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 [21] Appl. No. **820,830**
 [22] Filed **May 1, 1969**
 [45] Patented **Sept. 7, 1971**
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[54] **DISHWASHER DOOR SEAL**
 12 Claims, 10 Drawing Figs.

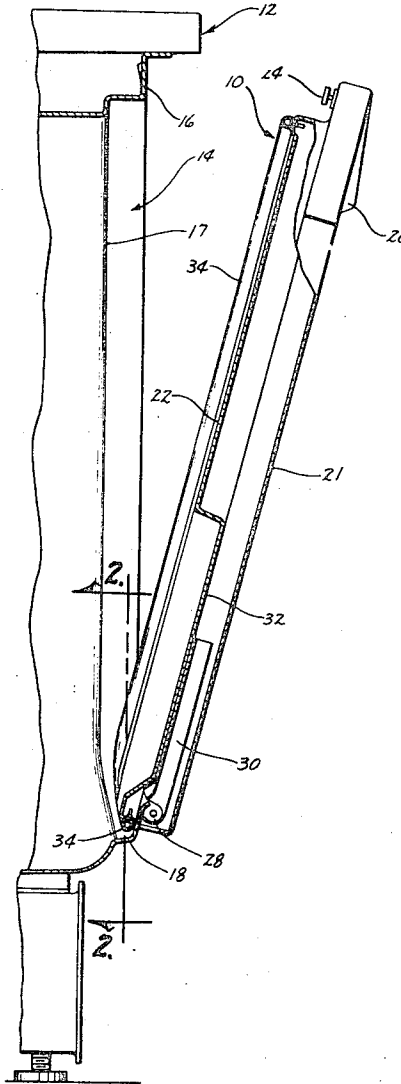
[52] U.S. Cl. 49/485,
 49/489
 [51] Int. Cl. E06b 7/22
 [50] Field of Search 49/402,
 475, 479, 485, 488, 489, 498; 312/296, 213, 214,
 228, 351, 327, 276; 134/57 D, 57 DL

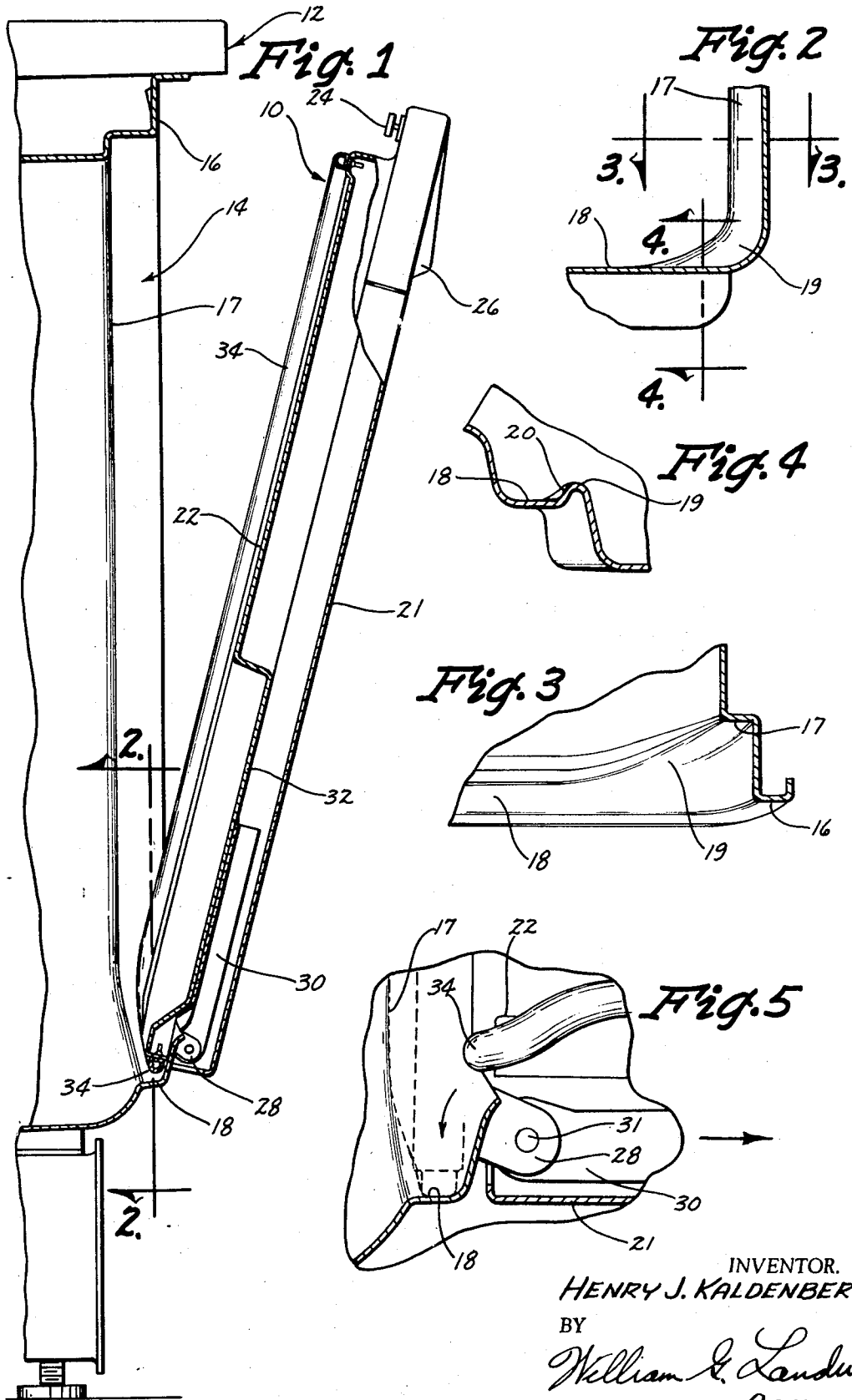
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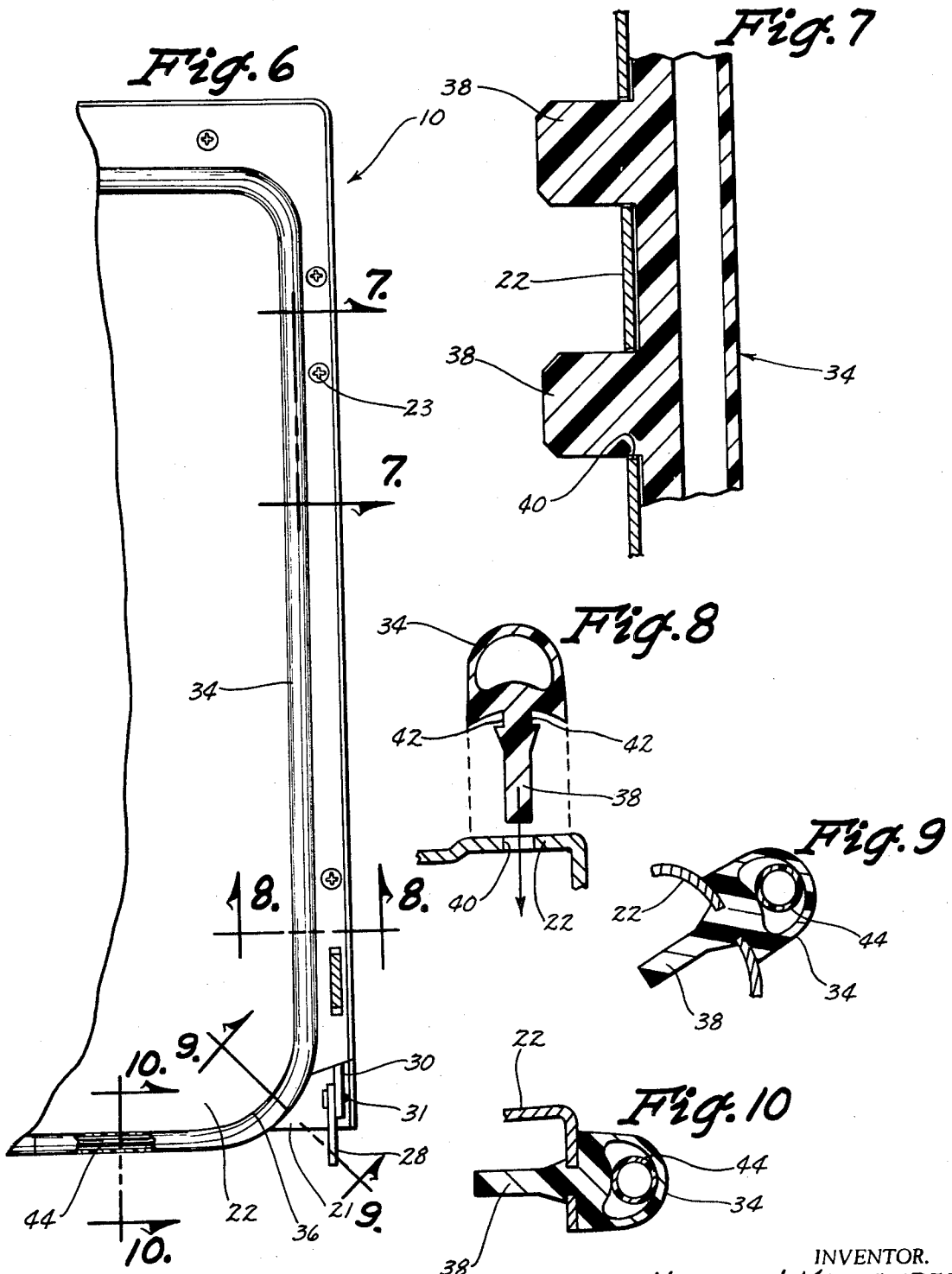
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ABSTRACT: An improved seal structure is provided for automatic dishwashers having an access opening in the front for the insertion or removal of dishes. The dishwasher has a generally forwardly facing vertical seal abutment adjacent to the top and sides of the opening and a generally upwardly facing horizontal seal abutment adjacent to the bottom of the opening. The door is hinged at the bottom, and has an inner panel, which carries an elastomeric sealing strip. The sealing strip runs along the face of the inner panel juxtaposed to the perimeter of the inner panel at the top and sides and then along the bottom flange of the inner panel to form a seal with corresponding seal abutments when the door is closed. The elastomeric strip is continuous at the bottom corners of the inner panel and is twisted about 90° at these corners to form a smooth sealing transition between the face and bottom of the inner panel.





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DISHWASHER DOOR SEAL

BACKGROUND OF THE INVENTION

The present invention relates to an improved door seal structure, and more specifically to an improved bottom-hinged door including an improved seal arrangement, for automatic dishwashers and the like.

It is a common practice in the manufacture of automatic dishwashers to hinge the door at the bottom so that the dish rack may be rolled out onto the door for easy loading and unloading. Because the dish rack must be permitted to roll out onto the door, a seal structure may not be placed on the inside face along the bottom of the door, since this would interfere with the rolling of the dish rack. This creates some difficulty with the provision of sealing along the bottom of the door, particularly at the lower corners—the very area that requires exceptionally good sealing because of particularly high turbulence during operation of the dishwasher. The surging of water at the bottom of the dishwasher during operation creates additional requirements for excellent sealing at the lower corners. Finally, it is desirable to have a seal structure that prevents food and water from falling to the floor when the door is opened and closed, and which also prevents the entrapment of food and water.

SUMMARY OF THE INVENTION

It is an object of the instant invention to provide an improved seal structure for a front-opening dishwashing appliance.

It is a further object of the instant invention to provide a seal structure for a dishwashing appliance front-opening door having a continuous unitary seal around the lower corners of the door.

It is a further object of the instant invention to provide an improved seal member having holding means for conformably securing the seal member to the lower corners of the door while changing from an inwardly facing to a downwardly facing posture.

It is a further object of the instant invention to provide a seal structure for a dishwashing appliance wherein a unitary seal member is positionable on the inner face of the door along the sides and top and is positionable on the bottom flange of the door through a twisting of the seal about its longitudinal axis at the lower corners of the door.

Generally, the present invention relates to an improved bottom-hinged door and seal structure for automatic dishwashers of the type having a front access opening providing for the insertion and removal of dishes and the like. A generally vertical seal abutment is located immediately adjacent to the top and sides of the opening, and a generally horizontal seal abutment is located adjacent to the bottom of the opening. The bottom-hinged door has an inner panel including perimeter portions which face the vertical seal abutment adjacent to the top and sides of the opening when the door is closed. The bottom side of the inner panel then faces the generally horizontal seal abutment. A strip of elastomeric material is mounted on the inner wall in sealing contact with the vertical and horizontal seal abutments when the door is closed. In accordance with the present invention, in order to provide superior sealing at the bottom corners of the inner wall, the strip of elastomeric material is twisted about its longitudinal axis at the bottom corners. This twisting facilitates a smooth transition of the elastomeric strip from the perimeter face portion to the bottom of the inner panel.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, its organization and method of operation, will be best understood by reference to the following detailed description taken together with the drawings, in which:

FIG. 1 is a fragmentary view of a dishwasher embodying the features of the present invention partially in vertical section:

FIG. 2 is a fragmentary section view of a lower corner of the dishwasher of FIG. 1, with the door removed, as taken substantially along lines 2—2 of FIG. 1;

FIG. 3 is also a fragmentary section view of a lower corner of the dishwasher of FIG. 1, with the door removed, as taken substantially along lines 3—3 of FIG. 2;

FIG. 4 is a further fragmentary section view of a lower corner of the dishwasher of FIG. 1, with the door removed, taken substantially along lines 4—4 of FIG. 2;

FIG. 5 is an enlarged cross-sectional, fragmentary view illustrating the orientation of the seal structure when the dishwasher door is opened and closed;

FIG. 6 is a fragmentary plan view of the inside of a dishwasher door embodying the features of the present invention;

FIG. 7 is a cross-sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is an exploded cross-sectional view taken along line 8—8 of FIG. 6;

FIG. 9 is a cross-sectional view taken along line 9—9 of FIG. 6, and illustrating a preferred embodiment of the present invention; and

FIG. 10 is a cross-sectional view taken along line 10—10 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and more specifically to FIG. 1, the improved door and seal structure in accordance with the present invention is generally designated by reference numeral 10. In FIG. 1, the door and seal structure 10 is shown in combination with an automatic dishwasher, generally designated by reference numeral 12. The dishwasher 12 has a front opening 14 framed at the top and sides by a front vertical wall 16. A generally vertical forwardly facing seal abutment 17 is located immediately adjacent to the top and sides of the opening, and a generally horizontal upwardly facing seal abutment 18 is located adjacent to the bottom of the opening 14. For the purposes of the present invention, the generally horizontal seal abutment 18 is referred to as generally horizontal, since, as may be seen from the drawings, it need not be precisely horizontal. In the embodiment shown, the generally horizontal seal abutment 18 slants slightly downwardly toward the inside of the dishwasher 12.

As shown in FIGS. 2 through 4, the vertical and horizontal seal abutments 17 and 18, respectively, meet at a transition seal abutment portion 19 to form a continuous seal abutment around the opening 14. As best shown in FIGS. 1 through 5, the vertical seal abutment is in the form of a forwardly facing step in the dishwashing cabinet structure and the horizontal seal abutment is also in the form of an upwardly facing step or flange. These two seal abutments meet at each of the lower corners of the opening 14 and are blended together with a generous radius to form a transition seal abutment 19 defining a continuous smooth surface mating, when the door is closed, with a sealing strip to be defined hereinafter. As best shown in FIG. 4, the transition sealing abutment includes a portion 20 facing upwardly and forwardly and engageable by the sealing strip at the lower corners of the opening.

The door and seal structure 10 includes an outer door panel 21 and an inner door panel 22 affixed thereto by screws 23. A suitable latch 24, and handle 26 are provided so that the door and seal structure 10 may be opened and securely closed.

Referring to FIG. 5, the door and seal structure 10 is hinged at the bottom by a conventional hinge including a first hinge member 28 affixed to the dishwasher 12 and a second hinge member 30 journaled to the first hinge member 28 by hinge pin 31. Referring again to FIG. 1, the second hinge member 30 is affixed to the door and seal structure 10. In the embodiment shown, the second hinge member 30 is attached to a recessed portion 32 of the inner door panel 22 by any suitable means such as welding and the like.

The elastomeric sealing strip 34 runs around the inner door panel 22 preferably in endless fashion. The sealing strip 34 is

mounted on the inner door panel 22 adjacent the perimeter thereof. As shown in the drawings, the door and seal structure 10 is arranged so that a perimeter portion of the inner door panel 22 faces the vertical seal abutment 17 adjacent to the top and sides of the opening 14 when the door is closed. Accordingly, the elastomeric sealing strip 34 on the perimeter portion is in sealing contact with the vertical seal abutment 17 along the top and sides of the opening 14. It will be seen that the inner door panel 22 is slightly raised at the perimeter portion along the top and sides although this is not essential to the present invention.

The elastomeric sealing strip also runs along the bottom of the inner door panel 22, and is mounted in a manner such that it is in sealing contact with the generally horizontal seal abutment 18 when the door is closed. The formation of this sealing contact is shown in FIG. 5, where the phantom lines illustrate the orientation of the inner door panel 22 and the elastomeric seal 18 when the door is closed.

The elastomeric sealing strip 34 may be formed from an extruded member with the ends of the member meeting at some generally central location along the bottom of the inner door panel 22 and may be joined, as by a heat weld, to form an endless seal. The broader objects of the invention, however, may be achieved in an alternate embodiment in which ends of the seal strip 34 are not joined but in which the seal strip is continuous at the lower corners 36 of the inner door panel 22 and form a smooth continuous seal in a transition from the face of the door to the lower edge.

Referring to FIG. 6, it will be seen that the elastomeric sealing strip is continuous as it forms the transition between the face and bottom of the inner door panel 22. This transition is formed at the lower corners 36 of the inner door panel 22. At each lower corner 36, the elastomeric seal is twisted about its own longitudinal axis approximately 90° as indicated in FIG. 6. In this fashion, the use of separate seals or seal mounting members at the bottom and along the side of the inner door panel is avoided, and an unbroken seal is formed at the junction of the vertical and horizontal seal abutments 17, 18, respectively.

Referring now to FIGS. 7-10, it will be seen that the elastomeric strip 34 is mounted on the inner door panel 22 by means of a plurality of mounting tabs 38, which in the preferred embodiment are an integral part of the elastomeric sealing strip 34 and are formed by cutting away part of the extruded member. As shown in FIGS. 8 and 10, the elastomeric sealing strip 34 is of generally semicircular cross-sectional configuration, and is most preferably hollow in order to facilitate deformation of the sealing strip 34 to form an efficient seal. As best shown in FIGS. 7 and 8, the inner door panel 22 has a plurality of spaced apertures 40 which are positioned for penetration of the mounting tabs 38. The spacing between the apertures is uniform except at the lower corners where the spacing is reduced to assist in the prevention of collapse of the seal as it passes around the corner and is twisted and to insure conformity of the seal to the panel. FIG. 8 shows that, in the preferred embodiment, the mounting tabs 38 each carry locking notches 42 which engage the sides of the apertures 40, so that the sealing strip 34 may be easily pressed into and retained in position and will form a tight fit.

As shown in FIGS. 9 and 10, in the most preferred embodiment, the elastomeric strip 34 has internal reinforcing means where it goes over the lower corners 36 of the inner door panel 22. This reinforcing means comprises a tubular strip of elastomeric material 44 insertable at selected positions within the hollow portion of the sealing strip 34.

Referring again to FIGS. 1 and 5, it will be seen that, in operation, when the door and seal structure 10 is closed, the elastomeric sealing strip 34 contacts the front vertical wall 16 of the dishwasher 12 around the front opening 14 at the top and sides, forming a tight seal. Along the bottom of the inner door panel 22, the sealing strip 34 contacts the generally horizontal wall 18 adjacent to the bottom of the front opening 14. This is best shown in FIG. 5. At the critical lower corners

36 of the inner door panel 22, the seal 34 contacts the transition seal abutment and forms a watertight seal. As the door is closed, the seal 34 moves toward the seal abutments so that face contact is achieved at substantially all points and relatively little "wiping" of the seal on the seal abutments occurs. Twisting of the seal, which sometimes causes leaks, is thereby avoided.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, these are used in a generic and descriptive sense only and not for purposes of limitation. Changes in form and the proportion of parts as well as the substitution of equivalents are contemplated, as circumstances may suggest or render expedient, without departing from the spirit or scope of this invention as further defined in the following claims.

I claim:

1. In a dishwasher having an opening in the front thereof to provide access for the insertion and removal of articles, an improved seal structure comprising: a generally forwardly facing substantially vertical seal abutment portion adjacent to the top and sides of said opening; a generally upwardly facing substantially horizontal seal abutment portion at the bottom of said opening; a rounded transition seal abutment portion at the juncture of said vertical and horizontal seal abutment portions, said seal abutment portions comprising a generally endless seal abutment around said opening; a bottom-hinged door having an inner panel including a generally rearwardly facing substantially vertical seal surface portion juxtaposed said vertical seal abutment portion when said door is closed and further including a bottom generally downwardly facing substantially horizontal seal surface portion juxtaposed said horizontal seal abutment portion and a rounded transition seal surface portion facing said transition seal abutment portion when said door is closed, said seal surface portions comprising a seal surface generally facing said seal abutment and disposed generally parallel thereto; and a strip of elastomeric material extending substantially around said opening and disposed between said seal abutment and said seal surface for compressive sealing therebetween when said door is closed, said strip of elastomeric material comprising an attaching region along one side of said strip of material including means attaching said one side to one of said seal abutment and said seal surface and further comprising a sealing region along generally the opposite side of said strip of material for sealing engagement with the other of said seal abutment and said seal surface, said strip of elastomeric material being continuous and twisted about its longitudinal axis in the area of said transition portions for maintaining a generally cooperative orientation of said attaching and sealing regions relative to said seal abutment and seal surface for compressive sealing therebetween.

2. The improved seal structure as defined in claim 1 wherein said strip of elastomeric material is unitary.

3. The improved seal structure as defined in claim 1 and further including reinforcing means in said strip of elastomeric material at said bottom corners.

4. In a dishwasher having an opening in the front thereof to provide access for the insertion and removal of articles, an improved seal structure comprising: means defining a seal abutment including a generally forwardly facing substantially vertical portion adjacent to the top and sides of said opening, a generally upwardly facing substantially horizontal portion adjacent to the bottom of said opening and generally rounded transition portions connecting said vertical and horizontal portions; a bottom hinged door having an inner panel, said inner panel including perimeter portions along the top and sides facing said vertical seal abutment portion and further including a bottom portion facing said horizontal seal abutment and bottom corner portions generally facing said transition portions when said door is closed, said perimeter portions, said bottom portion, and said bottom corner portions comprising a seal surface juxtaposed and generally parallel to said seal abutment, said inner panel having a plurality of spaced aper-

tures along the top and side perimeter portions thereof and along said bottom portion and corner portions thereof; and a strip of elastomeric material disposed between said seal abutment and said seal surface for compressive sealing therebetween, said strip of elastomeric material comprising an attaching region including a plurality of tabs formed on one side thereof engageable with said apertures for retaining said strip on said panel and further comprising a sealing region along generally the opposite side of said strip of material for sealing engagement with said seal abutments, and said strip of elastomeric material being continuous at the bottom corner portions of said inner panel and being twisted about its longitudinal axis at the bottom corner portions of said inner panel for maintaining a generally cooperable orientation of said attaching and sealing regions relative to said seal abutment and seal surface for compressive sealing therebetween.

5. The improved seal structure as defined in claim 4 wherein said strip of elastomeric material is unitary and endless.

6. The improved seal structure as defined claim 4 wherein said strip of elastomeric material is of generally semicircular uniform cross section configuration.

7. The improved seal structure as defined in claim 8 further including reinforcing means in said strip of elastomeric material at the bottom corner portions of said inner panel.

8. The improved seal structure as defined in claim 4 wherein said tabs include locking notches adapted to engage said apertures to lock said strip in position.

9. The improved seal structure as defined in claim 6 wherein said tabs are uniformly spaced along the entire length of said strip of elastomeric material and wherein said apertures are uniformly spaced along the top and side perimeter portions and along said bottom portion of said inner panel and are relatively closer spaced at the bottom corners of said inner panel to conformably secure said strip of elastomeric material to said inner panel.

10. In a dishwasher having an opening in the front thereof to provide access for the insertion and removal of articles, an improved seal structure comprising: a generally forwardly facing substantially vertical seal abutment portion adjacent to the top and sides of said opening; a generally upwardly facing substantially horizontal seal abutment portion at the bottom of said opening; a pair of rounded transition seal abutment portions at the junctures of said substantially vertical and horizontal seal abutment portions and forming with said vertical and horizontal abutment portions a continuous seal abutment around said opening; a bottom-hinged door having an inner panel, said inner panel having a perimeter portion, a bottom portion, and lower corner portions facing said vertical seal abutment portion, said horizontal seal abutment portion, and said transition seal abutment portions respectively, when said door is closed to define a seal surface juxtaposed and generally parallel to said seal abutment; and a strip of elastomeric material disposed between said seal surface and said seal abutment for

compressive sealing therebetween when said door is closed, said strip of elastomeric material comprising an attaching region generally along one side of said strip of material including means attaching said one side to the seal surface on said inner panel and further comprising a sealing region along generally the opposite side of said strip of material for sealing engagement with said seal abutment, said strip of elastomeric material being continuous at the bottom corner portions of said inner panel and being twisted approximately 90° at the bottom corner portions of said inner panel and conformably secured thereto along its entire length for maintaining a generally cooperable orientation of said attaching and sealing regions relative to said seal abutment and seal surface for compressive sealing therebetween.

11. The improved seal structure as defined in claim 10 wherein said strip of elastomeric material is unitary and wherein the ends of said strip are joined to provide an endless seal around said openings.

12. A seal structure for a dishwasher including a cabinet structure having a generally rectangular opening therein to provide access for the insertion and removal of articles, door means for selectively closing said opening, and hinge means attached to said cabinet structure and said door means adjacent one side of said opening, the combination comprising: means on said cabinet structure defining an endless seal abutment including a first portion adjacent the three sides of said opening not adjacent said hinge means facing generally the same direction as said opening and further including a second portion along the side of said opening adjacent said hinge means and facing generally at a right angle to the direction of said opening, said seal abutment further including rounded transition junction corners connecting said first and second portions; panel means on said door means defining an endless seal surface juxtaposed to and conforming generally to the contour of said seal abutment, said seal surface being spaced from and facing said seal abutment in a generally parallel relationship when said door is closed; and a strip of elastomeric material extending substantially around said opening and disposed between said seal abutment and said seal surface for compressive sealing contact with each of said seal abutment and seal surface when said door is closed, said strip of elastomeric material comprising an attaching region including means attaching said strip of material to one of said seal abutment and said seal surface and further comprising a sealing region for sealing engagement with the other of said seal abutment and said seal surface, said strip of elastomeric material being continuous at the junction corners of the first and second portions of said seal abutment and being twisted approximately 90° about its longitudinal axis at said corners for maintaining a generally cooperable orientation of said attaching and sealing regions relative to said seal abutment and seal surface for compressive sealing therebetween.

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