first channel 381. As described with reference to FIG. 3A, shared wall 331 is inclined downward in the direction toward rear wall 359, while

lid plate 341 is substantially horizontal. Accordingly, heights of first partitioning wall 371, second partitioning wall 372, and third partitioning wall 373 gradually increase toward rear wall 359. In this case, variations of a flow resistance of first channel 381 become wider when ridge 342 is not present. According to the principle of this embodiment, the designer provides ridge 342 on lid 340 to make a cross-sectional area of first channel 381 substantially uniform throughout a predetermined section. The shape of ridge 342 may be appropriately determined in accordance with flow characteristics of the inside of channel box 360. Accordingly, the principle of this embodiment is not limited to a particular shape of ridge 342.

[0074]

As illustrated in Fig. 7, shared wall 331 is provided with left insertion hole 332 and right insertion hole 333. Left engaging plate 343 is inserted into left insertion hole 332. Right engaging plate 344 is inserted into right insertion hole 333.

[0075]

FIG. 14A is a schematic perspective view of washing machine 100. FIG. 14B is a schematic cross-sectional view of washing machine 100 illustrated in FIG. 14A. Functions of left engaging plate 343 and right engaging plate 344 are described with reference to FIGS. 9A, 11, 14A, and 14B.

[0076]

When lid 340 is attached to water supply box 330, left engaging plate 343 and right engaging plate 344 protrude into storage space 352 as illustrated in FIG. 9A. Detergent case 400 illustrated in FIG. 11 is disposed at a storage position where first chamber 410, second chamber 420, and third chamber 430 are stored within storage space 352.

Detergent case 400 illustrated in FIG. 14A is disposed at an exposed position where first chamber 410, second chamber 420, and third chamber 430 are exposed from storage space 352. Storage wall 351 holds detergent case 400 such that detergent case 400 is movable between the storage position and the exposed position.

[0077]

As illustrated in FIG. 9A, left engaging plate 343 protrudes into first chamber 410. Right engaging plate 344 protrudes into third chamber 430. When detergent case 400 comes to the exposed position, left engaging plate 343 comes into contact with first sectioning wall 411. When detergent case 400 is disposed at the exposed position, right engaging plate 344 comes into contact with third sectioning wall 431. According to this embodiment, left engaging plate 343 is an example of an engaging piece.

[0078]

<Reduction of Internal Pressure>

A conventional channel structure (see PTLs 1 to 3) includes a plate member disposed above a detergent case. The plate member is provided with a small hole. Water drops into the detergent case through the small hole. When an internal pressure of the channel structure is high, water is powerfully ejected downward. At this time, if the user accidentally pulls out the detergent case, water collides with surfaces of components constituting the washing machine, and scatters. Hereinafter, there is described a washing machine having a structure capable of preventing scatter of water even when the user accidentally pulls out the detergent case.

[0079]

The internal pressure of the channel formed in the channel

structure part is high in this embodiment. Accordingly, water can be powerfully ejected from the dropping hole. As a result, the detergent is efficiently mixed with water. However, when the user accidentally pulls out the detergent case, the water ejected from the dropping hole scatters. A technique for reducing the internal pressure of the channel in accordance with the position of the detergent case is hereinafter described.

[0080]

FIG. 15A is a schematic cross-sectional view of detergent case 400 disposed at the storage position. FIG. 15B is a schematic cross-sectional view of detergent case 400 moved from the storage position to the exposed position. The technique for reducing the internal pressure of the channel is described with reference to FIGS. 6, 7, 15A, and 15B.

[0081]

As illustrated in FIG. 15B, shared wall 331 includes protruding wall 334 protruding into storage space 352. Protruding wall 334 forms recess 335 within first channel 381. Protruding wall 334 defines leak hole 336 opened in the horizontal direction.

[0082]

As described above, shared wall 331 is inclined downward in the direction toward rear wall 359. Protruding wall 334 is located closer to rear wall 359 than to front edge 358. Accordingly, water within first channel 381 efficiently flows into recess 335.

[0083]

Detergent case 400 includes protruding plate 403 which protrudes toward rear wall 359 from a boundary between first sectioning wall 411 and second sectioning wall 421. When detergent case 400 is disposed at the storage position, protruding plate 403 closes leak hole 336. During this period, water is ejected from dropping holes 383, 384, and 385 toward

detergent case 400. Accordingly, the detergent within detergent case 400 can be efficiently dissolved in water. Thereafter, water overflows from detergent case 400, and reaches lower wall 353 to be received thereon. Since a pressure of the water overflowing from detergent case 400 is not higher than water pressures at dropping holes 383, 384, and 385, the water overflowing from detergent case 400 does not collide with lower wall 353 with excessively strong force. Accordingly, while detergent case 400 is located at the storage position, water hardly scatters. According to this embodiment, lower wall 353 is an example of a receiving plate.

[0084]

When detergent case 400 moves from the storage position to the exposed position, protruding plate 403 opens leak hole 336. As a result, water within first channel 381 is allowed to leak from leak hole 336. Leak hole 336 is formed larger than each of dropping holes 383, 384, and 385. Accordingly, a water pressure at leak hole 336 does not become excessively high. Moreover, a large volume of water is allowed to leak from leak hole 336. In this case, the internal pressure of first channel 381 promptly decreases.

[0085]

The principle of the foregoing aspect concerning reduction of the internal pressure is not limited to the washing machine including the detergent case which divides first storage chamber 410 into mixing chamber 412 and foaming chamber 413. Accordingly, this principle is applicable to a washing machine including a detergent case in which both production and foaming of a detergent solution are performed within a common storage chamber.

[0086]

<Various Rib Structures>

The rib structure for preventing the powder detergent from flowing out too fast may have various shapes designed by the designer designing the detergent case. Various types of rib structure are hereinafter described.

[0087]

FIG. 16A is a schematic plan view of detergent case 400A. FIG. 16B is a schematic plan view of detergent case 400B. Each of detergent cases 400A and 400B may be used as detergent case 400 described with reference to FIG. 1.

[0088]

Detergent case 400A includes single rib 463 constituting the rib structure. Rib 463 protrudes within mixing chamber 412. Rib 463 extends in a direction crossing a flow line of water from notch 402 formed in boundary wall 401 to notch 415 formed in intermediate wall 414.

[0089]

Detergent case 400B includes left rib 461A and right rib 462A constituting the rib structure. Right rib 462A is disposed on the upstream side with respect to left rib 461A in the flow of water from notch 402 formed in boundary wall 401 to notch 415 formed in intermediate wall 414. A part of left rib 461A faces right rib 462A in the flow direction of water from notch 402 to notch 415. According to this embodiment, right rib 462A is an example of a first rib. Left rib 461A is an example of a second rib.

[0090]

Washing machine 100 according to an aspect of the present invention includes detergent case 400 that is provided with first storage chamber 410 in which a detergent is stored, and channel structure part 320 that forms a channel above detergent case 400. Channel structure

part 320 is provided with a plurality of dropping holes that direct water from the channel toward detergent case 400. Detergent case 400 includes separation wall 414 that separates first storage chamber 410 into mixing chamber 412 where the detergent and the water are mixed to produce a solution of the detergent, and foaming chamber 413 where the solution flowing from mixing chamber 412 is foamed. The plurality of dropping holes include first dropping hole 383 that directs the water toward mixing chamber 412, and second dropping hole 385 that directs the water toward the foaming chamber.

[0091]

According to this structure, the detergent is efficiently dissolved by the water supplied from the first dropping hole to the mixing chamber. Accordingly, a solution containing the sufficiently dissolved detergent is produced. The solution is efficiently foamed by using the water supplied from the second dropping hole to the foaming chamber. Accordingly, a sufficiently foamed solution is used for washing clothes.

[0092]

In the foregoing structure, separation wall 414 may be provided with first notch 415. The water supplied to mixing chamber 412 may flow toward foaming chamber 413 through first notch 415.

[0093]

According to this structure, the water supplied to the mixing chamber flows toward the foaming chamber through the first notch. In this case, the detergent solution produced in the mixing chamber is efficiently foamed by using the water supplied from the second dropping hole to the foaming chamber. Accordingly, a sufficiently foamed solution is used for washing clothes.

[0094]

In the foregoing structure, detergent case 400 may include first sectioning wall 411 that sections first storage chamber 410. First sectioning wall 411 may include first wall part 419, first wall part 419 and separation wall 414 being configured to section foaming chamber 413. First wall part 419 may include first upper edge 452 disposed apart from the channel structure part.

[0095]

According to this structure, the first wall part includes the first upper edge disposed apart from the channel structure part. Thus, an air layer is formed between a liquid surface of the solution within the foaming chamber and the channel structure part. The water ejected from the second dropping hole therefore enters the foaming chamber while introducing air from the air layer. As a result, the detergent solution is efficiently foamed. Accordingly, a sufficiently foamed solution is used for washing clothes.

[0096]

In the foregoing structure, first upper edge 452 may be disposed apart from channel structure part 320 by 5 mm or more.

[0097]

According to this structure, the first upper edge is disposed apart from the channel structure by 5 mm or more. Accordingly, the air layer between the liquid surface of the solution and the channel structure part has a sufficient thickness for effective foaming of the solution.

[0098]

In the foregoing structure, first sectioning wall 411 may include second wall part 418. Second wall part 418 and separation wall 414 may be configured to section mixing chamber 412. Second wall part 418 may include second upper edge 451 disposed closer to the channel structure

part than first upper edge 452.

[0099]

According to this structure, the second wall part includes the second upper edge disposed closer to the channel structure part than the first upper edge. Accordingly, the detergent solution produced within the mixing chamber efficiently flows into the foaming chamber through the first notch.

[0100]

In the foregoing structure, detergent case 400 may include second sectioning wall 421 that sections second storage chamber 420 disposed adjacent to mixing chamber 412, and boundary wall 401 disposed on a boundary between mixing chamber 412 and second storage chamber 420. The plurality of dropping holes may include third dropping hole 384 that directs the water toward second storage chamber 420. Boundary wall 401 may be provided with second notch 402. The water supplied to second storage chamber 420 may flow toward mixing chamber 412 through second notch 402.

[0101]

According to this structure, the plurality of dropping holes include the third dropping hole which directs the water toward the second storage chamber disposed adjacent to the mixing chamber. The detergent solution is also produced in the second storage chamber. The detergent solution flows to the mixing chamber through the second notch formed in the boundary wall. Accordingly, the detergent solution is efficiently foamed in the foaming chamber similarly to the detergent solution produced in the first storage chamber.

[0102]

In the foregoing structure, detergent case 400 may include rib

structure 460 that protrudes within mixing chamber 412. Rib structure 460 may extend in a direction crossing a flow line of the water flowing from second notch 402 to first notch 415.

[0103]

According to this structure, the rib structure extends in the direction crossing a flow line of the water flowing from the second notch to the first notch. Accordingly, the detergent within the mixing chamber hardly flows to the foaming chamber before dissolution.

[0104]

In the foregoing structure, rib structure 460 may include first rib 461, and second rib 462 disposed apart from first rib 461.

[0105]

According to this structure, the rib structure includes the first rib, and the second rib disposed apart from the first rib. In this case, a complicated flow pattern of water is produced within the mixing chamber. Accordingly, the detergent within the mixing chamber is efficiently dissolved.

[0106]

In the foregoing structure, first rib 462A may be disposed on the upstream side with respect to second rib 461A in a flow of the water flowing from second notch 402 to first notch 415.

[0107]

According to this structure, the first rib is disposed on the upstream side with respect to the second rib in the flow of the water flowing from the second notch to the first notch. Accordingly, the detergent within the mixing chamber hardly flows to the foaming chamber before dissolution.

[0108]

In the foregoing structure, a part of first rib 462A may face second

rib 461A in the direction of the flow of the water flowing from second notch 402 to first notch 415.

[0109]

According to this structure, a part of the first rib faces the second rib in the direction of the flow of the water flowing from the second notch to the first notch. Accordingly, the detergent within the mixing chamber hardly flows to the foaming chamber before dissolution.

[0110]

In the foregoing structure, the detergent may include a first detergent in a form of powder, and a second detergent in a form of liquid. The first detergent may be supplied to mixing chamber 412. The second detergent may be supplied to second storage chamber 420.

[0111]

According to this structure, a user can wash clothes by using the first detergent in the form of powder and the second detergent in the form of liquid.

[0112]

In the foregoing structure, the washing machine may further include housing 600. Detergent case 400 may include handle 440 exposed from housing 600. First sectioning wall 411 may be connected to handle 440. Mixing chamber 412 may be disposed between foaming chamber 413 and handle 440.

[0113]

According to this structure, the mixing chamber is disposed between the foaming chamber and the handle. Accordingly, the user can easily supply the detergent to the mixing chamber.

[0114]

Washing machine 100 according to another aspect of the present

invention includes: detergent case 400 that includes a storage chamber in which a detergent is stored; and water supply box 330 that includes holding part 351 that forms a storage space in which detergent case 400 is stored, and channel structure part 320 that defines a channel through which water is supplied to detergent case 400. Holding part 351 holds detergent case 400 such that detergent case 400 is movable between an exposed position where the storage chamber is exposed from holding part 351, and a storage position where the storage chamber is stored within the storage space. Water supply box 330 includes support wall 331 that supports the water flowing along the channel, and support wall 331 is disposed between holding part 361 and channel structure part 320. Support wall 331 is provided with dropping holes 383, 384, and 385, and leak hole 336. Each of dropping holes 383, 384, 385, and 336 is formed between holding part 351 and channel structure part 320 and defines a dropping path of the water toward detergent case 400 disposed at the storage position. Leak hole 336 causes the water to leak from the channel when detergent case 400 is disposed at the exposed position. Detergent case 400 closes leak hole 336 when detergent case 400 is disposed at the storage position.

[0115]

According to this structure, the support wall is provided with the leak hole. In this case, the water within the channel is allowed to leak from the leak hole when the detergent case is disposed at the exposed position. Since the leak of the water from the leak hole decreases the internal pressure of the channel, the pressure of the water ejecting from the dropping holes decreases. Accordingly, scattering of the water hardly occurs even when the user accidentally pulls out the detergent case to the

exposed position. When the detergent case is disposed at the storage position, the detergent case closes the leak hole. Accordingly, in the state

where the detergent case is disposed at the storage position, the internal pressure of the channel is maintained at a high level. During this period, the water ejected from the dropping holes powerfully agitates the detergent within the detergent case disposed at the storage position.

[0116]

In the foregoing structure, leak hole 336 may be larger than each of dropping holes 383, 384, and 385.

[0117]

According to this structure, the internal pressure of the channel considerably decreases when the storage chamber is disposed at the exposed position. Accordingly, scattering of the water hardly occurs even when the user accidentally pulls out the detergent case, and puts the storage chamber at the exposure position.

[0118]

In the foregoing structure, support wall 331 may include protruding wall 334 that protrudes to the storage space. Protruding wall 334 may form recess 335 within the channel structure part. Leak hole 336 may be formed in protruding wall 334.

[0119]

According to this structure, the protruding wall forms the recess within the channel structure part. In this case, the water within the channel structure part flows to the protruding wall. The leak hole is formed in the protruding wall. Accordingly, the water is efficiently discharged from the leak hole.

[0120]

In the foregoing structure, holding part 351 may include front edge 358 that defines an insertion port through which detergent case 400 is inserted, and rear wall 359 disposed on the side opposite to front edge 358.

Protruding wall 334 may be disposed closer to rear wall 359 than to front edge 358.

[0121]

According to this structure, the protruding wall is disposed closer to the rear wall than to the front edge. In this case, the water is discharged from the leak hole located away from the insertion port. Accordingly, scattering of the water hardly occurs even when the user accidentally pulls out the detergent case, and puts the storage chamber at the exposure position.

[0122]

In the foregoing structure, holding part 351 may include receiving plate 353 that receives the water below detergent case 400 when the water overflows from detergent case 400 disposed at the storage position. Leak hole 336 may be open in a horizontal direction.

[0123]

According to this structure, the leak hole is open in the horizontal direction. In this case, the direction of a pressure applied to the water overflowing from the leak hole is different from the direction in which the receiving plate is present. Accordingly, the water leaking from the leak hole hardly scatters.

[0124]

In the foregoing structure, detergent case 400 may include sectioning walls 411 and 421 that section the storage chamber, and protruding plate 403 that protrudes from sectioning walls 411 and 421. Protruding plate 403 may close leak hole 336 when detergent case 400 is disposed at the storage position.

[0125]

According to this structure, the protruding plate closes the leak

hole when the detergent case is disposed at the storage position. In this case, the internal pressure of the channel is maintained at a high level while the detergent case disposed at the storage position. During this period, the water ejected from the dropping holes powerfully agitates the detergent within the storage chamber of the detergent case disposed at the storage position.

[0126]

In the foregoing structure, channel structure part 320 may include lid 340 that faces support wall 331. Lid 340 may include engaging pieces 343 that protrude into the storage space. Engaging pieces 343 may come into contact with sectioning walls 411 and 421 when detergent case is disposed at the exposed position.

[0127]

According to this structure, the engaging pieces come into contact with the sectioning walls when the detergent case is disposed at the exposed position. Accordingly, unintended separation of the detergent case from the holding part hardly occurs.

INDUSTRIAL APPLICABILITY

[0128]

The principle of this embodiment is applicable to various types of devices having a washing function.

REFERENCE MARKS IN THE DRAWINGS

[0129]

- 100 washing machine
- 320 channel structure part
- 330 water supply box

331 shared wall
334 protruding wall
335 recess
336 leak hole
340 lid
343 left engaging plate
351 storage wall
352 storage space
353 lower wall
358 front edge
359 rear wall
381 first channel
383, 384, 385 dropping hole
391 insertion port
400, 400A, 400B detergent case
401 boundary wall
402 notch
403 protruding plate
410 first chamber
411 first sectioning wall
412 mixing chamber
413 foaming chamber
414 intermediate wall
415 notch
417 notch
418 upstream wall
419 downstream wall
420 second chamber

421 second sectioning wall
440 handle
451, 452 upper edge
460 rib structure
461, 461A left rib
462, 462A right rib
600 housing

CLAIMS

1. A washing machine comprising:

a detergent case that includes a storage chamber in which a detergent is stored; and

a water supply box that includes a holding part that forms a storage space in which the detergent case is stored, and a channel structure part that defines a channel through which water is supplied to the detergent case, wherein

the holding part holds the detergent case such that the detergent case is movable between an exposed position where the storage chamber is exposed from the holding part, and a storage position where the storage chamber is stored within the storage space,

the water supply box further includes a support wall that supports the water flowing along the channel, and the support wall is disposed between the holding part and the channel structure part,

the support wall includes a dropping hole and a leak hole, the dropping hole and the leak hole being formed between the holding part and the channel structure part, the dropping hole defining a dropping path of the water toward the detergent case disposed at the storage position, and the leak hole being a hole through which the water from the channel leaks when the storage chamber is disposed at the exposed position, and the detergent case closes the leak hole when the detergent case is disposed at the storage position.

2. The washing machine according to claim 1, wherein the leak hole is larger than the dropping hole.

3. The washing machine according to claim 1, wherein

the support wall includes a protruding wall that protrudes to the storage space,

the protruding wall forms a recess within the channel structure part, and the leak hole is formed in the protruding wall.

4. The washing machine according to claim 3, wherein

The holding part includes a front edge that defines an insertion port through which the detergent case is inserted, and a rear wall disposed on a side opposite to the front edge, and

the protruding wall is formed closer to the rear wall than to the front edge.

5. The washing machine according to claim 3, wherein

the holding part includes a receiving plate that receives the water below the detergent case when the water overflows from the detergent case disposed at the storage position, and

the leak hole is open in a horizontal direction.

6. The washing machine according to claim 5, wherein

the detergent case includes a sectioning wall that sections the storage chamber, and a protruding plate that protrudes from the sectioning wall, and

the protruding plate closes the leak hole when the detergent case is disposed at the storage position.

7. The washing machine according to claim 6, wherein

the channel structure part includes a lid that faces the support wall, the lid includes an engaging piece that protrudes into the storage space, and

the engaging piece comes into contact with the sectioning wall when the detergent case is disposed at the exposed position.