US011272826B2

(12) **United States Patent**
Krieger et al.

(10) **Patent No.: US 11,272,826 B2**
(45) **Date of Patent: Mar. 15, 2022**

(54) **APPLIANCE DOOR LATCH SYSTEM WITH PRE-LATCHING CATCH ALIGNMENT SYSTEM**

(71) Applicant: **Illinois Tool Works Inc.**, Glenview, IL (US)

(72) Inventors: **Jeffrey J. Krieger**, Mukwonago, WI (US); **Nicola Sartori**, Comerio (IT)

(73) Assignee: **Illinois Tool Works Inc.**, Glenview, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 677 days.

(21) Appl. No.: **16/010,798**

(22) Filed: **Jun. 18, 2018**

(65) **Prior Publication Data**

US 2018/0368652 A1 Dec. 27, 2018

Related U.S. Application Data

(60) Provisional application No. 62/524,147, filed on Jun. 23, 2017.

(51) **Int. Cl.**

A47L 15/42	(2006.01)
E05C 19/00	(2006.01)
E05C 5/00	(2006.01)
E05C 19/02	(2006.01)
E05B 15/04	(2006.01)

(52) **U.S. Cl.**

CPC ***A47L 15/4259*** (2013.01); ***E05C 5/00*** (2013.01); ***E05C 19/009*** (2013.01); ***E05C 19/02*** (2013.01); *E05B 2015/0493* (2013.01); *E05C 2005/005* (2013.01); *E05Y 2900/304* (2013.01)

(58) **Field of Classification Search**

CPC A47L 15/4259; E05C 5/00; E05C 19/009; E05C 19/02; E05C 2005/005; E05B 2015/0493; E05Y 2900/304; Y10S 292/04; Y10S 292/69

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,931,205 A *	4/1960	Schmitz	.....	E05B 65/0053 70/92
5,174,618 A *	12/1992	Kropf	.....	A47L 15/4259 292/254
5,401,067 A *	3/1995	Kurosaki	.....	E05C 5/00 292/63

(Continued)

FOREIGN PATENT DOCUMENTS

CN	101258296 A	9/2008
CN	102597397 A	7/2012

(Continued)

OTHER PUBLICATIONS

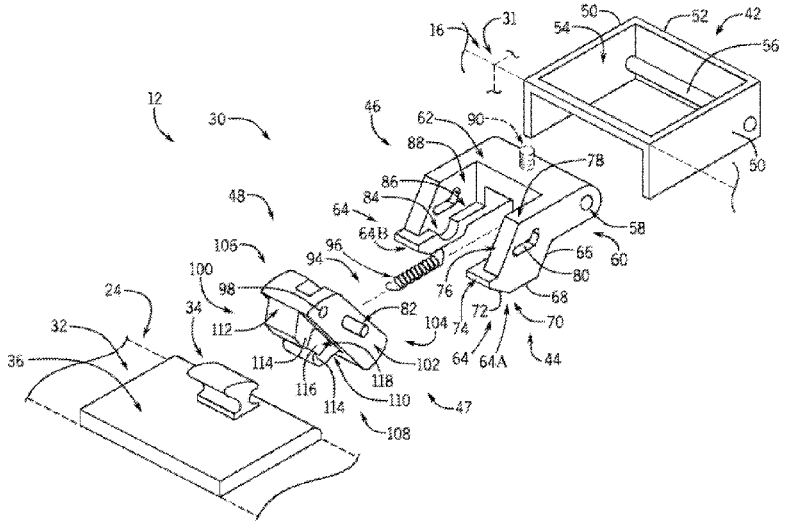
EPO Exam Report dated Mar. 26, 2021, for Application No. EP 18 739 693.2-1005.

Primary Examiner — Christine M Mills
Assistant Examiner — Steven A Tullia
(74) *Attorney, Agent, or Firm* — Boyle Fredrickson, S.C.

(57) **ABSTRACT**

An appliance door latch system is provided that automatically aligns latching components each time an appliance door is closed with a pre-latching catch alignment system. The pre-latching catch alignment system may include a floating catch carrier that is deflected by a door-mounted latch feature to passively reposition a catch to properly align with the striker assembly.

20 Claims, 14 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

6,145,898	A *	11/2000	Onderka	D06F 37/42 292/228
6,152,500	A *	11/2000	Kowalewski	E05B 83/16 292/216
6,155,616	A *	12/2000	Akright	E05B 5/00 292/198
6,290,270	B1 *	9/2001	Spiessl	E05C 3/24 292/216
6,390,518	B1 *	5/2002	Elick	A47L 15/4259 292/117
7,306,266	B2	12/2007	Hapke et al.	
8,733,802	B2 *	5/2014	Promutico	D06F 37/28 292/57
9,370,294	B2 *	6/2016	Osvatic	E05C 19/02
9,487,976	B2	11/2016	Ala et al.	
2005/0194795	A1	9/2005	Hapke	
2006/0033346	A1 *	2/2006	Ala	A47L 15/4259 292/216
2008/0042447	A1 *	2/2008	Neumann	E05C 5/00 292/126
2012/0119522	A1 *	5/2012	Bauriedl	E05C 19/024 292/228
2013/0234578	A1	9/2013	Ala	
2015/0035295	A1 *	2/2015	Li	A47L 15/4259 292/219
2015/0267446	A1	9/2015	Promutico, I	
2016/0138809	A1 *	5/2016	Colucci	E05C 19/00 292/122
2017/0188785	A1 *	7/2017	Park	E05C 19/02

FOREIGN PATENT DOCUMENTS

DE	102004061231	B3 *	4/2006	F24C 15/022
DE	102011075554	A1 *	11/2012	A47L 15/4259
EP	1304436	A1	4/2003	
EP	1469147	A2 *	10/2004	E05B 47/023
EP	2643535		10/2013	
GB	2193525	A *	2/1988	E05C 3/24
GB	2193525	A	2/1988	
WO	WO-2006111501	A1 *	10/2006	E05B 63/20
WO	WO-2008096222	A2 *	8/2008	D06F 39/14
WO	WO-2014061044	A2 *	4/2014	E05C 19/12

* cited by examiner

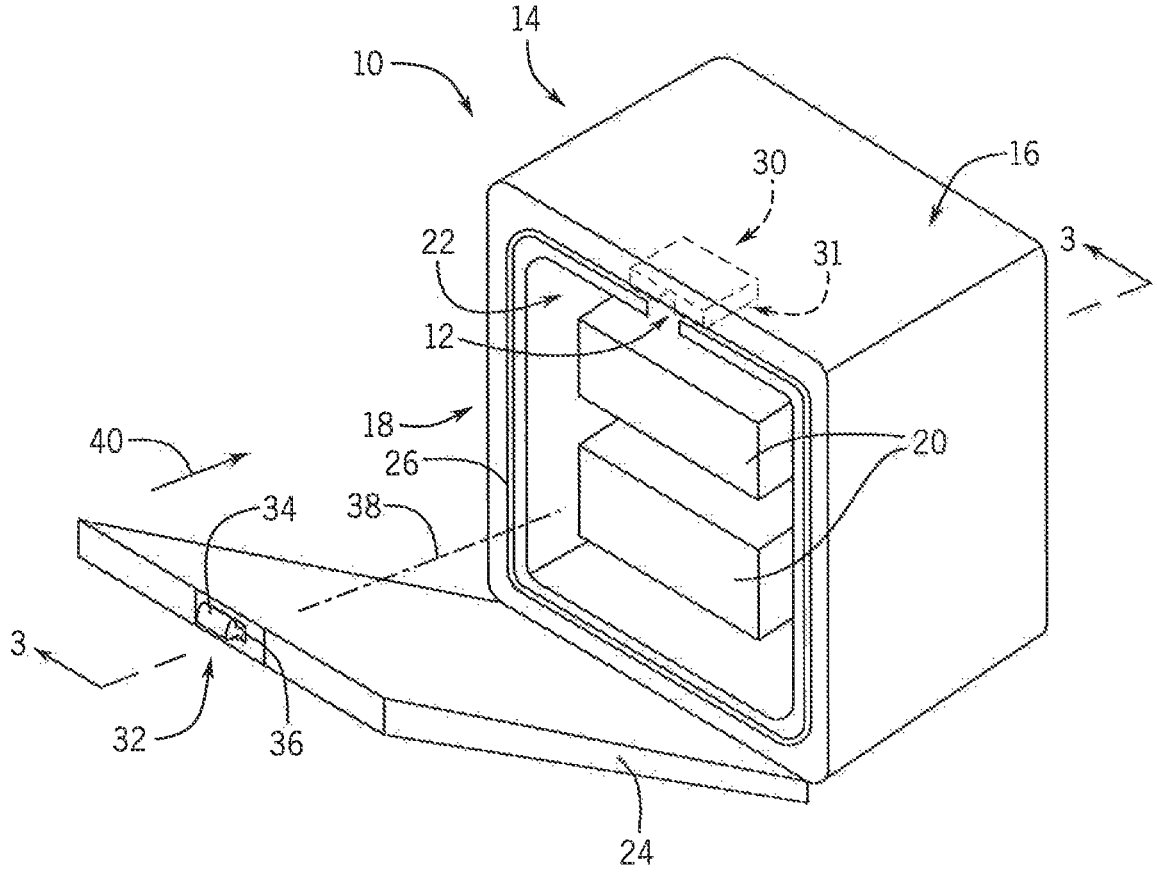


FIG. 1

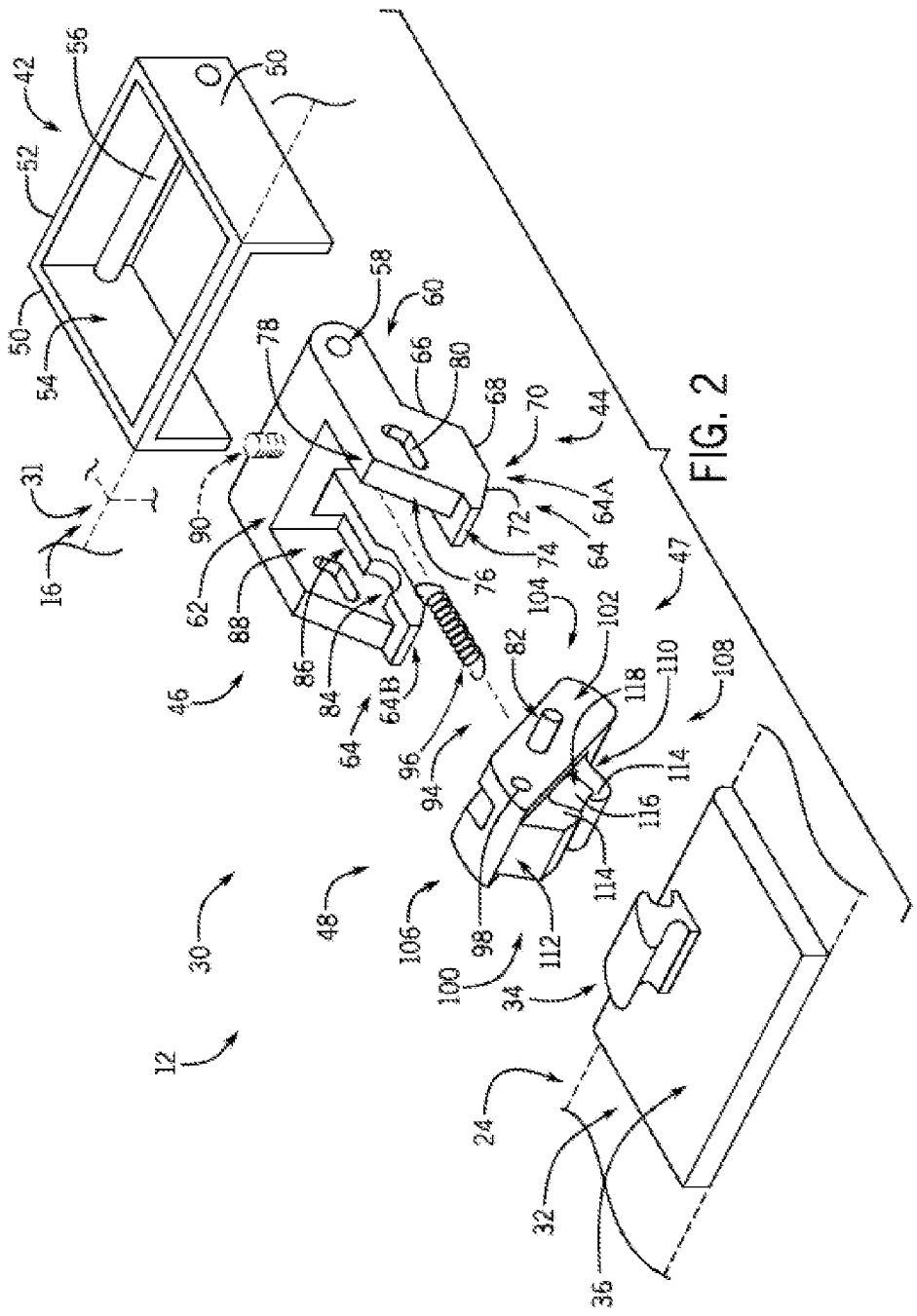

42
56
50
52
50
54
58
60
66
80
68
70
44
78
31
90
72
64A
16
62
88
74
64
47
76
104
102
46
86
84
64B
82
118
110
108
64
96
94
114
116
114
48
106
98
112
30
100
34
12
24
32
36

FIG. 2

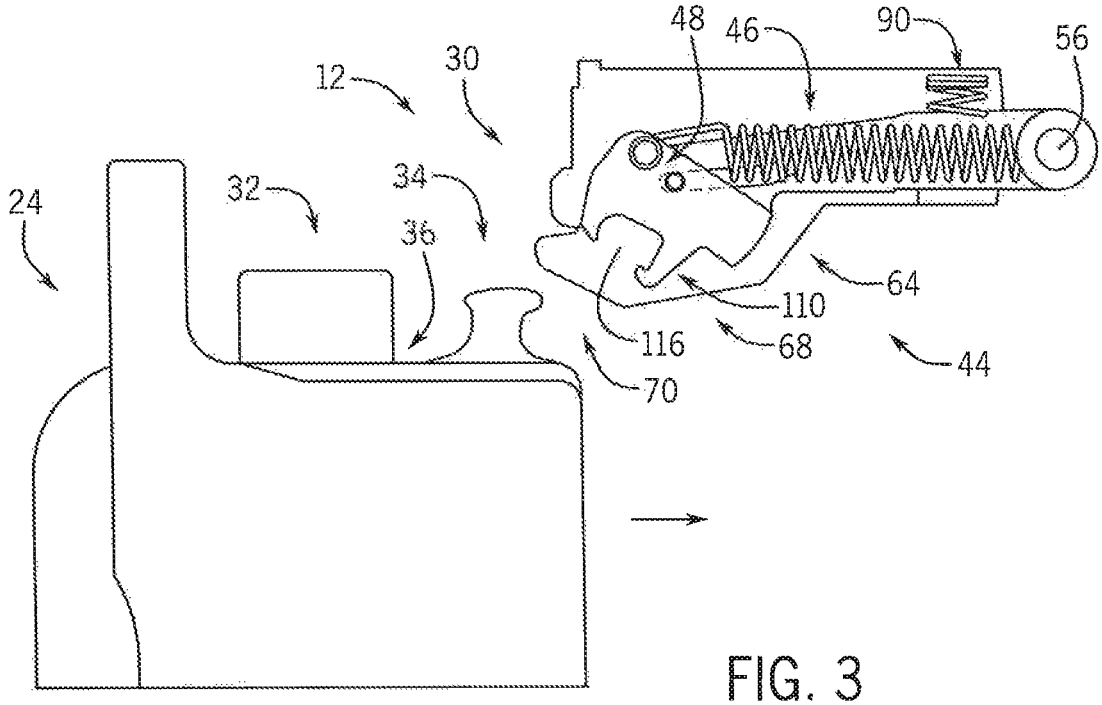

48
46
90
56
12
30
24
32
34
36
64
110
116
68
44
70

FIG. 3

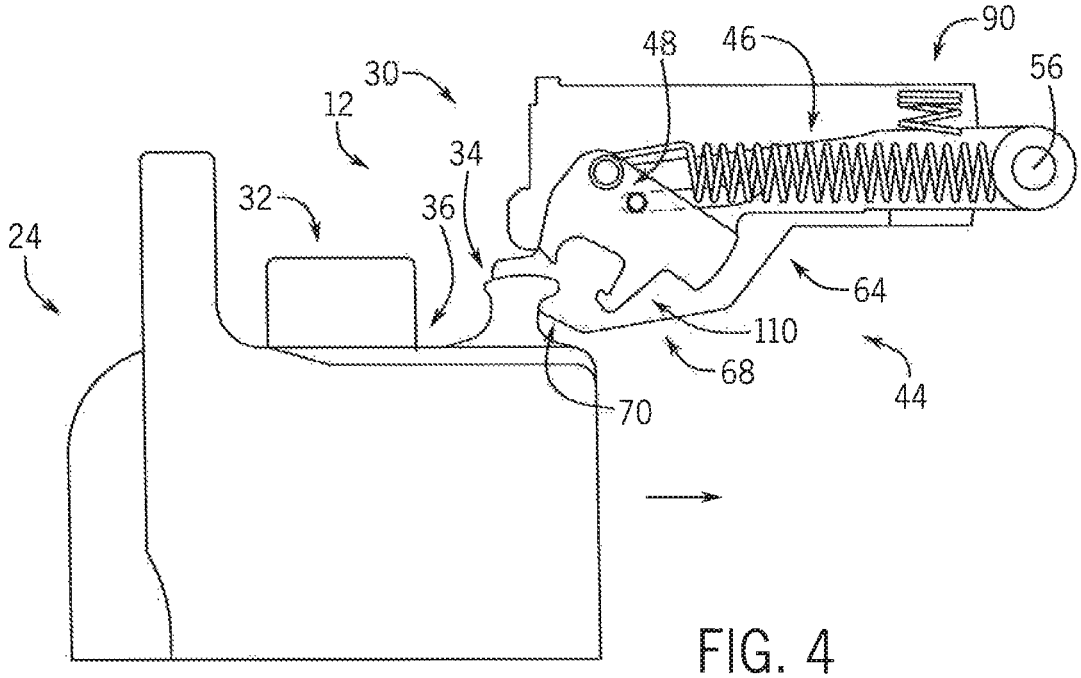

90
48
46
56
30
12
34
32
36
24
64
110
68
44
70

FIG. 4

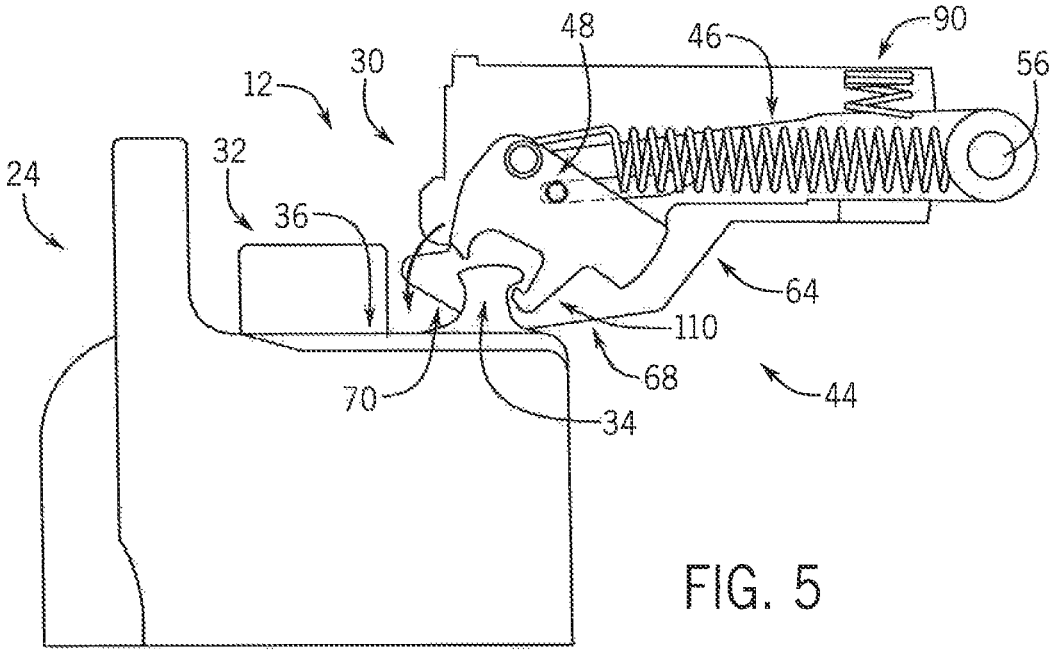

48
46
90
30
12
56
24
32
36
64
110
68
70
44
34

FIG. 5

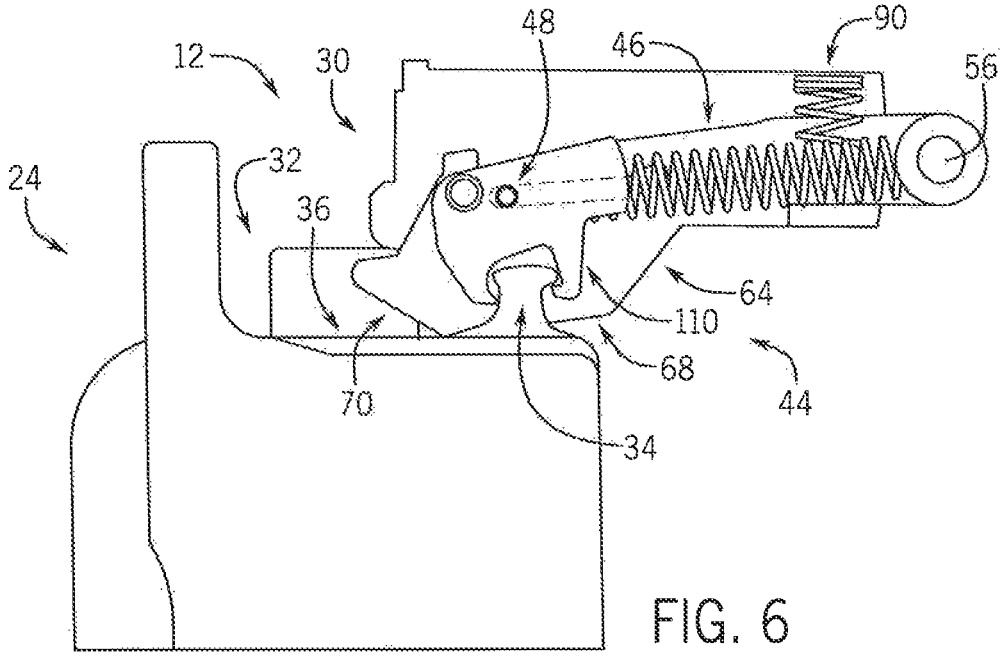

48
46
90
12
30
56
24
32
36
64
110
68
70
44
34

FIG. 6

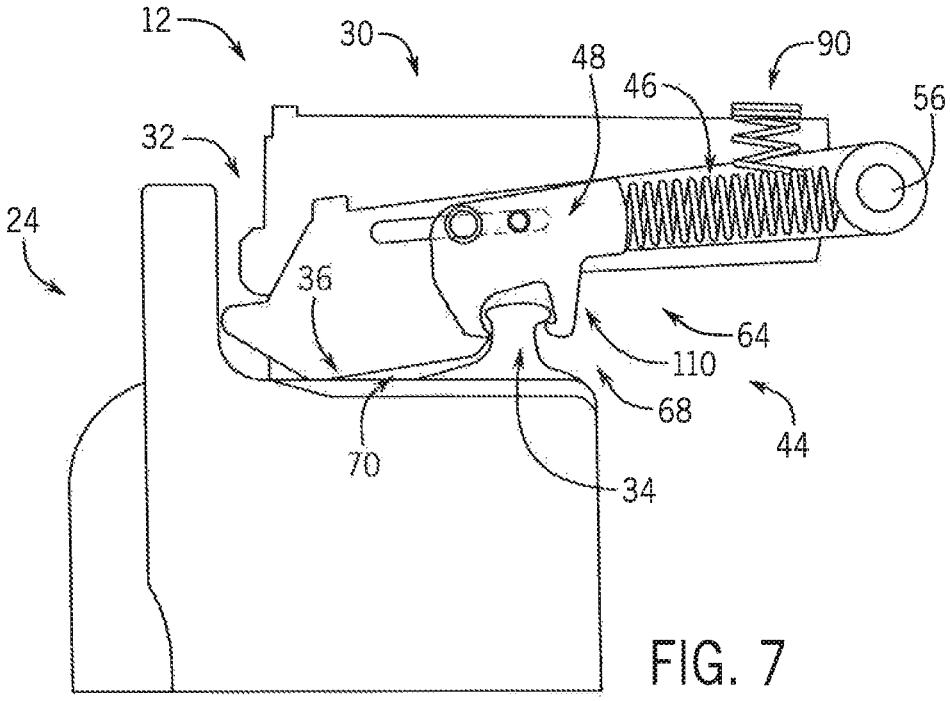


FIG. 7

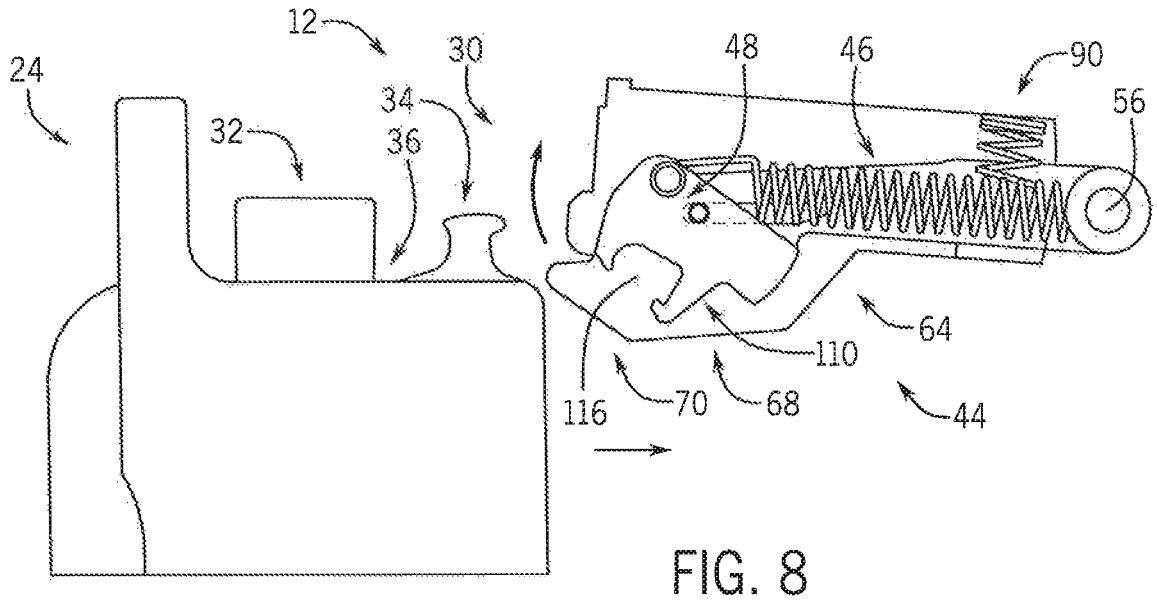

12
30
48
46
90
24
34
56
32
36
64
110
116
70
68
44

FIG. 8

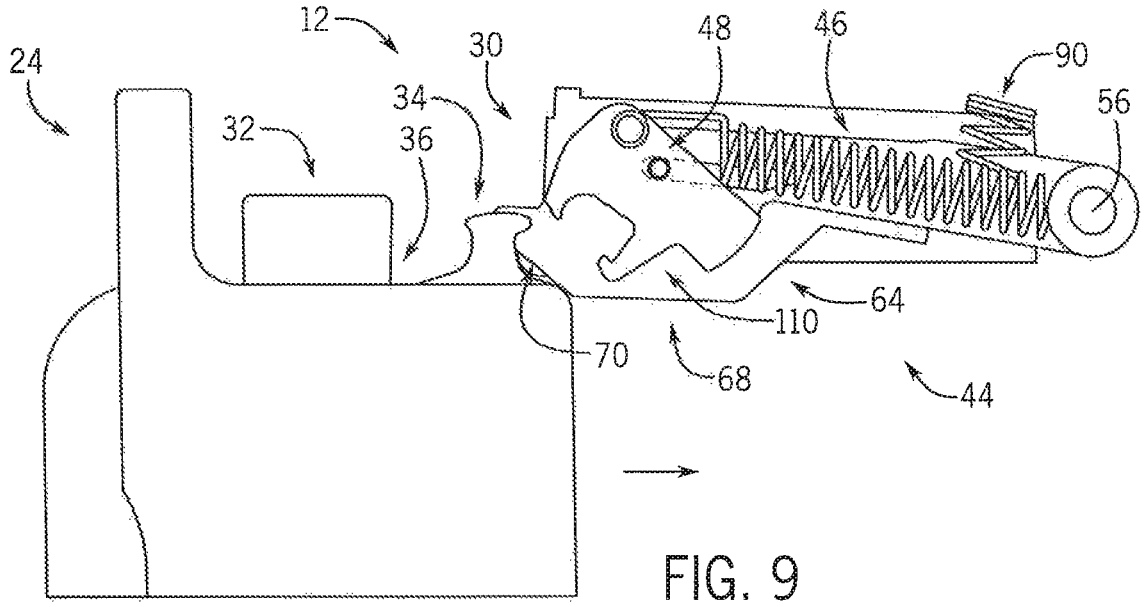

12
30
48
46
90
24
34
56
32
36
64
110
70
68
44

FIG. 9

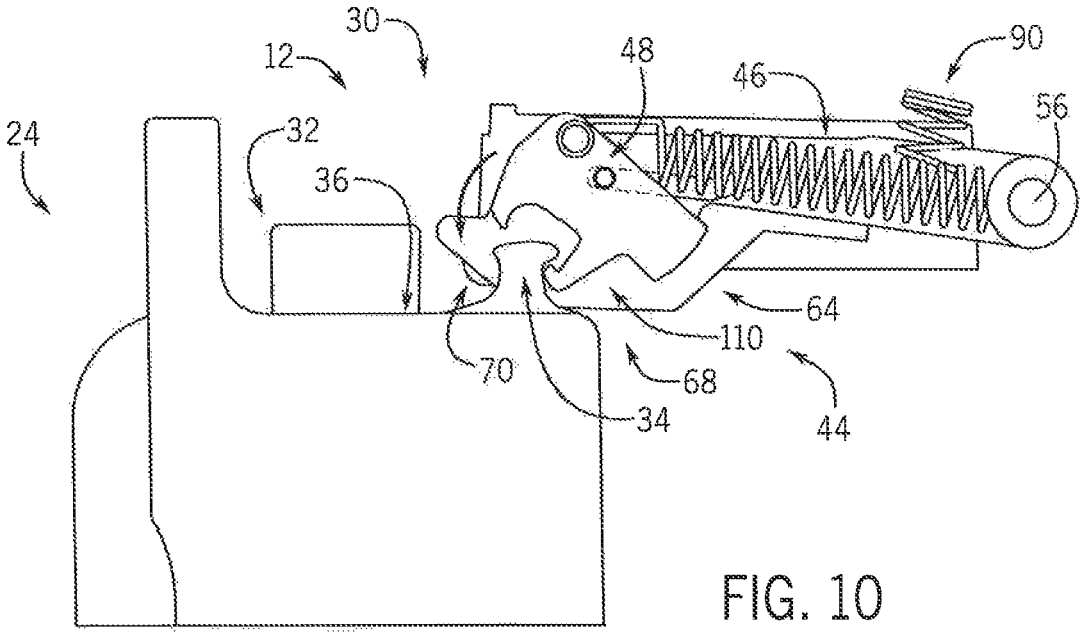

30
12
48
46
90
56
24
32
36
64
110
70
68
34
44

FIG. 10

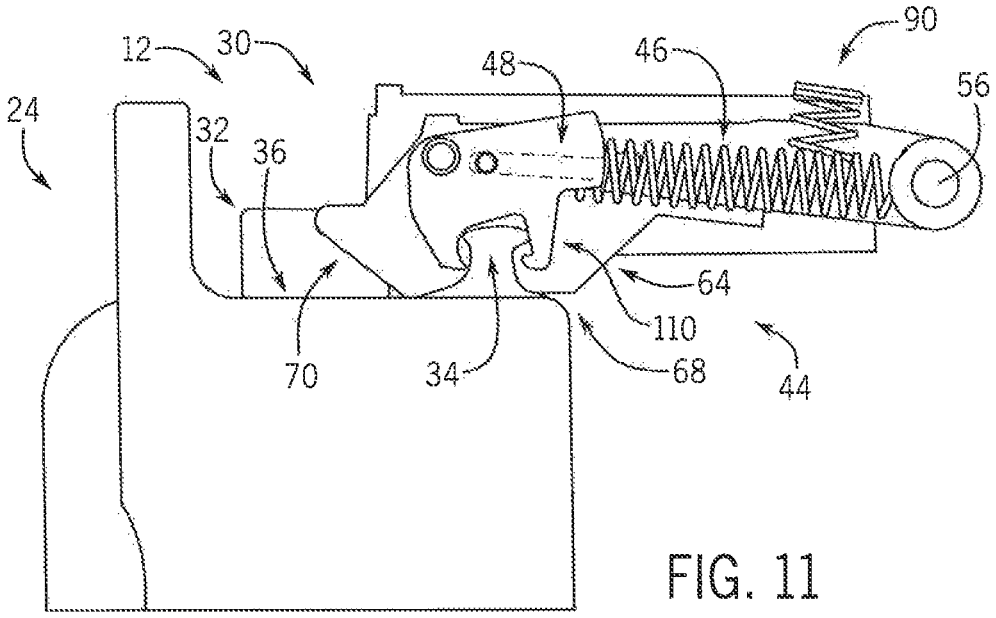

12
30
48
46
90
56
24
32
36
64
110
70
34
68
44

FIG. 11

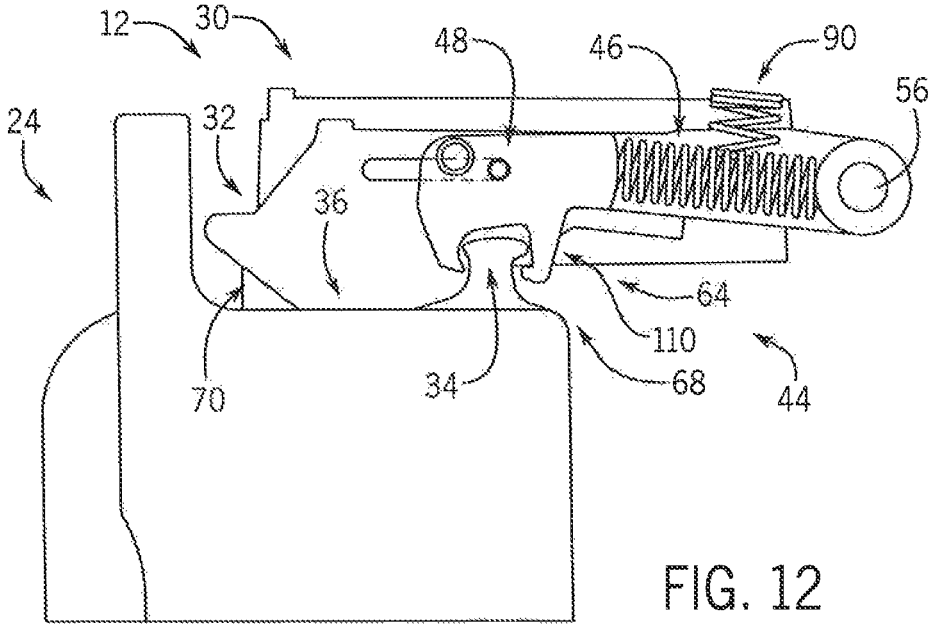


FIG. 12

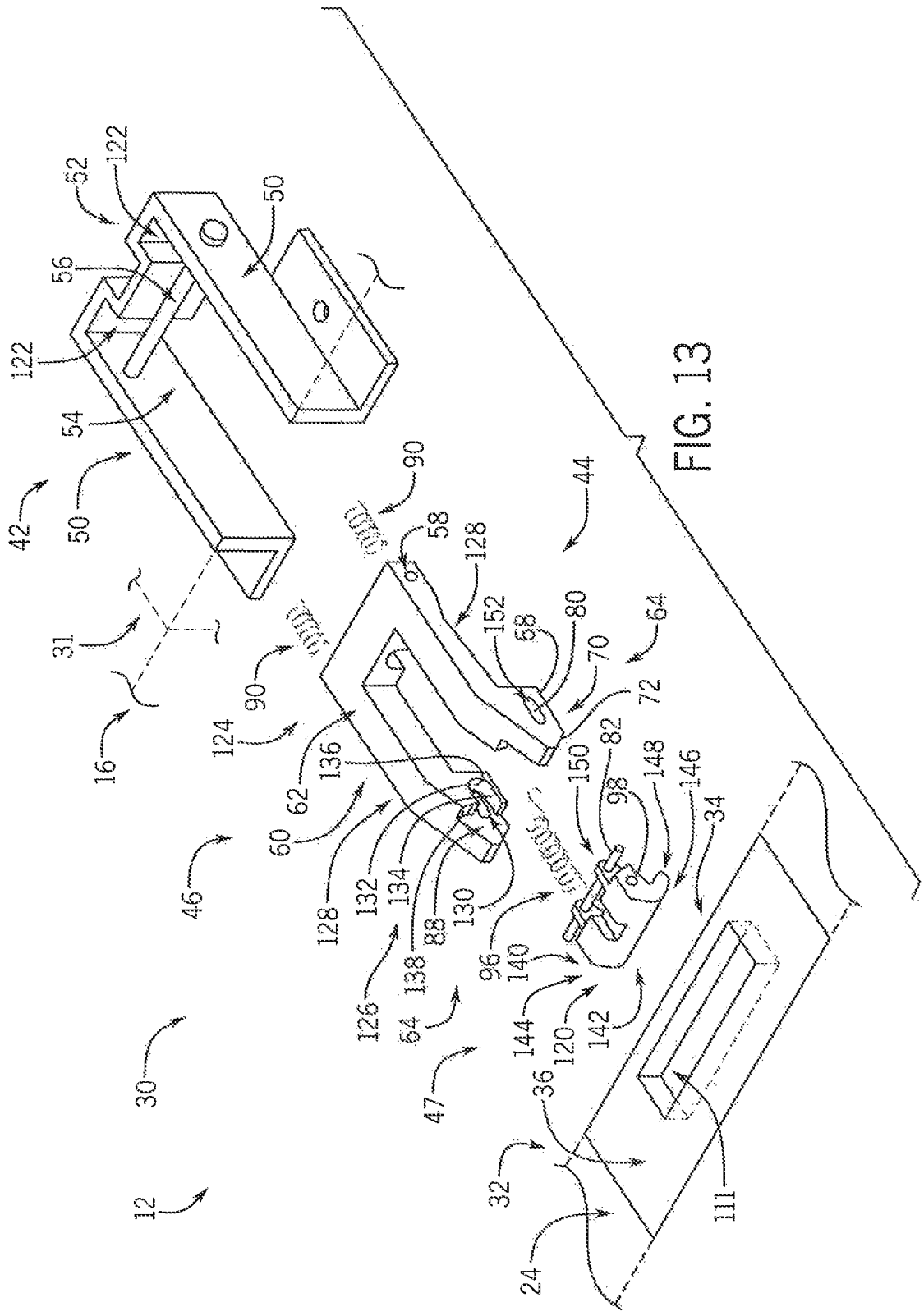

52
122
56
50
122
54
50
42
31
16
90
124
90
58
128
44
152
68
80
64
70
72
62
136
60
128
132
134
88
130
46
82
150
98
148
146
34
96
140
144
120
142
126
138
64
47
30
12
36
32
24
111

FIG. 13

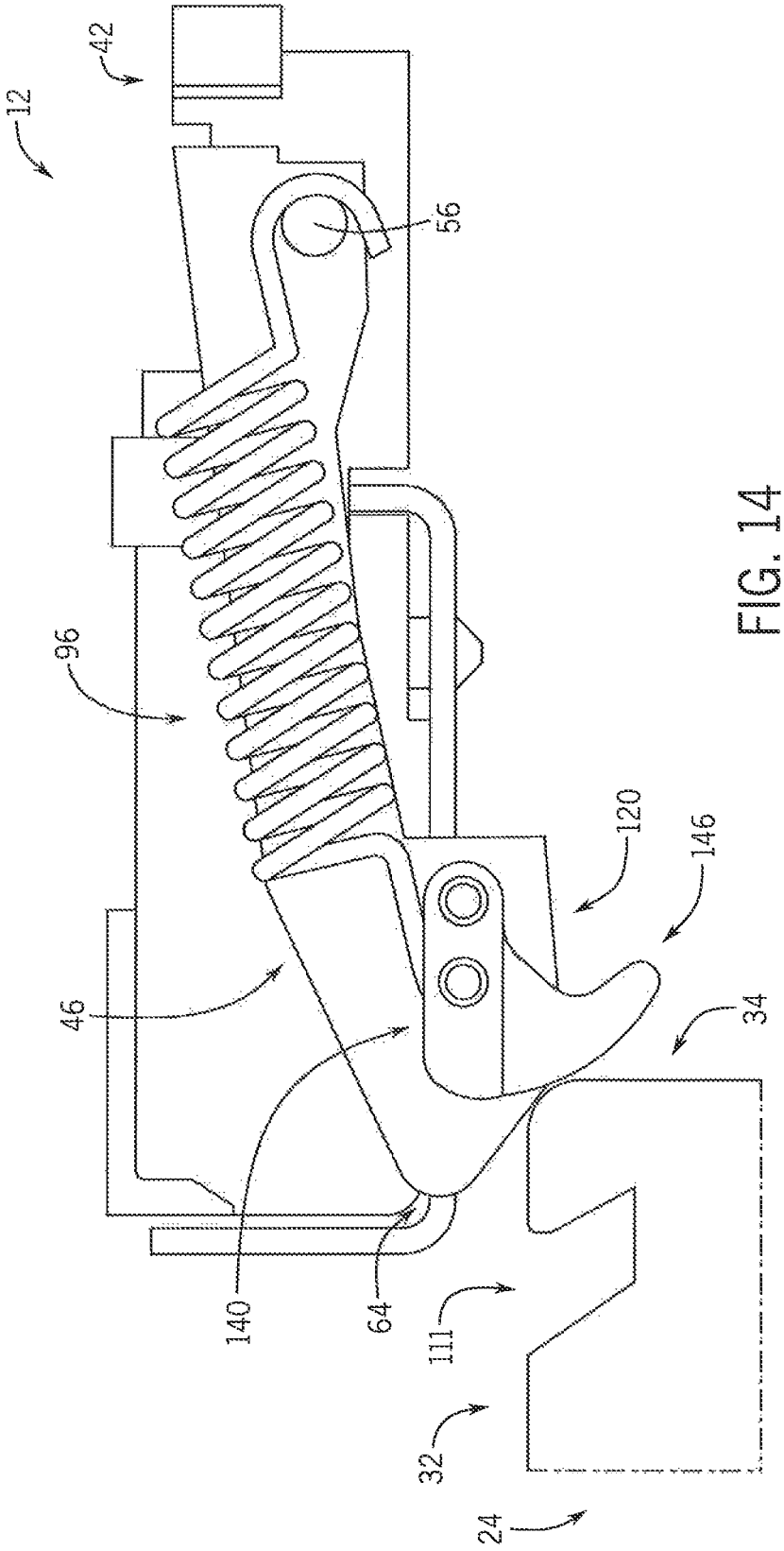


FIG. 14

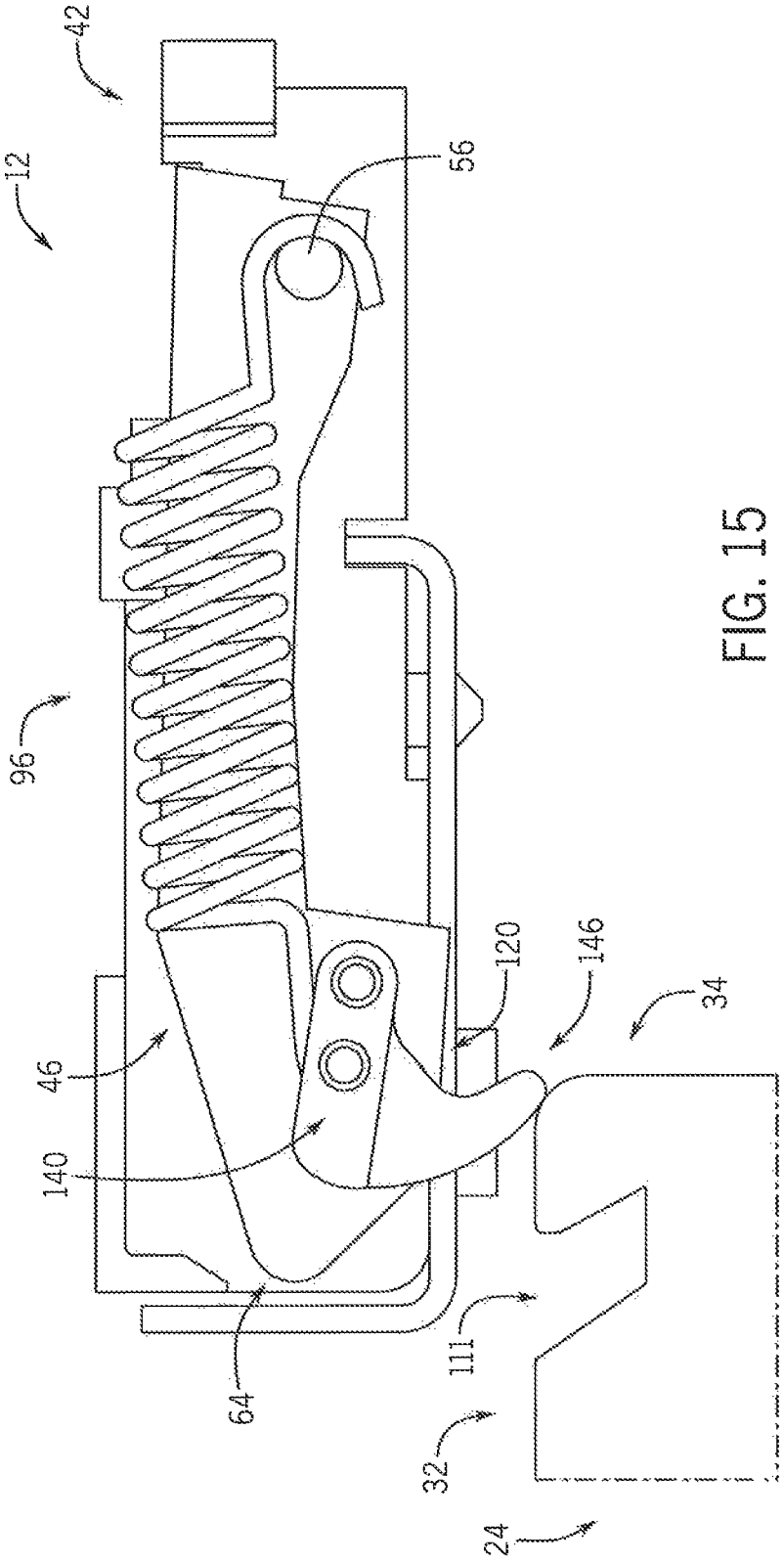


FIG. 15

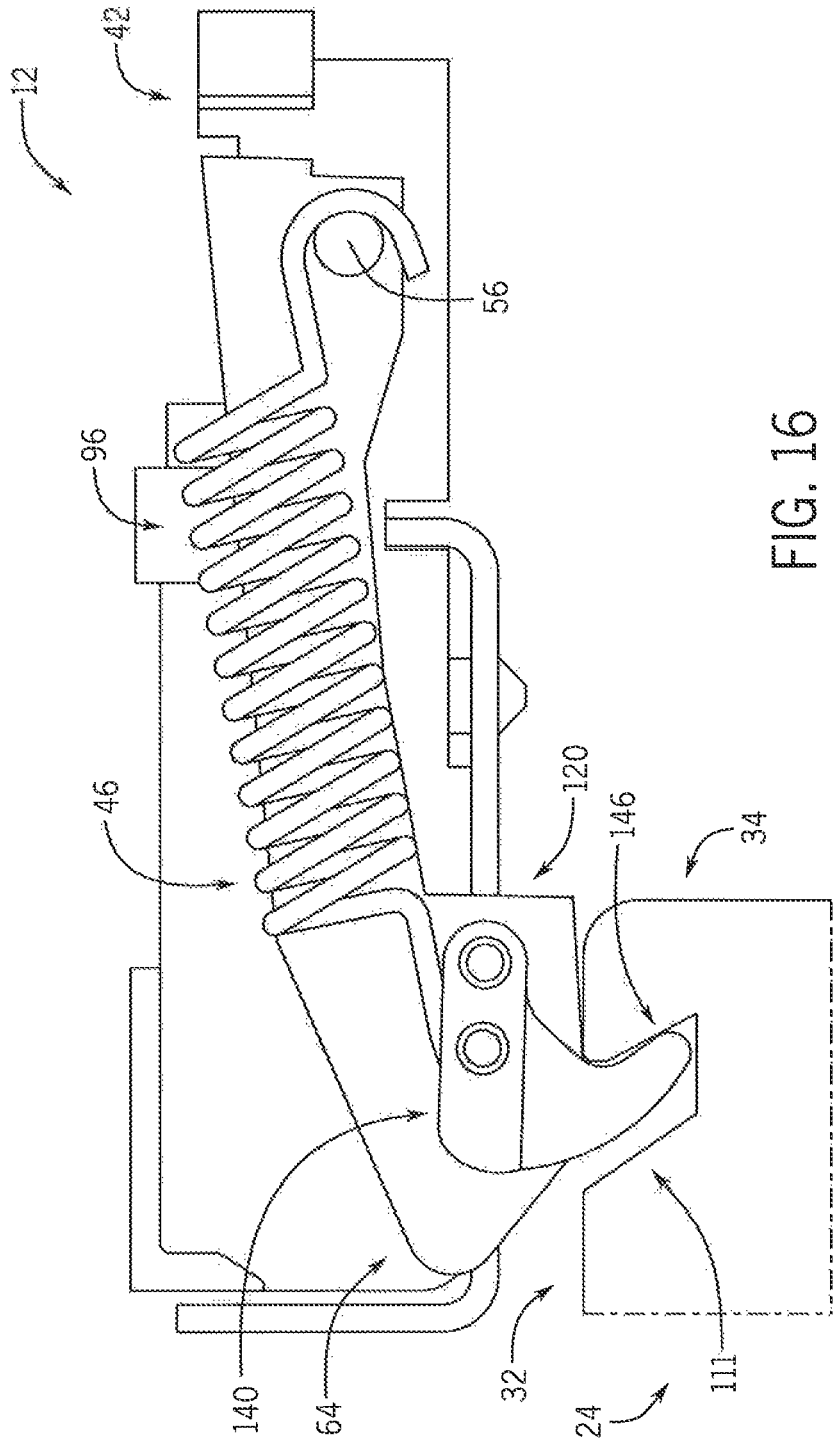


FIG. 16

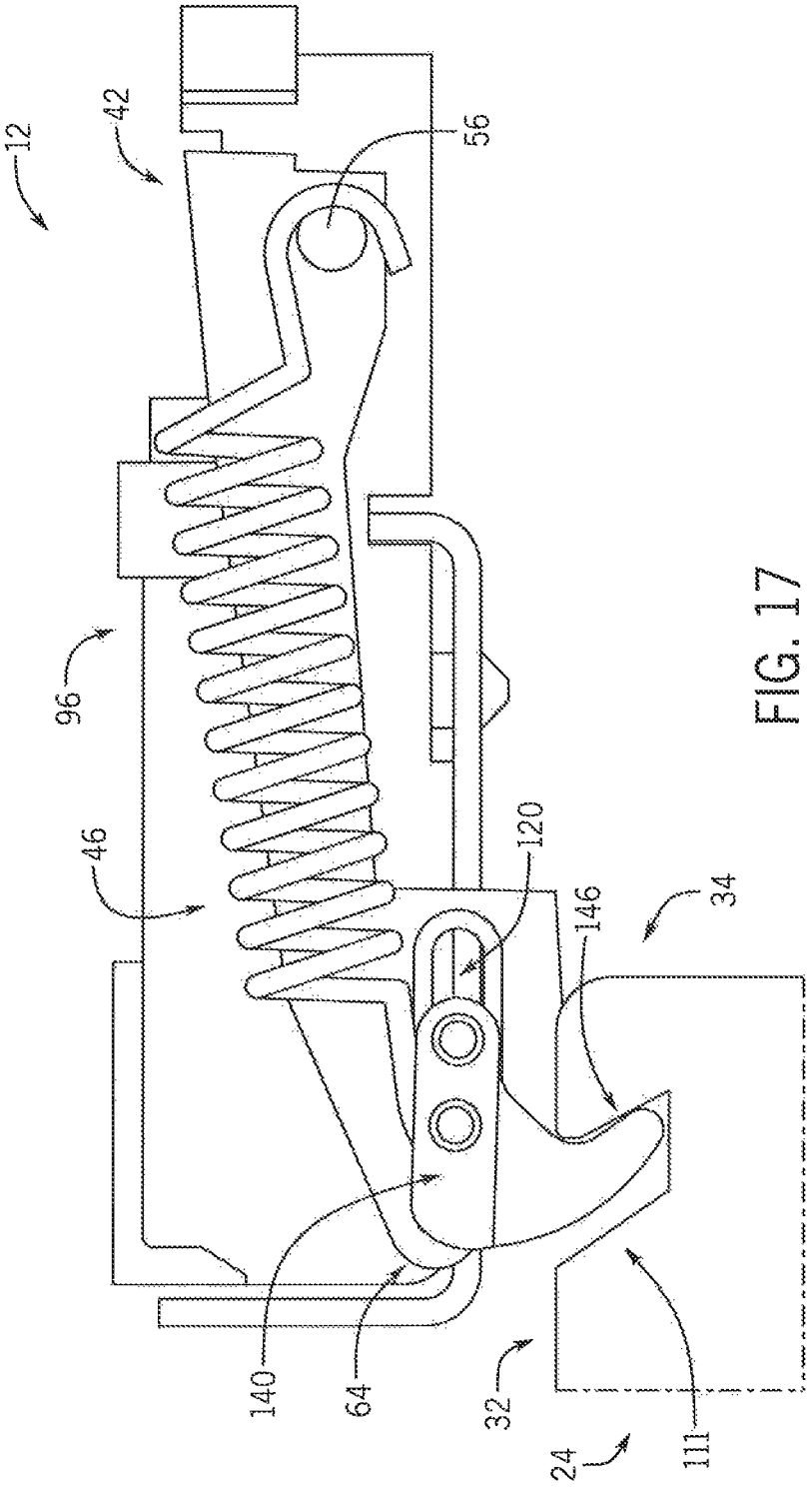


FIG. 17

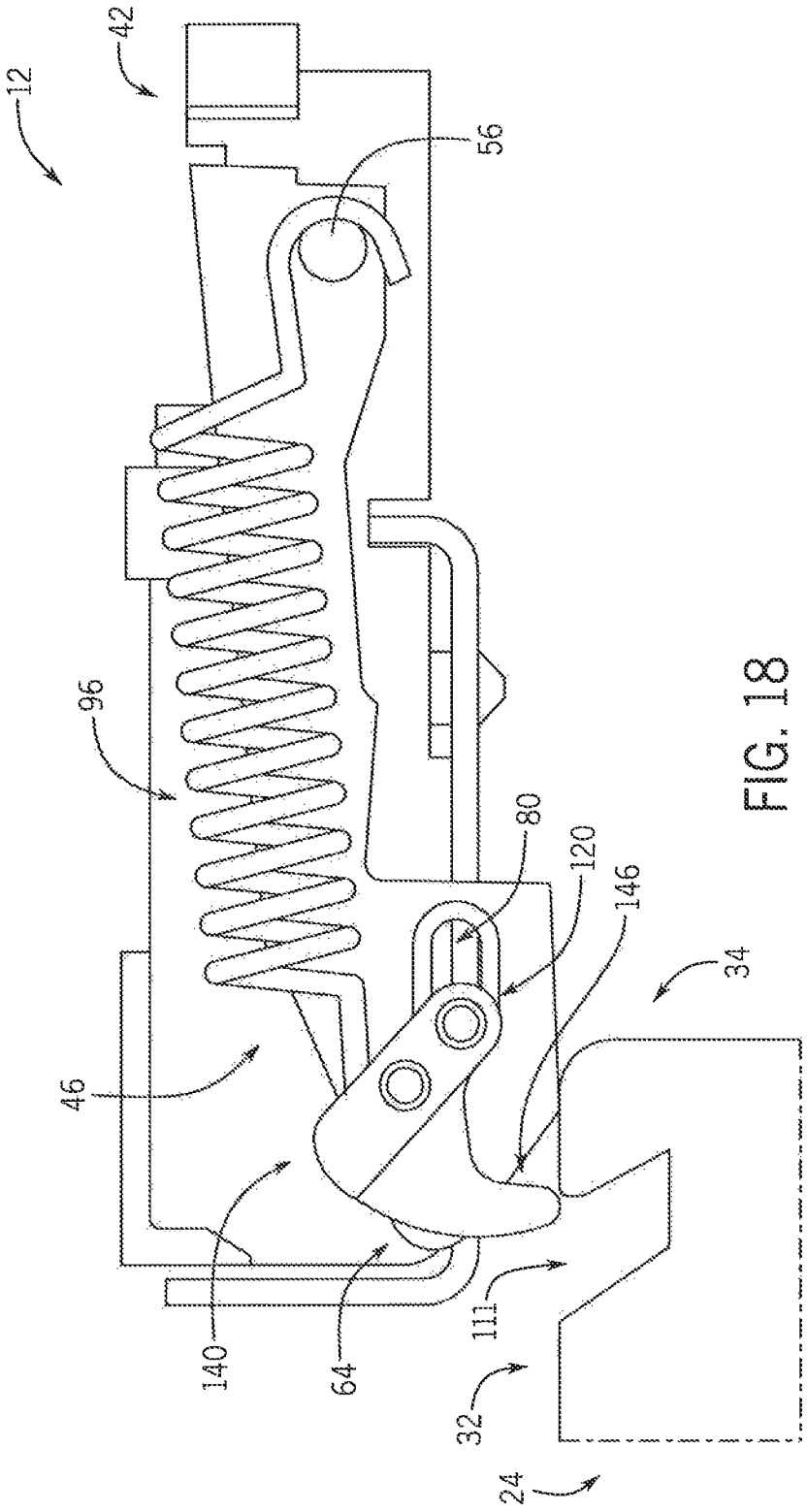


FIG. 18

APPLIANCE DOOR LATCH SYSTEM WITH PRE-LATCHING CATCH ALIGNMENT SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. provisional application 62/524,147 filed Jun. 23, 2017 and is hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to home appliances such as dishwashers and front-loading washing machines which may have access doors with latching mechanisms and to an appliance door latch system that provides consistent and quiet operation while accommodating door height variation.

BACKGROUND OF THE INVENTION

Appliances such as dishwashers and front-loading washing machines may have front access doors and latches that hold the doors shut to compress door gaskets to seal water within washing chambers of the appliances. In order to eliminate the need for a latch handle, it is known to use an over-center spring mechanism in an appliance door latch that toggles between a stable closed position and a stable open position when the door is pushed closed and pulled open. U.S. Pat. Nos. 9,487,976 and 7,306,266, assigned to the present assignee and hereby incorporated by reference, describe appliance door latches.

Appliance door height can vary between units, even within the same appliance model line. This is due to manufacturing and production or assembly variations. The variations include component size variations and alignment variations during assembly that collectively provide tolerance stack-ups. Door height variations can cause corresponding relative position variations between latch components such as latch strikers and latch cams or catches, which can lead to misalignment-related latching performance issues.

In order to accommodate these variations in latch component positions, the latch cams are typically made large with large slots that provide a relatively loose fit that are still operable despite potential component misalignment(s). Accordingly, the large and loose-fitting latch cams ensure that the latch cams can receive the strikers regardless of their assembled position(s). However, large latch components limit their mounting location options.

Over-center spring mechanisms are typically used to actuate latch cams, with springs that are energized as the doors are opened. However, when the springs release their energy as the doors close, loose-fitting latch cams can produce loud noises. That is because the large clearances between the strikers and cam surfaces in loose-fitting latch cams allow the over-center spring mechanisms to accelerate the closing rotation of the latch cams to speeds that allow the latch cams to collide with the striker with enough force to generate loud slapping or clunking noises.

SUMMARY OF THE INVENTION

The present invention provides an appliance door latch system that handles tolerance stack-ups and/or other manufacturing and production or assembly variations with small interacting components that provide a compact configuration that improves mounting placement and results in quiet operation.

Specifically, in one embodiment, the invention provides an appliance door latch system with a door-mounted latch feature such as a striker assembly or a receptacle supported by an appliance door. The striker assembly includes a striker that moves with the door toward and away from an appliance housing when the appliance door is moved between door closed and open positions. A latch mechanism receives the striker or other door-mounted latch feature(s) to secure the appliance door in the door closed position and releases the striker to release the appliance door when the door is opened. The latch mechanism includes a catch that selectively engages the striker or other door-mounted latch feature(s) for holding the appliance door in the door closed position. A pre-latching catch alignment system supports the catch and aligns the catch relative to the door-mounted latch feature(s) while the door is moved from the door open position toward the door closed position.

It is, thus, a feature of at least one embodiment of the invention to provide a mechanism for automatically aligning appliance door latch components.

The pre-latching catch alignment system may include a floating catch carrier that supports the catch. At least a portion of the floating catch carrier is movable with respect to the appliance housing when the floating catch carrier and/or catch engages the striker assembly or other door-mounted latch feature(s). The floating catch carrier may lift upwardly to accommodate the striker passing under the catch during an appliance door latching event in which the striker or other door-mounted latch feature(s) is inserted into the latch mechanism. The floating catch carrier may include an inner end that faces away or is further from the appliance door and an outer end that faces or is closer to the appliance door. The floating catch carrier outer end may provide the height-adjusting movement by pivoting upwardly when the striker passes under it during the appliance door latching event.

The floating catch carrier may be spring biased to a first position against a stop and includes a sloped guide surface receiving a feature of the striker assembly or, for example, a surface of door itself, to move the floating catch carrier away from the stop against the spring biasing to position the catch carrier into alignment with the striker or other door-mounted latch feature(s) as the door is closed. The surface or feature may be offset a predetermined distance from the reminder of the striker or door-mounted latch feature(s). In a striker implementation of the door-mounted latch feature, this may include being offset from the striker toward the floating catch carrier to bring the catch carrier into alignment before the catch reaches the striker.

It is, thus, a feature of at least one embodiment of the invention to provide components with cooperating configurations to align the catch to the door-mounted latch feature(s) before they contact each other, such as before a catch-to-striker contact.

It is, thus, a feature of at least one embodiment of the invention to provide a mechanically simple mechanism for aligning appliance door latch components by way of a floating component(s) that is pushed into a correct position during a door latching event.

The catch may be a pawl with a pawl body that is connected to the floating catch carrier and a pawl claw that extends from the pawl body. The pawl claw may selectively engage a receptacle as the door-mounted latch feature(s) to latch the appliance door in the door closed position. The

pawl may be movable between a pawl lowered position and a pawl raised position. When in the pawl lowered position, a tip of the pawl claw may extend downwardly beyond a lower surface of the floating catch carrier, such as a bottom wall of the floating catch carrier, to define a first tip position. When in the pawl raised position, the tip of the pawl claw may define a second tip position that is raised relative to the first tip position, such as at the same height or higher than the bottom wall of the floating catch carrier. The pawl may move from the pawl lowered position to the pawl raised position to accommodate an upper door edge or other surface or feature that moves in unison with the door passing under the floating catch carrier during an appliance door unlatching event in which the door-mounted latch feature(s) is withdrawn from the latch mechanism. The pawl may be pivot-mounted to the floating catch carrier so that the pawl pivots between the lowered and raised positions. The pawl may be biased toward the pawl lowered position and, therefore, in a normally lowered position. The pawl may be movable between retracted and extended positions. When in the retracted position, the pawl body is arranged relatively farther inward relative to the appliance housing or away from the door. When in the pawl extended position, the pawl body is arranged relatively farther outward relative to the appliance housing or moved outwardly from the retracted position. A translation joint between the pawl and the floating catch carrier may allow relative movement between the pawl and the floating catch carrier and guide the movement of the pawl between the pawl retracted and extended positions. The translation joint may include a slot that extends longitudinally along the floating catch carrier and provides a pathway along which the pawl moves. A pin may extend transversely through and be mounted to move longitudinally within the slot in the floating catch carrier to connect the pawl to the floating catch carrier at the translation joint. The pin may also define a pivot axis of the pawl to allow the pawl to move both longitudinally and pivotally with respect to the floating catch carrier. The pawl may be biased toward the retracted position so that the pawl is normally retracted in a seated position.

It is, thus, a feature of at least one embodiment of the invention to provide a catch of simple construction, such as a pawl, that can default to a latched position and be pulled away from the latched position during the unlatching event.

In another embodiment, the invention provides a dishwasher with a height-correcting latch mechanism adapted to receive a striker or other door-mounted latch feature(s) to secure the appliance door in the door closed position and release the striker to release the appliance door to permit movement of the appliance door to the door open position. The latch mechanism may include a catch and a floating catch carrier that support the catch and at least a portion of which is movable with respect to the appliance housing. This may automatically provide height adjustment of the catch to vertically align the catch with the striker or other door-mounted latch feature(s) during a door-latching event in which the striker or other door-mounted latch feature(s) is inserted into the latch mechanism.

It is, thus, a feature of at least one embodiment of the invention to provide a dishwasher with an automatic height-adjusting door latch system of simple construction.

In another embodiment, the appliance door latch system may include an over-center spring mechanism, a cam-type catch, and a floating catch carrier implemented as a floating cam carrier that automatically moves the cam to a position that properly aligns a cam with a striker or other door-mounted latch feature(s) during a latching event, regardless of the striker's position. The floating cam carrier includes an alignment block that, during a latching event, contacts the striker assembly or other door-mounted latch feature(s) before the cam and slides across the striker assembly or other door-mounted latch feature(s) to deflect the floating cam carrier and automatically align a cam opening with the striker or other feature to provide a constant height between the cam and door-mounted latch feature. This ensures consistent points of engagement between cams and strikers or other latch features despite differences in relative positions caused by manufacturing and production or assembly variations, which allows for providing cams and strikers or other door-mounted latch features with tighter fits. Cams and strikers or other door-mounted latch features that fit tighter against each other produce less noise during latching events. The invention may also ensure proper alignment of close-fitting cams and strikers or other door-mounted latch features by ensuring consistent points of engagement even though latch component positions may have changed over time due to such things as component wear in appliance door hinges or other system joints or changes in compliance or other wear characteristics of door gaskets. By ensuring consistent cam-to-striker or other feature alignment by passively adjusting cam height to a proper height relative to the striker or other feature, smaller cams can be implemented that provide shorter overall latch assembly heights, permitting installation in locations that would otherwise be challenging, such as between the top of a washer tub and an underside of a countertop surface.

It is, thus, a feature of at least one embodiment of the invention to provide a catch of simple construction, such as a cam, that automatically vertically floats to reposition the cam for proper alignment during a latching event.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims, and drawings in which like numerals are used to designate like features.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified isometric view of an appliance that incorporates the appliance door latch system with a pre-latching catch alignment system;

FIG. **2** is an exploded isometric view of a first embodiment of the appliance door latch system of FIG. **1**;

FIG. **3** is a cross-sectional view of the appliance door latch system of FIG. **2** with a first mounting height variation of a striker assembly and an unlatched cam;

FIG. **4** is another cross-sectional view of the appliance door latch system of FIG. **3** with the door advanced farther toward a closed and latched position;

FIG. **5** is another cross-sectional view of the appliance door latch system of FIG. **3** with the door advanced yet farther toward a closed and latched position;

FIG. **6** is another cross-sectional view of the appliance door latch system of FIG. **3** with the door advanced yet farther toward a closed and latched position;

FIG. **7** is another cross-sectional view of the appliance door latch system of FIG. **3** with the door in a fully closed and latched position;

FIG. **8** is a cross-sectional view of the appliance door latch system of FIG. **2** with a second mounting height variation of a striker assembly and an unlatched cam;

FIG. **9** is another cross-sectional view of the appliance door latch system of FIG. **8** with the door advanced farther toward a closed and latched position;

FIG. **10** is another cross-sectional view of the appliance door latch system of FIG. **8** with the door advanced yet farther toward a closed and latched position;

FIG. **11** is another cross-sectional view of the appliance door latch system of FIG. **8** with the door advanced yet farther toward a closed and latched position;

FIG. **12** is another cross-sectional view of the appliance door latch system of FIG. **8** with the door in a fully closed and latched position;

FIG. **13** is an exploded isometric view of a second embodiment of the appliance door latch system of FIG. **1**;

FIG. **14** is cross-sectional view of the appliance door latch system of FIG. **13** at the beginning of a latching event;

FIG. **15** is another cross-sectional view of the appliance door latch system of FIG. **13** further into the latching event;

FIG. **16** is another cross-sectional view of the appliance door latch system of FIG. **13** at the end of the latching event or beginning of an unlatching event;

FIG. **17** is another cross-sectional view of the appliance door latch system of FIG. **13** further into the unlatching event; and

FIG. **18** is another cross-sectional view of the appliance door latch system of FIG. **13** yet further into the unlatching event.

Before the embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of "including" and "comprising" and variations thereof is meant to encompass the items listed thereafter and equivalents thereof, as well as additional items and equivalents thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. **1**, an appliance **10** is shown incorporating an appliance door latch system **12**. Appliance **10** is shown here as dishwasher **14**, although it is understood that appliance door latch system **12** may be provided on a different type of appliance **10**, such as a washing machine. Appliance **10** includes a housing **16**, such as a dishwasher housing when the appliance **10** is a dishwasher **14**, that may have a front opening **18**. In the case of a dishwasher **14**, front opening **18** exposes one or more dish racks **20** for holding dishes or the like for washing within an inside space or housing volume **22**. A door **24** may be hingeably attached to the front of the housing **16** to seal against the front of the housing **16** by compressing intervening peripheral gasket **26** encircling the front opening **18**.

Appliance door latch system **12** has cooperating components arranged at housing **16** and door **24**, including latch mechanism **30** that is mounted to housing **16** and door-mounted latch feature shown here as a striker assembly **32** that is mounted to door **24**. Latch mechanism **30** may have a latch mechanism housing **31** as an enclosure that surrounds the components of the latch mechanism while permitting various latch mechanism **30** components to interact with the striker assembly **32**, such as through an opening in a front wall of the latch mechanism housing **31**. Striker assembly **32** includes striker **34** that may be a projection, such as a pin or the like, shown here with necked-down narrower lowering intermediate sections and wider outer or top end that presents a generally T-shaped form in cross-section. Striker **34** may extend upwardly from a striker plate **36**, shown here with a rounded front edge, at an upper end or edge of door **24**. Striker **34** is received in the latch mechanism **30**, explained in greater detail elsewhere herein, along a horizontal axis **38** in a receiving direction **40** (parallel to horizontal axis **38**). Once so received, striker **34** is retained within latch mechanism **30** to hold the door **24** in a closed position during the washing cycle with a sealing compression of the gasket **26**.

Referring now to FIG. **2**, a first embodiment of a latch mechanism **30** is shown here with its components that may be enclosed by the latch mechanism housing **31** (FIG. **1**). The latch mechanism **30** may include a latch frame shown as latch base **42** that supports a pre-latching alignment system **44**, represented here as a cam pre-engagement or cam pre-latching alignment system. The pre-latching alignment system **44** may include a swing arm or floating catch carrier **46** that carries a catch **47** for engaging the striker **34** to latch the appliance door closed. Catch **47** is shown here with a cam configuration as cam **48**. The pre-latching alignment system **44** automatically vertically aligns and provides a constant relative height between cam **48** and striker **34** during latching events in which door **24** closes and latches shut. Latch base **42** may be mounted in a forward-facing edge of a top wall of housing **16**. Latch base **42** has a boxlike configuration with interconnected walls shown as side walls **50** and back wall **52** that extend about the respective portions of a latch base interior **54**. A pin **56** extends through the latch base interior **54**, near back wall **52** and between side walls **50**, and extends into a bore(s) **58** toward the back of a catch carrier body **60** of the floating catch carrier **46** to define a pivot joint that pivotably holds the floating catch carrier **46** in the latch base interior **54**. The pre-latching alignment system **44** therefore provides the latch mechanism **30** and striker assembly **32** with features that engage and cooperate through various, for example, sliding interfaces that facilitate pre-alignment of the catch **47** to the striker **34** before they collide with each other during active latching.

Still referring to FIG. **2**, catch carrier body **60** is shown having base segment **62**, through which bore **58** extends. Base segment **62** is arranged toward the back of and extends across the width of catch carrier body **60**. At least one alignment block, generally referred to as alignment block **64**, is shown here as a pair of for first and second alignment blocks **64**A, **64**B, which are arranged toward the front of catch carrier body **60**. The alignment blocks **64**A, **64**B are shown transversely spaced from each and extend longitudinally from and lower than base segment **62** to provide a downward and forward-extending forked configuration to a front end of the catch carrier body **60**. Alignment blocks **64**A, **64**B, may be identical to each other. Only features of the lower-positioned (as shown in FIG. **2**) or first alignment block **64**A are labeled, but are applicable to the upper-positioned (as shown in FIG. **2**) or second alignment block-**64**B. Each alignment block **64**A may include a back lower surface **66** that extends angularly down from base segment **62**. An intermediate bottom surface **68** of alignment block **64**A extends from a front edge of back lower surface **66**. Alignment ramp **70** is shown defined by a front lower surface **72** of alignment block **64**A that connects at its front end to shelf **74** that has a forward-facing surface and an upper surface. Front upper surface **76** extends angularly up and rearward from shelf **74** and connects to the top wall **78** of alignment block **64**A.

Still referring to FIG. **2**, each alignment block **64** is shown with a slot **80** that is configured to hold and guide a pin **82** of cam **48** to movement of cam **48** in a longitudinal direction and angularly up and back toward the back of slot **80**. This provides a rearward and upward sliding movement path of cam **48** to push back and climb up and over striker **34** for permitting latching, if the cam **48** is improperly in a pivoted-down closed position before closing the door **24** instead of a proper pivoted-up open position as shown in FIG. **2**. Pins **82** extend through slots **80** and define a translation joint along which the cam **48** can advance and retract relative to the catch carrier **46**. Slots **80** are shown here with forward generally horizontal segments and rear angled segments that extends angularly back and upward from the forward slot segments. The catch carrier body **62** has various features that provide stops and movement guides that cooperate with corresponding features of the cam **48** to, for example, prevent the latch rotation at various states of operation and provide discrete cam **48** positions and guide its movement between unlatched and latched positions. Below slots **80**, carrier sockets **84** may be defined in the catch carrier body **62**, shown here extending downwardly into inner carrier shelves **86** of the alignment blocks **64** that may extend longitudinally along the alignment blocks **64** and transversely inward, into a space **88** between the alignment blocks **64**. Sockets **84**, only one of which is visible in FIG. **2**, may have generally V-shaped configurations and may have straight front socket walls that extend angularly back and down from the top surface of the shelves **86** and curved back socket walls that extend from the bottom edge of the front socket wall upward to the shelves **86**. The angles and contours of the sockets **84** may match those of surfaces of the back and bottom wall segments of the cam **48** so that the back of cam **48** can nest in the sockets **84** and angle upwardly from the catch carrier **46** when in an open or unlatched state. To achieve a closed or latched state, the cam **48** is rotated downwardly about pins **82** to a tripped position and the pins **82** move rearwardly through the slots **80** while the cam **48** is retracted into the interior space **88**. Movement of the cam **48** from its initially tripped position to its fully closed or latched position is guided by cooperating sliding surfaces, such as the lower surface or bottom wall of cam **48** that interfaces with and slides over the shelves **86**. This engagement between the bottom wall of cam **48** and the carrier shelves **86** further provides and anti-rotation feature that prevents the cam **48** from rotating until it is again pulled outwardly to an extended position, which allows the back of the cam **48** to clear the rear segment(s) of the shelves **86** and rotate down into the catch socket(s) **84**. Spring **90** is arranged at a top surface of carrier body base segment **62** for biasing the floating catch carrier **46** to pivot downwardly about a pin **56**, in a default state, whereby, at rest and when unlatched, the floating catch carrier **46** is pivoted down by spring **90**, shown as a compression spring, and the back of cam **48** is nested within the sockets **84**. This may allow the floating catch carrier **46** may be spring biased, for example by spring **90**, to a first position such as a downward position against a stop. The sloped guide surface of the alignment ramp **70** receives a feature of the striker assembly **32** to move the floating catch carrier **46** away from the stop against the spring biasing to position the floating catch carrier **46** into alignment with the striker **34** as the door **24** is closed, which may be before engagement of the cooperating components that latch as a pre-engagement alignment.

Still referring to FIG. **2**, latch mechanism **30** is shown with over-center spring mechanism **94** that includes spring **96**, shown as a tension spring. Over-center spring mechanism **94** is configured to operate the cam **48** in a bi-stable mode in which the cam **48** has two stable states which positions are defined by the cam **48** pivoted up into an open or unlatched position and the cam **48** pivoted down into a closed or latched position. To provide the bi-stable operation, a front end of spring **96** is connected to cam **48** beyond its pivot axis defined by pins **82**, shown here as connected to spring pin **98**, and a back end of spring **96** is connected behind cam **48**, such as pin **56**.

Still referring to FIG. **2**, cam **48** includes cam body **100** with a pair of sides **102** (only one of which is visible in FIG. **2**) from which pins **82** extend, and back and front ends **104**, **106** respectively facing toward and away from back wall **52** of latch base **42**. Cam body **100** has a top and an opposite bottom, with a clasp **108** extending from the bottom of cam body **100**. Clasp **108** includes back tooth **110** and front tooth **112** that are spaced from each other and each of which may have a projection **114** facing inwardly to define a clasp opening **116** between the projections **114**. Clasp opening **116** permits access into a clasp interior space **118** between the back and front teeth **110**, **112**. A perimeter shape of **118** corresponds to a perimeter shape of striker **34** so that striker **34** can nest tightly in the clasp **108**. The height of the clasp opening **116** relative to alignment block intermediate bottom surface **68** may correspond to a height of striker **34** relative to striker plate **36** so that a floating action of floating catch carrier **46** allows for passive vertical (re)positioning of cam **48**, if needed, by face-to-face sliding abutment of the alignment block **64** and striker **34** to ensure receipt of striker **34** into the clasp interior space **118** through clasp opening **116**.

Referring generally to FIGS. **3-12**, various door closing and latching sequences are shown that illustrate how appliance door latch system **12** accommodates variation and striker height with pre-latching alignment system **44** by passively adjusting a height of cam **48** relative to striker **34** to provide a constant relative height between cam **48** and striker **34** before their engagement during latching events. FIGS. **3-7** represent an extreme low position of door **24** and striker **34**, such as with the door **24** and striker **34** assembled in their lowest possible position according to manufacturing and assembly variations with typical tolerances. FIGS. **8-12** represent an extreme high position of door **24** and striker **34**, such as with the door **24** and striker **34** assembled in their highest possible position according to manufacturing and assembly variations with typical tolerances.

Referring now to FIGS. **3-7** a latching event is shown with door **24** and/or striker **34** in their lowest positions. In this configuration, pre-latching alignment system **44** may operate without the floating catch carrier **46** passively adjusting the height of cam **48**. FIG. **3** shows that while closing door **24**, cam **48** is in its stable open or unlatched position. FIG. **4** shows that striker plate **36** passes slightly underneath or makes grazing contact with alignment block(s) **64**, such as at an edge defined by the intersection of the intermediate bottom surface **68** and ramp **70**. FIG. **5** shows door **24** closing farther, with striker **34** making the initial contact with cam **48** at the cam back tooth **110**. FIG. **6** shows door **24** after closing yet farther to its closed and latched position. Striker **34** is pushed against the cam back tooth **110** far enough to pivot cam **48** to its downward and stable closed or latched position. During this latching event, alignment block(s) **64** contact striker plate **36** before engagement of striker **34** and cam **48** without appreciable deflection of floating catch carrier **46** so that cam **48** remains in substantially the same height position during the latching event and the striker **34** is substantially aligned with the clasp opening

116 (FIG. 3) at the beginning of the latching event. FIG. 7 shows door 24 in a fully closed position, with the cam 48 moved rearwardly further into the floating catch carrier 46, as guided by pins 82 (FIG. 2) sliding through the slots 80 (FIG. 2). An unlatching event occurs in the opposite order, with the cam 48 slid forward through the floating catch carrier 46 and then rotated in the opposite direction to return to its stable open or unlatched position.

Referring now to FIGS. 8-12, a latching event is shown with door 24 and striker 34 in their highest positions. In this configuration, pre-latching alignment system 44 may operate with the floating catch carrier 46 passively adjusting the height of cam 48 to automatically lift the cam 48 to match the height of striker 34 before the cam 48 and striker 34 engage. The description of FIGS. 3-7, with respect to the lowest mounting position(s) of door 24 and/or striker 34, is applicable here with respect to FIGS. 8-12 with the highest mounting position(s) of door 24 and/or striker 34, only differs in the following ways. FIG. 8 shows vertical misalignment of striker 34 and cam 48. Striker 34 is positioned too high to be directly received into clasp opening 116. As door 24 is closed farther, the rounded leading edge of striker plate 36 contacts ramp 70, shown here with a point of initial contact toward the outer end of ramp 70 near shelf 74. A comparison of the positions of alignment block 64 in FIGS. 8 and 9 show that closing the door 24 farther from the point of initial contact between striker plate 36 and ramp 70 lifts the alignment block 64 through sliding contact as striker plate 36 slides across ramp 70, farther under alignment block 64. This lifts the cam 48 upwardly by deflecting the floating catch carrier 46 to pivot upwardly about pin 56 while overcoming the biasing force of and compressing the spring 90. Movement from the position(s) of FIG. 9 to that of FIG. 10 shows that, as door 24 continues to close, striker 34 advances toward cam 48, and an upper surface of striker plate 36 slides in face-to-face abutment under the alignment block intermediate bottom surface 68, and the floating catch carrier 46 may pivotally deflect upward slightly farther and striker 34 makes initial contact with cam 48 at the cam back tooth 110. FIG. 11 shows door 24 after closing yet farther to its closed and latched position. Striker 34 is pushed against the cam back tooth 110 far enough to pivot the cam 48 to its downward and stable closed or latched position. During this latching event, alignment block(s) 64 guide a passive height adjustment of cam 48 by engaging striker plate 36 before engagement of striker 34 and cam 48 and lifting the floating catch carrier 46 to pivot upwardly into a position that aligns striker 34 with the clasp opening 116 (FIG. 7) of cam 48. FIG. 12 shows door 24 in a fully closed position, with the cam 48 moved rearwardly further into the floating catch carrier 46, as guided by pins 82 (FIG. 2) sliding through the slots 80 (FIG. 2). Here again, the unlatching event occurs in the opposite order, with the cam 48 rotated in the opposite direction to return to its stable open or unlatched position.

Referring now to FIG. 13, a second embodiment of latch mechanism 30 and a second embodiment of striker assembly 32 are shown. Instead of the door-mounted latch feature having a projecting configuration like that in FIG. 2, this door-mounted latch feature is shown here with a recessed configuration with a receptacle 111 that extends downwardly into the top wall of door 24 or the door upper edge from the striker plate 36. The striker 34 is shown here defined by a front and/or upper edge of the door 24 inner panel that provides the intersection between the inwardly facing surface of the inner wall and the upper edge or upwardly facing surface of the top wall of door 24 that gets contacted by the latch mechanism 30 to automatically move the various components of latch mechanism 30 into proper alignment for door closure. Latch mechanism 30 of this embodiment is shown with its components that may be enclosed by the latch mechanism housing 31 (FIG. 1), which are mostly the same as those in FIGS. 2-12, whereby those descriptions are applicable here, only differing in the following ways.

Instead of a cam-type catch that is bi-stable in two positions, the latch mechanism 30 of FIG. 13 has no over-center spring mechanism and its catch 47 is shown here as a pawl 120 that is biased downwardly toward a neutral state in a locking position or pawl lowered position to hook into the receptacle 111 that is shown here embedded in the front door panel's upper edge. The latch frame or latch base 42 is shown with two spring pockets 122 recessed into its back wall 52 that receive a pair of horizontally arranged springs 90 that push against a back wall of the catch carrier body base segment 62. This biases the swing arm or floating catch carrier 46 about the pin 56 at its floating catch carrier back or inner end 126, which pivots the floating catch carrier front or outer end 124, pivoted downwardly. A pair of floating catch carrier arms 128 extend between the inner and outer ends 124, 126 to connect the base segment 62 to the alignment blocks 64. The back portions of the alignment blocks 64 have structures that control and limit movement of the pawl 120. Receptacles 130 have top and bottom walls 132, 134 and a curved back wall 136 that collectively define a sideways generally U-shaped opening that can receive and locate respective portions of the pawl 120. A stop 138 is defined by a surface that extends down and angularly back from the top wall of the alignment blocks 64 and connects to a front edge of the receptacle top wall 132.

Still referring to FIG. 13, pawl 120 includes a pawl body 140 with front and back ends 142, 144. A pawl claw 146 extends down and rearwardly with respect to the pawl body front end 142 and has a tip 148 that is arranged farthest from the pawl body 140. A pair of lobes 150 are spaced from each other and extend rearwardly from the back wall of the pawl body 140. The pin(s) 82, about which the pawl 120 can pivot, extends outwardly from each of the lobes 150, shown here extending through and beyond the sides of the lobes 150. A translation joint 152 is defined by the interconnection of pawl 120 and the floating catch carrier 46. Within the translation joint 152, pin(s) 82 defines a translatable pivot axis about which the pawl 120 can pivot with respect to the floating catch carrier 46 while permitting longitudinal movement. Pin(s) 82 are guided within the slot(s) 80 of the translation joint 152 for longitudinal translation with respect to the floating catch carrier 46. This arrangement allows the pawl 120 both pivot up and down and move back and forth in a front to back direction within the translation joint 152.

Still referring to FIG. 13, the translation joint 152 may allow for multiple discrete maximum movement positions of the pawl 120. The example shown here may be configured to provide three discrete maximum movement positions that correspond to three states of the pawl 120. A default or resting state is defined with the pawl 120 in a retracted position and a lowered position, such as a combined retracted and lowered position. In this resting or retracted state, the pawl 120 may be stably seated within the alignment block(s) 64. The pin(s) 82 may abut the back wall of the slot 80 and the lobes 150 may be nested in the receptacles 130 so that the receptacle top and bottom walls 132, 134 prevent pivoting of the pawl 120 when retracted, restricting movement to linear movement of the pawl 120 away from the receptacle back wall 136 against the force of spring 96. In an extended state, the pawl 120 is moved forward to a maximum forward position and the pin(s) 82 may abut a

front wall of the slot **80**. The pawl **120** may define an extended and lowered state in which the pawl **120** is in the extended position and remains pivoted down or in the same angular orientations as it was in the retracted state. This may position the tip of the pawl claw **146** in a first position so that it extends downwardly beyond a lower surface of the floating catch carrier, such as bottom wall **68** of the alignment block **64**. The pawl **120** may define an extended and raised state in which the pawl **120** is in the extended position and is pivoted up away from its position when in the lowered state. This may position the tip of the pawl claw **146** in a second position so that it is raised and points in a different direction relative to the first lowered position. To achieve this position, the pawl **120** may be pivoted up and rearward until further movement is prevented by an engagement between the pawl body **140** and the stop(s) **138** at the alignment block(s) **64**.

Referring now to FIGS. **14-16**, a latching event with automatic alignment is shown with the embodiment of the latch mechanism **30** and striker assembly **32** of FIG. **13**. FIG. **14** shows the floating catch carrier **46** and pawl **120** in their resting states, with the catch carrier **46** biased down and the pawl **120** biased down and back or in the pawl retracted and lowered position(s). During the latching event, initial contact occurs between the striker **34** and at least one of the floating catch carrier **46** and the pawl **120**, shown here contacting angularly intersecting or overlapping surfaces of the floating catch carrier **46** and the pawl **120** substantially simultaneously. FIG. **15** shows the floating catch carrier **46** pivoted upwardly as a function of the height of the door panel upper edge relative to the pawl **120**. Pawl **120** remains seated in the alignment block **64** and thus in the pawl lowered and retracted position so that the height correcting deflection is achieved through the upward pivoting of the floating catch carrier **46** while the door panel upper edge slides underneath the floating catch carrier **46** and pawl **120**. FIG. **16** shows the completed latching event. The pawl **120** has been pulled down into the receptacle **111** of the door panel upper edge, with the pawl claw **146** and an angled front wall of the receptacle **111** engaging each other along an angled interface to resist both upward and rearward withdrawal of the pawl **120** from the receptacle **111** of the door panel upper edge. The floating catch carrier **46** and pawl **120** are shown in substantially the same slightly downward slanted orientation as that shown in FIG. **14** at the initial contact of the latching event, although it is understood that if more vertical height correction is required for particular implementation, the floating catch carrier **46** and pawl **120** may slant downwardly less or be closer to parallel to the latch frame or base **42**.

Referring now to FIGS. **16-18**, an unlatching event is shown with the embodiment of the latch mechanism **30** and receptacle **111** of FIG. **13**. FIG. **16** represents the dishwasher or other appliance door **24** in its closed and latched position, from which the unlatching event is initiated. FIG. **17** shows the door **24** starting to be pulled upon during the unlatching event. Pawl **120** is unseated from its retracted position and moved linearly forward to an extended position while remaining in the lowered position, or downward, and unpivoted position. Pulling the door **24** farther open from this point moves the pawl **120** to pivot away from its lowered position to its position shown in FIG. **18**. In FIG. **18**, the pawl **120** is in its extended and raised state or position, with the pawl **120** as far forward in the slot **80** as permitted and pivoted upwardly as far as permitted by stop **138** (FIG. **13**). Alignment block **64** is shown contacting the upper surface of the door panel upper edge, while being slid under the floating catch carrier **46** and pawl **120**. After the pawl claw **146** clears and is fully withdrawn from the recess of receptacle **111** in the door panel upper edge, spring **96** biases the pawl **120** back into its seated position within the alignment block **64** and, therefore, in its retracted and lowered position. This may lever the floating catch carrier **46** upwardly, if the pawl **120** remains in contact with the upper surface of the door panel upper edge so that the floating catch carrier **46** and pawl **120** achieve a position like that shown in FIG. **15**. Further opening the door **24** from that point withdraws the door **24** from contacting the pawl **120** and/or floating catch carrier **46**, at which point the floating catch carrier **46** falls back down to its lowered resting state position and the floating catch carrier **46** and pawl **120** return to the state shown in FIG. **14**.

Certain terminology is used herein for purposes of reference only, and, thus, is not intended to be limiting. For example, terms such as "upper", "lower", "above", and "below" refer to directions in the drawings to which reference is made. Terms such as "left", "right", "front", "back", "rear", "bottom", and "side" describe the orientation of portions of the component within a consistent but arbitrary frame of reference which is made clear by reference to the text and the associated drawings describing the component under discussion. Such terminology may include the words specifically mentioned above, derivatives thereof, and words of similar import. Similarly, the terms "first", "second", and other such numerical terms referring to structures do not imply a sequence or order unless clearly indicated by the context.

When introducing elements or features of the present disclosure and the exemplary embodiments, the articles "a", "an", "the", and "said" are intended to mean that there are one or more of such elements or features. The terms "comprising", "including", and "having" are intended to be inclusive and mean that there may be additional elements or features other than those specifically noted. It is further to be understood that the method steps, processes, and operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance. It is also to be understood that additional or alternative steps may be employed.

Various features of the invention are set forth in the following claims. It should be understood that the invention is not limited in its application to the details of construction and arrangements of the components set forth herein. The invention is capable of other embodiments and of being practiced or carried out in various ways. Variations and modifications of the foregoing are within the scope of the present invention. It also being understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text and/or drawings. All of these different combinations constitute various alternative aspects of the present invention. The embodiments described herein explain the best modes known for practicing the invention and will enable others skilled in the art to utilize the invention.

What is claimed is:

1. An appliance door latch system of an appliance for latching an appliance door to secure the appliance door in a door closed position in which the door is held against an appliance housing to cover an appliance housing opening and for unlatching the appliance door to release the appliance door to permit movement of the appliance door away

from the appliance housing to a door open position that exposes the appliance housing opening, the appliance door latch system comprising:

a door-mounted latch feature supported by and is moveable with the appliance door toward and away from the appliance housing when the appliance door is moved between the door closed and open positions;

a latch mechanism adapted to receive the door-mounted latch feature to secure the appliance door in the door closed position and release the door-mounted latch feature to release the appliance door to permit movement of the appliance door to the door open position, the latch mechanism including:

a catch that is selectively engageable with the door-mounted latch feature holding the appliance door in the door closed position; and

a pre-latching catch alignment system that supports the catch and aligns the catch relative to the door-mounted latch feature while the door is moved from the door open position toward the door closed position and makes contact with the door-mounted latch feature before the catch contacts the door-mounted latch feature.

2. The appliance door latch system of claim **1**, wherein the pre-latching catch alignment system includes a floating catch carrier that supports the catch and at least a portion of which is movable with respect to the appliance housing when at least one of the floating catch carrier and the catch engages the door-mounted latch feature.

3. The appliance door latch system of claim **2**, wherein the floating catch carrier is spring biased to a first position against a stop and includes a sloped guide surface receiving a surface of the door-mounted latch feature to move the floating catch carrier away from the stop against the spring biasing to position the catch carrier into alignment with the door-mounted latch feature as the door is closed.

4. The appliance door latch system of claim **3**, wherein the floating catch carrier includes:

a floating catch carrier outer end that faces toward the appliance door;

a floating catch carrier inner end that faces away from the appliance door; and

wherein the lifting upwardly of the floating catch carrier is defined by an upward pivoting movement of the floating catch carrier outer end with respect to the appliance housing.

5. The appliance door latch system of claim **4**, wherein a pivot joint is defined at the floating catch carrier inner end for providing pivoting movement between the floating catch carrier and the appliance housing to accommodate pivoting of the floating catch carrier outer end upwardly while the door-mounted latch feature passes under the floating catch carrier outer end during the appliance door latching event.

6. The appliance door latch system of claim **5**, wherein:

a translation joint is defined between the catch and the floating catch carrier; and

during an appliance door unlatching event in which the door-mounted latch feature is withdrawn from the latch mechanism, the catch moves along the translation joint from a retracted position farther inward of the floating catch carrier to an extended position farther outward of the floating catch carrier.

7. The appliance door latch system of claim **2**, wherein the catch provides a pawl that includes:

a pawl body that is connected to the floating catch carrier; and

a pawl claw that extends from the pawl body and selectively engages the door-mounted latch feature to latch the appliance door in the door closed position.

8. The appliance door latch system of claim **7** wherein the pawl is movable between:

a pawl lowered position in which a tip of the pawl claw extends downwardly beyond a lower surface of the floating catch carrier to define a first tip position; and

a pawl raised position in which the tip of the pawl claw defines a second tip position that is raised relative to the first tip position.

9. The appliance door latch system of claim **8**, wherein movement of the pawl from the pawl lowered position to the pawl raised position is defined by an upward pivoting movement of the pawl with respect to the floating catch carrier.

10. The appliance door latch system of claim **9**, wherein the pawl is biased toward the pawl lowered position.

11. The appliance door latch system of claim **7**, wherein the pawl is movable between:

a pawl retracted position in which the pawl body is arranged relatively farther inward relative to the appliance housing; and

a pawl extended position in which the pawl body is arranged relatively farther outward relative to the appliance housing.

12. The appliance door latch system of claim **11**, wherein a translation joint is defined between the pawl and the floating catch carrier that is adapted to allow relative movement between the pawl and the floating catch carrier and guide the movement of the pawl between the pawl retracted and extended positions.

13. The appliance door latch system of claim **12**, wherein the translation joint includes a slot that extends longitudinally along the floating catch carrier and provides a pathway along which the pawl is movable while moving between the pawl retracted and extended positions.

14. The appliance door latch system of claim **13**, wherein the translation joint includes a pin that extends transversely through and is longitudinally movable within the slot in the floating catch carrier and connects the pawl to the floating catch carrier so that the pawl and pin move in unison longitudinally along the slot in the catch carrier.

15. The appliance door latch system of claim **14**, wherein the pin of the translation joint defines a pivot axis of the pawl so that the pawl is urged into both a translation movement toward the pawl extended position and a pivot movement during an appliance door unlatching event in which the striker is withdrawn from the latch mechanism.

16. The appliance door latch system of claim **9**, wherein the pawl is biased toward the pawl retracted position.

17. A dishwasher comprising:

a dishwasher housing providing an opening for accessing an interior of the dishwasher;

a door movable between a door closed position in which the door covers the dishwasher housing opening and a door open position in which the door is moved away from the dishwasher housing to uncover the dishwasher housing opening;

a door-mounted latch feature mounted to the door for holding the door in the door closed position;

a height-correcting latch mechanism adapted to receive the door-mounted latch feature to secure the door in the door closed position and release the door-mounted latch feature to release the door to permit movement of the door to the door open position, the height-correcting latch mechanism including:

a catch that is selectively engageable with the door-mounted latch feature for holding the door in the door closed position and moveable to release the door to the door open position; and

a floating catch carrier that supports the catch and at least a portion of which is movable with respect to the dishwasher housing, the floating catch carrier including a guide surface arranged outwardly of the catch to contact, engage and slide with respect to the door-mounted latch feature during a door latching event in which the door-mounted latch feature is inserted into the latch mechanism to automatically provide height adjustment of the catch to vertically align the catch with the door-mounted latch feature before a contact event between the catch and the door-mounted latch feature.

18. The dishwasher of claim **17**, wherein the floating catch carrier is pivot mounted relative to the dishwasher housing and biased downwardly so that the vertical alignment of the catch with the door-mounted latch feature is provided by the catch carrier pivoting upwardly in response to engagement of the door-mounted latch feature and at least one of the catch and the floating catch carrier while the door-mounted latch feature slides under the catch carrier during the latching event.

19. The dishwasher of claim **18**, wherein the floating catch carrier defines an inner pivot joint at which the floating catch carrier can pivot with respect to the dishwasher housing and an outer pivot joint at which the catch can pivot with respect to the floating catch carrier away from a resting state position to accommodate at least one of the door latching event in which the door-mounted latch feature is inserted into the latch mechanism and a door unlatching event in which the door-mounted latch feature is withdrawn from the latch mechanism.

20. The dishwasher of claim **19**, wherein the floating catch carrier includes a slot and the catch is movably mounted with respect to the slot providing movable mounting of the catch to the floating catch carrier to accommodate longitudinal translational movement of the catch along the slot.

* * * * *