United States Patent [19]

Goldsmith

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[54] **DOOR ASSEMBLIES**

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[73] Assignee: **British Aircraft Corporation, Limited,** London, England

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[30] **Foreign Application Priority Data**

Aug. 3, 1972 Great Britain 36197/72

[52] **U.S. Cl.** ..... **49/13,** 49/34, 49/395, 244/129 D, 292/11

[51] **Int. Cl.** **G08b 13/08**

[58] **Field of Search** ..... 49/13, 34, 395; 292/11; 70/432, 438, DIG. 59; 244/129 D; 109/59

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[57] **ABSTRACT**

A door assembly, in which the door is liable to become distorted when open, is provided with a plurality of latching units each with an actuation means to effect latching and a sensing device which senses when its associated latching unit is in a position to be latched and then causes its actuation means to effect latching, the assembly being arranged such that when, due to any distortion present, perhaps just one latching unit becomes latched as the door is closed such latching is effective to cause a further sensing device to cause latching of its associated latching unit and so on in random sequence.

6 Claims, 7 Drawing Figures

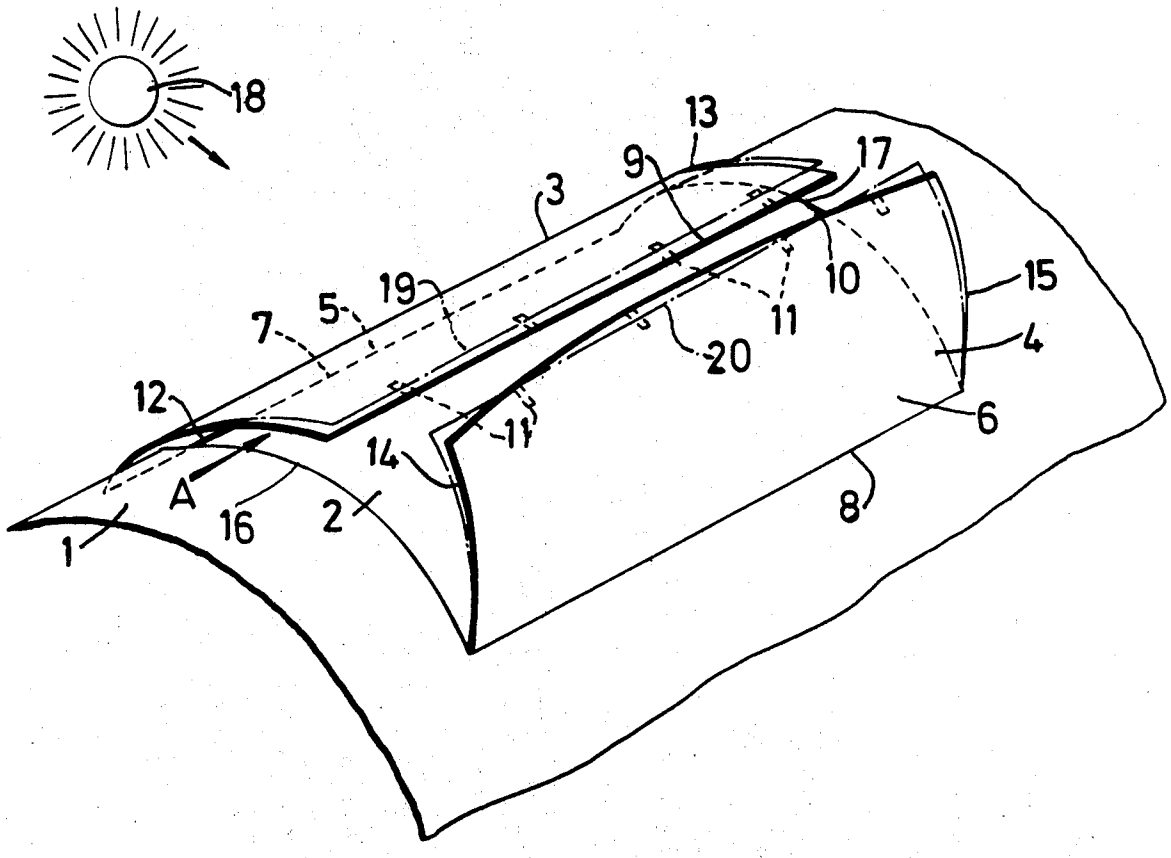


FIG.1.

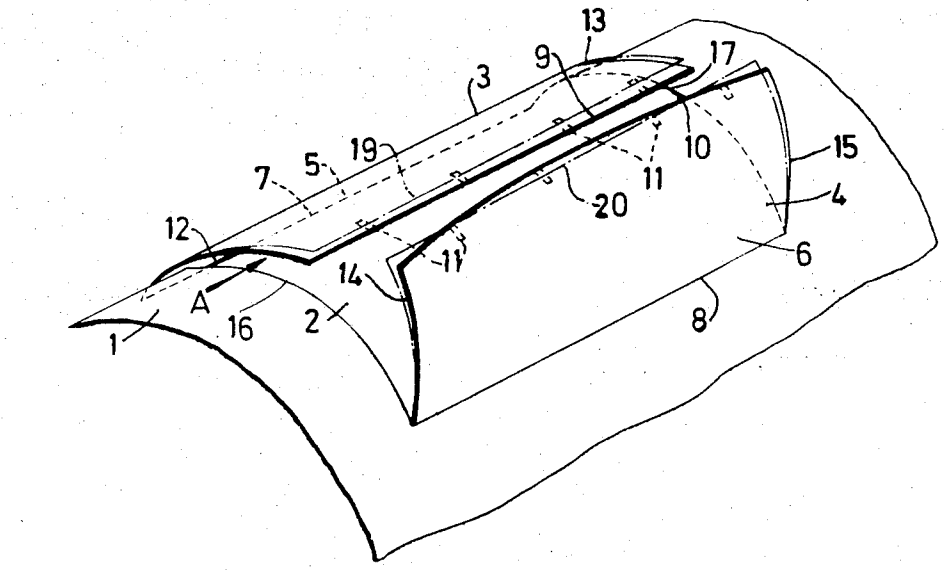
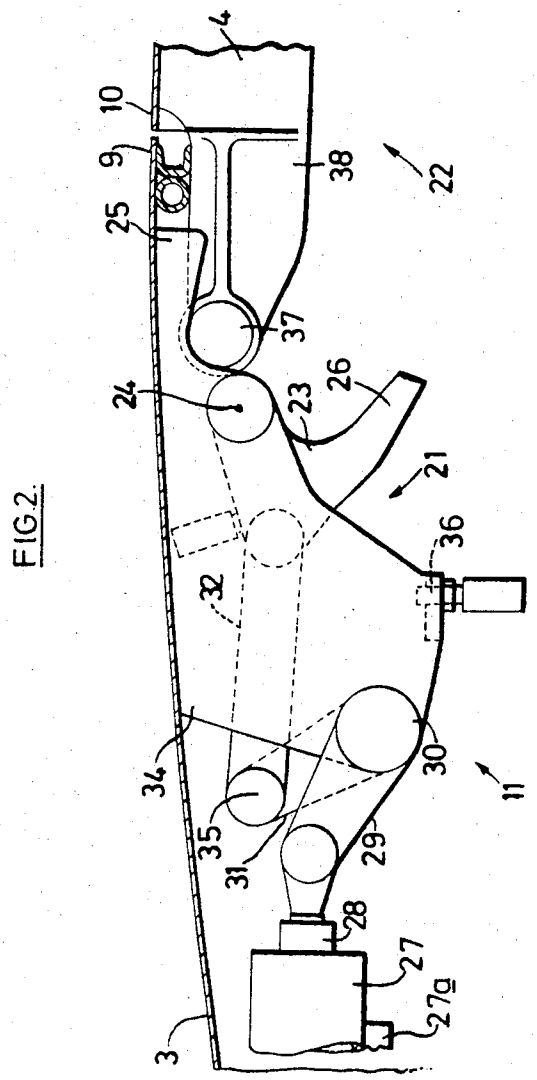


FIG 2.



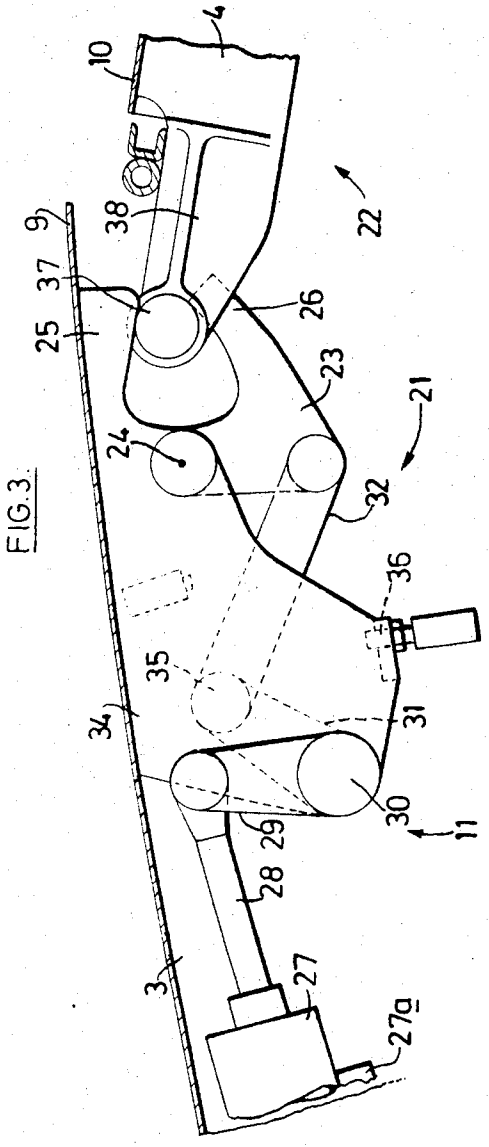


FIG.3

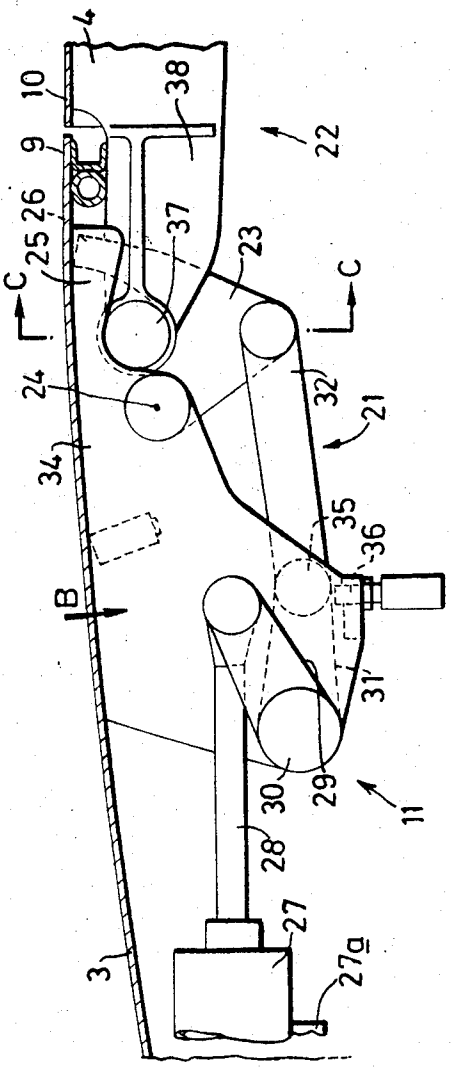


FIG.4.

FIG.5.

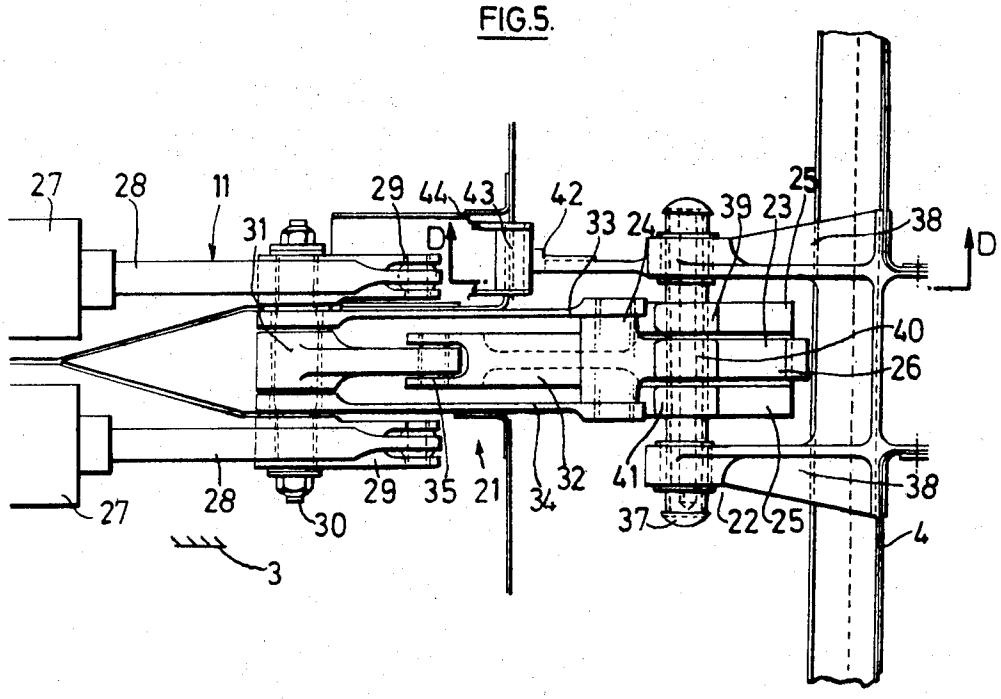


FIG.6.

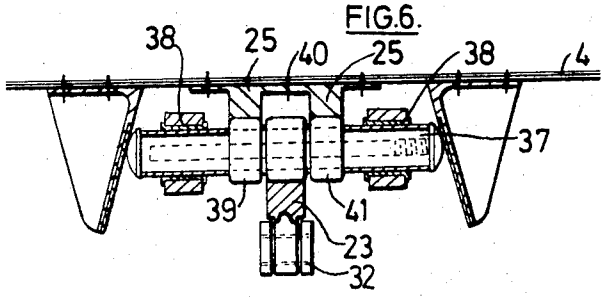
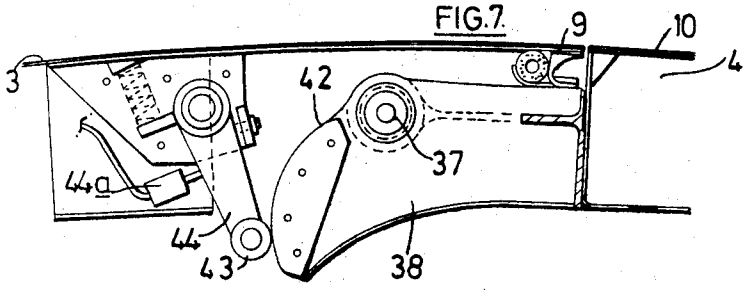


FIG.7.



DOOR ASSEMBLIES

This invention relates to door assemblies, the components of which may be subject to temporary distortion when open. When such distortion has occured the door or doors are diffiult to close especially where such an operation difficult to be achieved by remote control.

An object of the present invention is to provide a door assembly which, even though the components thereof are distorted, can be closed from a remote station without external assistance.

According to the present invention a door assembly includes in combination a hinged door, an adjacent member to which the door is latched when closed, and a plurality of spaced latching units, each with an actuation means to effect latching and a sensing device which senses when its associated latching unit is in a position to be latched and then causes its actuation means to effect latching, the combination being such that when one latching unit is latched such latching is effective to cause a further sensing device to cause latching of its associated latching unit.

By this arrangement, during closure of the door, and irrespective of the distortion of the door within predetermined limits, at least one latching unit will initially engage and in doing so will effect the sequential engagement of the further latches and accordingly ensure fully latched closure of the door.

The adjacent member may be a fixed structure or it may be a further door. In the latter case, the further door may also be subject to distortion when open.

One preferred embodiment of the invention is now described with reference to the accompanying drawings:

FIG. 1 is a perspective view of a door assembly,

FIG. 2 is a view in the direction of Arrow A of FIG. 1 of part of a door assembly when undistorted with a latching unit in an unlatched condition,

FIG. 3 is a similar view but with the door assembly distorted and the latching unit in an initially engaged condition,

FIG. 4 is again a similar view to that of FIG. 2 but showing the door assembly in a fully closed and latched condition,

FIG. 5 is a view in the direction of Arrow B of FIG. 4,

FIG. 6 is a sectional view in the direction of Arrows C—C of FIG. 4, and

FIG. 7 is a sectional view in the direction of Arrows D—D of FIG. 5.

Referring firstly to FIG. 1 a spacecraft has a cylindrical body shown partly at 1. An aperture 2 in the body is closed by two doors 3 and 4 having edges 5 and 6, respectively, which are pivoted to opposing sides 7 and 8 of the aperture. In the closed position the free edges 9 and 10, respectively, of the doors lie closely adjacent one another and the doors themselves lie flush with the external contour of the spacecraft. The doors 3 and 4 are swung arcuately open to clear the aperture 2 about their edges 5 and 6 by means of jacks, not shown.

The doors 3 and 4 are latched in the closed position by a plurality of latching units 11 located along the edges 9 and 10 of the doors, part of each latching unit being carried by one door and part being carried by the other. Additionally, further latches, not shown, are provided between the edges 12, 13 and 14, 15 of the doors

and opposing edges 16 and 17, respectively, of the aperture.

When open in space the doors 3 and 4 are liable to thermal distortion, the effects of which may be different on each door, for example when one door (for example that referenced 3) is illuminated by the sun, shown to the left of the Figure at 18, and is therefore hot and the other door (that referenced 4) is in shade and is therefore cold. The effects of such an extreme case are illustrated by the unbroken outline of the doors whilst for comparison, a relatively undistorted shape is shown in broken outline at 19 and 20, respectively. It is apparent from the Figure that on closure of the doors, such distortion could well prevent secure latching of the doors and accordingly the door assembly and its latching system must be able to accommodate the worst possible case.

Referring now to FIGS. 2–7 which illustrate one latching unit 11 in various conditions. The remaining latching units are identical; accordingly one will be described. Each latching unit 11 includes two portions, a claw portion 21 mounted upon the door 3 and a lug portion 22 mounted upon the door 4. The claw portion 21 itself comprises a movable claw 23 pivoted to the door structure at 24 and lying in a plane between two laterally spaced fixed claws 25. The free end 26 of the claw 23 lies between the two fixed claws 25 to embrace part of the lug portion 22 in the claw closed condition.

The movable claw 23 is pivoted about point 24 by means of twin jacks 27 which are themselves pivoted to the door 3. The jacks 27 have rams 28 each coupled to one of a pair of spaced levers 29 fixedly mounted on a transverse shaft 30. Also fixedly mounted on the shaft 30 between the levers 29 is a further lever 31 which together with the pair of levers 29 forms a bell-crank. This lever 31 is coupled to one end of a link 32 whose other end is coupled to the movable claw 23.

The fixed claws 25 are formed on spaced webs 33 and 34 which conveniently provide locations for the shaft 30 between the pair of levers 29 and the lever 31.

With the rams 28 extended, when the free end 26 of the movable claw lies between the fixed claws 25 in the door fully closed position, the lever 31 and the link 32 lie in an "over-centre" position in which they form a geometric look which effectively holds the movable claw 25 in that position. In this position the coupling 35 between the lever 31 and the link 32 lies against a stop 36, which may include a micro-switch to supply a signal confirming that the over-centre position has been reached.

The lug portion 22 includes a transverse shaft 37 mounted in spaced lugs 38 extending from the door 4. On the shaft between the lugs 38 are mounted three rollers 39, 40 and 41. The centre roller 40 is positioned to be contacted by the movable claw 23 whilst the two outer rollers 39 and 41 are positioned to be contacted by the fixed claws 25 when the doors 3 and 4 are in the closed position.

One lug 38 on the door 4 is formed with a cam track 42 protruding toward the door 3. This is shown in FIGS. 5 and 7. The track 42 is engaged by a cam follower 43 carried by a pivot arm 44 mounted upon the door 3. The pivot arm 44 is adapted in known manner by means of an electrical switch, 44a actuated by pivotal movement of the arm 44, connected to electrically

operated fluid valves 27*a* on the jacks 27 such that a signal from the switch causes fluid to be admitted to the jacks 27 to effect extension of the rams 25 thereof. The pivoting movement of the arm 44 caused by engagement of the cam follower 43 with the track 42, the positions of the follower 43 and the track being so arranged that the ram extension signal occurs at a predetermined local relative position of the doors when closing, the relative position being such that the movable claw 23 can initially embrace the roller 40. The items 42, 43, 44 and 44*a* form the sensing devices to which reference has already been made.

As illustrated in FIGS. 2, 3, and 4, the movable claw 23 and the fixed claws 25 are so shaped that in the initial engagement position of FIG. 3 with the rollers 39, 40, and 41 on the shaft 37, further extension of the rams 28 is such as to draw the engagement portions 21 and 22 into the full latching engagement position of FIG. 4, that is to say, the doors are drawn together despite any distortion tending to prevent this. The power of the rams effective at the said engagement portions is thus chosen to be sufficient to overcome the effects of any such distortion and is therefore a function of the stiffness of the door structure. The drawing together of the doors into full latching engagement is arranged to cause the sensing device of a further latching unit to effect latching thereof. Hence the individual latching devices are so spaced one from another in view of the local door structure stiffness that, in the worst possible case of distortion, when one latching device is fully latched a further latching device will always be moved to a position in which latching is possible.

Operation of the door assembly is as follows:

The doors 3 and 4 assumed to be open, are swung by jacks, not shown, toward the closed position. The doors may or may not be distorted but if at least one is, it is apparent that one part of the distorted door will reach the closed position before the remainder. Accordingly, as both doors 3 and 4 are urged closed, the cam surface 42 of one latching unit 11 will be engaged by the corresponding cam follower 43 of that latching unit 11. At the predetermined position of that local part of the doors 3 and 4 to which the latching unit 11 is mounted, the sensing unit initiates extension of the jack rams 28 to cause the movable claw 23 to move from the position of FIG. 2 to the position of FIG. 3 in which the rollers 39, 41 are engaged by the fixed claws 25 and the roller 40 is engaged by the movable claw 23. The shaft 37 on which the rollers 39, 40 and 41 are carried is in effect embraced by the claws 23 and 25. The continued extension of the rams 28 causes the rollers 39, 40 and 41 to be drawn into a fully engaged position with the claws 23 and 25 as the doors are further closed until the position of FIG. 4 is reached when the free end 26 of the claw 23 lies between the claws 25. The lever 31 and the link 32 lies in their "over-centre" condition to hold the claws in the fully engaged position.

During the movement from the position of FIG. 3 to that of FIG. 4, any distortion of a door is overcome and the cam track 42 and follower 43 of a sensing device of an adjacent latching unit 11 come into contact and hence energises the jacks 27 of the associated latching unit to cause latching as previously described. The remaining latching units 11 follow in sequence. The sequence is not necessarily always the same since the degree and location of the distortion of the door or doors will vary considerably upon the attitude of the vehicle with respect to the sun, in fact some latching units may be actuated simultaneously.

Although of particular value for space vehicles the described door assembly is considered to have utility in other fields where doors liable to distortion require to be closed by remote control.

I claim:

1. A door assembly including in combination a hinged door, an adjacent member to which the door is latched when closed, and a plurality of spaced latching units, each with an actuation means to effect latching and a sensing device which senses when its associated latching unit is in a position to be latched and then causes its actuation means to effect latching, and means operative when one latching unit is latched to cause a sensing device of a further latching unit to operate as aforesaid to cause latching of said further latching unit.

2. A door assembly according to claim 1 in which the said adjacent member is a further hinged door.

3. A door assembly according to claim 1 wherein the sensing devices include a pivotally mounted cam follower engageable with a cam track arranged to effect pivotal movement of the said follower and a signalling device arranged to yield a latching signal to the associated actuator at a predetermined pivotal position of the said follower.

4. A door assembly according to claim 1 in which the latching units have engagement portions so shaped that subsequent to any initial engagement the engagement portions are drawn into a fully latching engagement.

5. A door assembly according to claim 4 in which the latching units, when in the full latching engagement position, are held in that position by an "over centre" mechanism.

6. A door assembly including in combination a door, an adjacent fixed structure to which the door is hinged, an adjacent member, which may or may not be part of the said adjacent fixed structure, to which the door is latched when closed, and a plurality of spaced latching units each of which has an engagement portion carried by the door and an engagement portion carried by the said adjacent member, actuation means to urge the engagement portions into latching engagement, and a sensing device operatively associated with the actuation means to sense when the engagement portions are sorelatively positioned to be engageable, and means operative when the engagement portions of one latch unit are urged into latching engagement such engagement is effective to so position the engagement portions of a further latch unit that the sensing device of that further latch unit causes its actuator means to urge the engagement portions of that latching unit into latching engagement.

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