Dec. 25, 1945. R. FUNK 2,391,407

DETACHABLE PORT COVER

Filed June 10, 1943 2 Sheets-Sheet 1

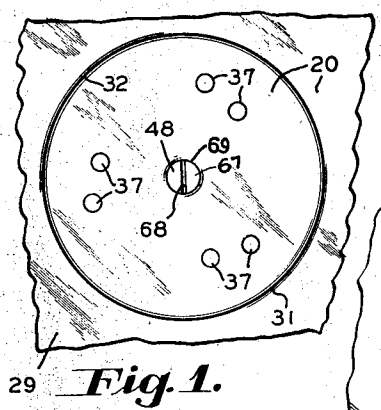
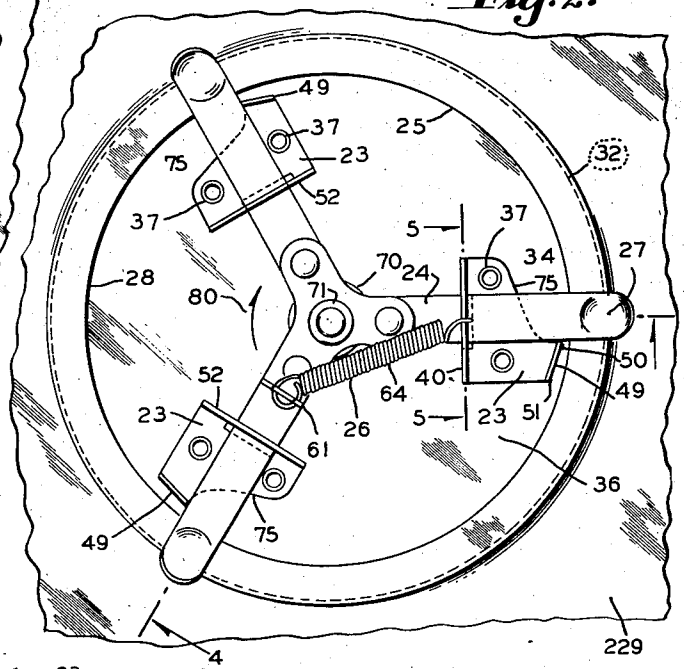


Fig. 1.

Fig. 2.



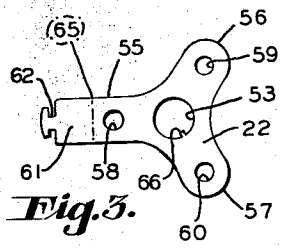


Fig. 3.

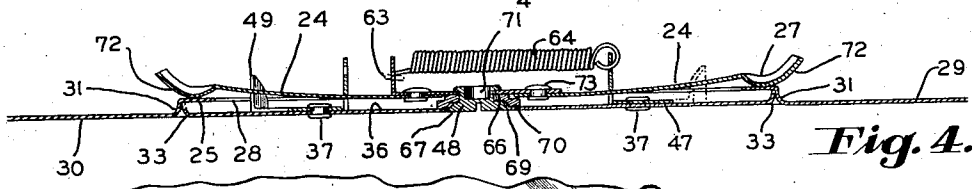


Fig. 4.

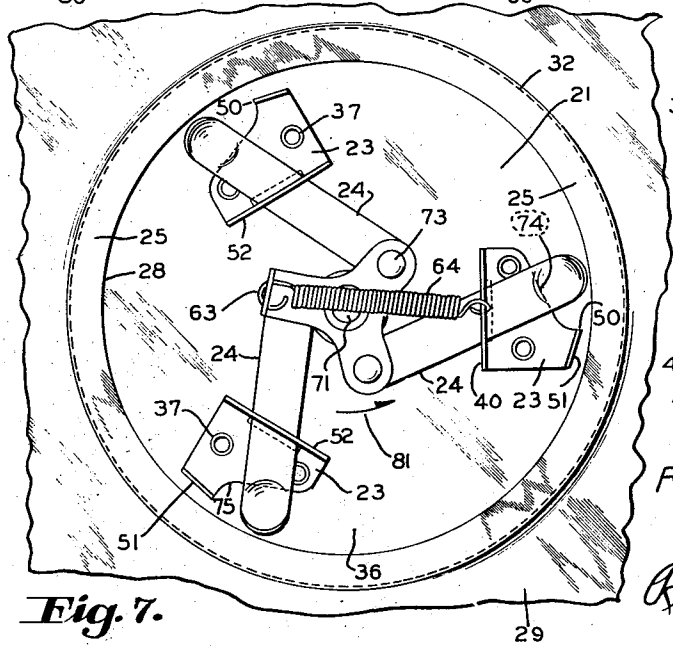


Fig. 7.

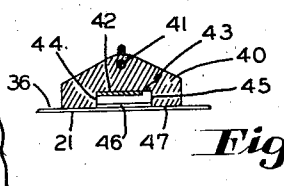


Fig. 5.

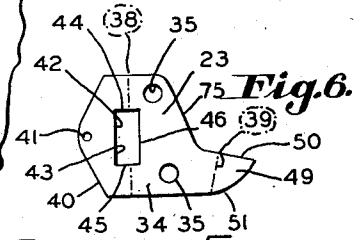


Fig. 6.

RUDOLPH FUNK
INVENTOR

BY Richard S. Temko
ATTORNEY

Dec. 25, 1945. R. FUNK 2,391,407

DETACHABLE PORT COVER

Filed June 10, 1943 2 Sheets-Sheet 2

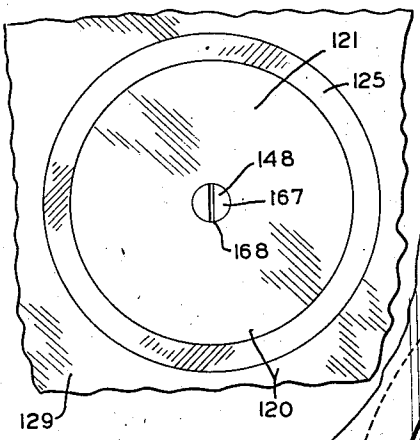


Fig.8.

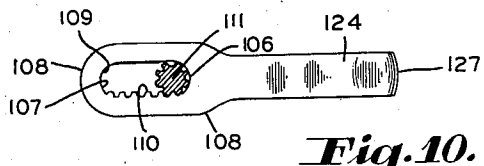


Fig.10.

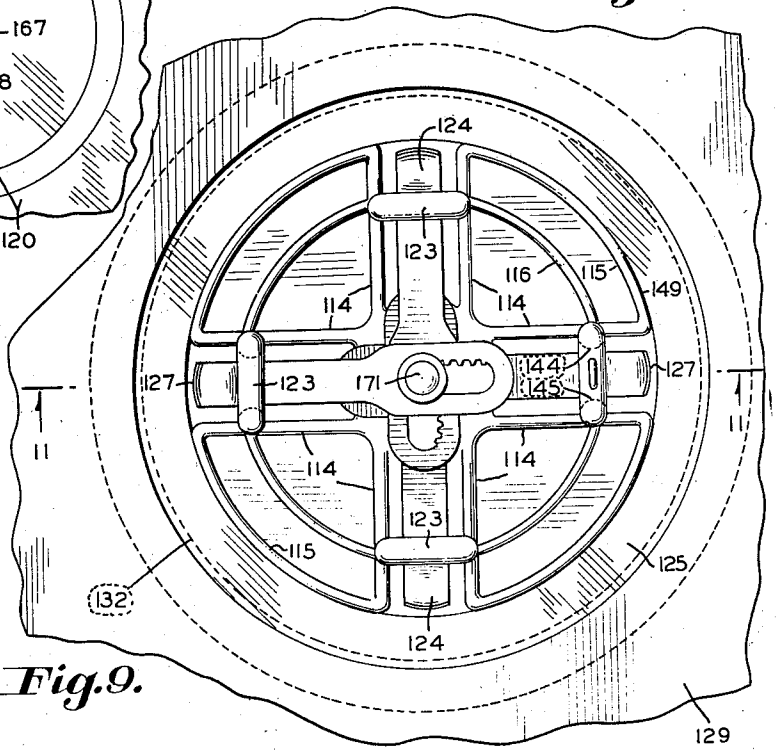
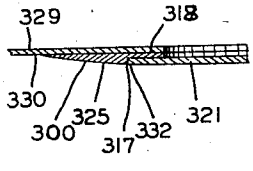


Fig.9.

Fig.15.



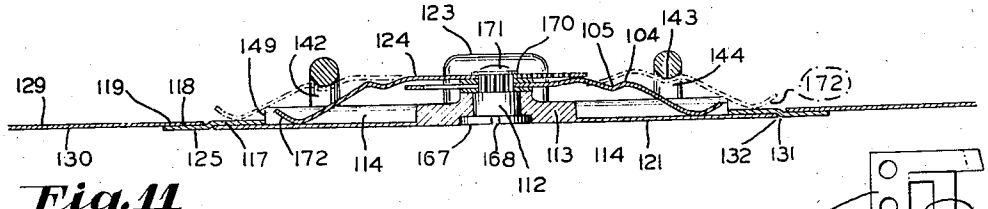


Fig.11

Fig.15.

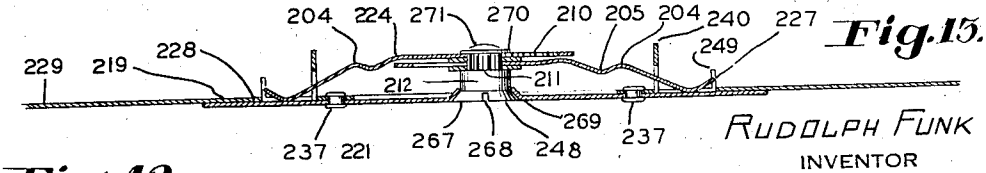


Fig.12.

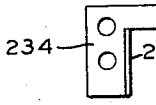


Fig.14.

RUDOLPH FUNK
INVENTOR

BY Richard S. Jemko
ATTORNEY

Patented Dec. 25, 1945 2,391,407

UNITED STATES PATENT OFFICE

2,391,407

DETACHABLE PORT COVER

Rudolph Funk, Hagerstown, Md.

Application June 10, 1943, Serial No. 490,297

2 Claims. (Cl. 292—7)

This invention relates generally to port closures and more particularly to a detachably engageable cover plate. While the present invention finds particular utility in covering and uncovering openings in the outer skin or fabric of airplane fuselages and similar structures, it will, of course, be obvious to those skilled in the art to which the present invention relates that this invention may be used as a detachable cover for openings of various kinds.

Among the principal objects of the invention lies the provision of detachable cover plate structure which when in the closed position thereof may have the outer or front face thereof in flush position with relation to the surrounding structure. This coplanar relationship of the outer surface of the cover plate and the contiguous outer surfaces of the objects being closed is desirable for many reasons among which are inconspicuousness from the point of view of esthetic design; safety in that no protuberances are presented which are likely to accidentally catch or strike other objects; and low parasitic drag or air resistance when used upon airplanes or similar bodies capable of high speed motion through the air.

Another object herein lies in the provision of detachable cover plate structure which may be readily removed and replaced so that the same may be used in connection with all types of emergency apparatus.

Another object herein lies in the provision of detachable cover plate structure which is very easily manipulated without the use of any special tools or skill.

Another object herein lies in a provision of devices of the class described which may have a long operative life with substantially foolproof and trouble free operation.

An important feature of the present constructions lies in the fact that the same are not deleteriously affected during the course of their normal operation by large ranges in temperature or high degrees of vibration.

Another object herein lies in the fact that by reason of the resilient coaction of the parts, they may accommodate in position with relation to each other so that close tolerances need not be maintained and the parts will function even after some distortion may have taken place either by reason of accident or slightly inaccurate assembly.

An object herein lies in the provision of detachable cover plate construction which may be readily installed upon an object even after the object itself has been completely fabricated.

A still further object herein lies in the provision of a structure of the class described which may be manufactured in relative high quantity at comparatively low cost, thus permitting a wide distribution and use both on devices intended for civilian use as well as those intended for military use.

These objects and other incidental ends and advantages will more fully appear in the progress of this disclosure and be pointed out in the appended claims.

In the accompanying drawings forming a material part of this disclosure similar reference characters designate corresponding parts throughout the several views in which

Figure 1 is a fragmentary front elevational view of a first embodiment of the invention shown in an engaged or closed position thereof.

Figure 2 is an enlarged fragmentary elevational view of the device shown in Figure 1, seen from the rear.

Figure 3 is a developed plan view of the blank used to form the spider element.

Figure 4 is a fragmentary sectional view as seen from the distorted plane 4—4 on Figure 2.

Figure 5 is a fragmentary sectional view as seen from the plane 5—5 on Figure 2.

Figure 6 is a developed plan view of the blank used to form one of the guide elements.

Figure 7 is a rear elevational view taken similarly to Figure 2 but showing the latching fingers in the disengaged or open position thereof.

Figure 8 is a fragmentary front elevational view of a second embodiment of the invention shown in an engaged or closed position thereof.

Figure 9 is an enlarged fragmentary rear elevational view of the device shown in Figure 8, unlatched.

Figure 10 is a top plan view of one of the latching fingers as removed from the device and showing a horizontal sectional view of the pinion of the operating element at the level of engagement with the latching finger.

Figure 11 is a fragmentary sectional view as seen from the plane 11—11 on Figure 9.

Figure 12 is a fragmentary sectional view corresponding generally to Figure 11 but showing a third embodiment of the invention.

Figure 13 is a developed plan view of one of the guide elements of the third embodiment of the invention.

Figure 14 is a plan view as bent up from the blank shown in Figure 13.

Figure 15 is a fragmentary sectional view show-

ing a modification of the rim reinforcement shown on Figure 11.

Turning now to the first embodiment of the invention illustrated in Figures 1 to 7 inclusive, the detachable cover plate device is generally indicated by numeral 20 and comprises broadly a cover element 21, a spider element 22, a plurality of guide elements 23, a plurality of latching fingers 24, an orifice rim 25, and resilient means 26.

The present device may be used, of course, with any object having an opening and presenting a rim which the outer terminals 27 of the latching fingers 24 may engage. For the purpose of illustration I have shown the device as combined with a circular orifice 28 in the outer skin 29 of an airplane fuselage (not shown), and this outer skin is shown as being composed of a metal sheet. As best seen in Figure 4 of the accompanying drawings, the skin or metal sheet 29 adjacent to the orifice rim 25 is deformed so as to produce a flange which is coextensive with the orifice rim. The flange or rim 25 is spaced in position with relation to the outer surface 30 of the skin 29 by the rabbet portion 31.

The cover element in the case of a circular orifice rim 25 is correspondingly shaped to have a circular peripheral edge 32. In order to save weight and to promote the rigidity of the cover element the outer edge thereof is dished as indicated by numeral 33 on Figure 4. The greatest diameter of the cover element 21 is substantially equal to or slightly less than the greatest diametrical distance between opposed portions of the rabbet 31.

The guide elements generally indicated by numeral 23 are substantially identical and a detailed description of one will suffice for all. As seen in Figure 6, the guide element 23 includes a base 34 provided with a plurality of orifices 35 by means of which it is secured to the rear or under surface 36 through the use of rivets 37. The base 34 includes that portion of the guide element 23 disposed between the inner bend line 38 and the outer bend line 39. The inner guide member is indicated by numeral 40 and includes the spring anchoring orifice 41. The blank, as shown in Figure 6, is provided with a substantially rectangular orifice 42 having a top edge 43, a first side edge 44, a second side edge 45 and a bottom edge 46. The distance between the top edge 43 and the bottom surface 47 of the base 34 affects the effective pressure of the latching fingers in the closed position thereof and the frictional resistance to rotation of the operating element 48, depending of course, upon the positioning of other parts. The distance between the said edges 45 and 44 is preferably slightly greater than the width of the latching fingers to allow the curved path of travel which they take during normal operation as will more fully appear hereinbelow. The outer guide member 49 is disposed outwardly of the outer bend line 39, includes a substantially straight edge 50 and a substantially curved or rounded edge 51. The curved edge 51 facilitates the insertion of the assembled cover plate within the rim 25 while the substantially straight edge 50 permits the proper flexure of the latching finger during the normal range of operation. All of the guide elements 23 are preferably of uniform construction for the purpose of low cost in large scale production though, as will be apparent, the anchoring orifice 41 of only one of the guide elements 23 is actually used. The guide elements 23 are preferably uniformly spaced about the periphery of the cover element 21 and the innermost surfaces 52 of the inner guide members 40 are preferably substantially perpendicular to an imaginary line drawn through the axis of rotation of the spider element 22 and bifurcating the latching fingers 24. The inner and outer guide members 40 and 49 respectively, in the finished form of the guide element 23 are preferably substantially perpendicularly arranged with respect to the base 34.

The spider element 22 which functions as an interconnector for the inner ends of the several latching fingers 24 is preferably formed as shown in Figure 3 and is provided with a central orifice 53 and a plurality of radiating orificed ears 55, 56 and 57, having the orifices 58, 59 and 60 respectively. One of the ears for example the ear 55, includes an extending spring anchoring portion 61. The portion 61 may be provided with suitable indentations 62 to receive one of the eye ends 63 of the spring 64. This portion 61 is preferably formed by bending the same perpendicularly about the bend line 65.

The central orifice 53 of the spider element 22 may have a key 66 projecting from an edge thereof, said key being adapted to engage a correspondingly positioned groove in the operating element 48. Other suitable means may be employed to integrate the spider element 22 with the operating element 48 so that these two elements may rotate as a unit. As best seen in Figures 1 and 4, the head 67 of the operating element 48 may be provided with a groove 68 adapted to receive any substantially universally available tool such as a screw driver or coin edge. The peripheral rear surface of the head 67 may be of frustoconical shape and adapted to be seated in a corresponding formation in the edges of the central orifice 69 in the cover element 21. Where, as shown, the cover element is composed of sheet material, the edges of the orifice 69 may be deformed for that purpose. In order to properly position the parts and to form a substantial bearing therefor a washer 70 is provided. The configuration of the washer is best seen in Figure 4 and it is disposed between the inner surface of the spider element 22 and the inner or rear surface of the cover element 21. The washer 70 has a central orifice which is of a diameter substantially equal to the greatest diameter of the hollow rivet-like shank 71 of the operating element 48.

The latching fingers 24 are of substantially identical construction and in order to avoid repetition a detailed description of one will suffice for all. The fingers 24 are preferably composed of pieces of strip stock and may be made of any suitably resilient material as for example, spring steel or phosphor bronze. The outer terminals of the fingers 27 are provided with rounded portions 72. These rounded portions are for the purpose of enabling the outer terminals of the fingers to rise (upwardly as viewed in Figure 4) over the edge of the rim 25. The fingers 24 do this when they are radially extended with relation to the operating element 48 by a wedging or camming action. The inner ends of the fingers 24 are provided with suitable orifices and are pivotally attached to the ears 55, 56 and 57 by means of rivets 73.

The spring 64 is articulately at an eye end 63 thereof connected to the portion 61 and the other end thereof engages the spring anchoring orifice 41 in the oppositely disposed guide element 23.

By way of example, one manner of assembling the device is here described. The fingers 24 are pivotally riveted to the ears of the spider element. The guide elements 23 may be placed upon the fingers 24 either before or after the last described

riveting operation since the orifices 42 are large enough to permit passage therethrough of the deformed outer ends 27. The operating element 48 is now placed within the orifice therefor 69 in the cover element 21 and the shank 71 is passed through the washer 70 and through the orifice 53 so that the rear groove therein engages the key 66. The rear end of the shank 71 is then swaged over. The guide elements 23 may now be secured in place by the rivets 37. Lastly, the spring 64 is snapped into place.

The mode of operation of the device as presently understood is as follows: As viewed in Figure 2 when the spider element 22 is rotated in a clockwise direction as indicated by the arrow 80, a rotation which is obtained by rotating the head 67 of the operating element 48 in a counter-clockwise direction, the spider element pulls the latching fingers radially inwardly in a curved path. During this stage the spring 64 is being expanded and as soon as the spring passes over the axis of rotation of the operating element 48 it goes beyond the dead center position and contracts so that the parts take the position shown in Figure 7. In this position the inner portions 74 of the rounded portions 72 strike against the edges 75 of the guide elements 23 which act as detents therefor. If the spring 64 is of sufficient contractile strength it may cause the rounded portions 74 to ride upon the bases 34 so that the most retracted position of the fingers 24 will be when the middle portions thereof abut against the inner extremities of their neighbors. Ordinarily this will not occur. However, the spring fingers are partially distorted and take an angle illustrated in Figure 4 caused by the elevation of the ends thereof by reason of the rounded portions 72. This distortion of the spring fingers in the opening and closing movements of the fingers causes a certain amount of friction between the rear or upper surfaces of the fingers and the top edges 43 of the guide elements 23. With the outer terminals 27 of the fingers in retracted position as just described, the entire cover plate device indicated generally by numeral 20 may be withdrawn from the circular orifice 28. The replacement of the cover of the device 20 is accomplished by reversing the above described procedure. It may be noted at this point that in replacing the cover elements with the parts attached thereto to engage within the orifice 28 that the outer guide members facilitate the proper positioning of the cover element. After the cover element is seated, the operating element 48 is rotated in a clockwise direction as viewed in Figure 1, which causes the parts to travel in the direction of the arrow 81 on Figure 7. Here again the spring 64 passes the dead center position to urge the latching fingers in their radially outward movement. By reason of the resiliency of the fingers, the outer terminals 27 are urged downwardly as viewed in Figure 4 to constantly resiliently and frictionally engage the rim 25 and they are supported in this engagement by the guide elements. It may be noted that the spring 64 is still under tension in the position it occupies in Figure 2 and that further counter-clockwise rotation of the spider element is prevented by the engagement of the side edges of the fingers against the straight edges 50 and the side edges 44 of the guide elements 23.

Turning now to the second embodiment of the invention illustrated in Figures 8 to 11 inclusive, the detachable cover plate device is generally indicated by numeral 120 and comprises broadly a cover element 121, a plurality of guide elements 123, a plurality of latching fingers 124, an orifice rim 119, an orifice rim reinforcement 125, and an operating element 148.

The second embodiment may be used with any objects having an opening and presenting a rim which the outer terminals 127 of the latching fingers 124 may engage. In the second embodiment of the illustration, structure is shown which may be almost completely fabricated of plastic materials. Such plastic materials may be of any of the well known types as for example, thermosetting phenolics, or high melting point thermoplastics. In accordance with the second embodiment of the invention, the cover element may co-act with a deformed orifice rim such as the rim 25 previously described, or the same may co-act with a raw edge in a piece of taut fabric by the use of the orifice rim reinforcement 125. Thus, by the use of this embodiment the installation of a removably covered port at any point on a fabric covered fuselage of an aeroplane may be readily and conveniently accomplished. Where the periphery 132 of the cover element 121 is circular, it becomes necessary only to cut a correspondingly shaped orifice in the skin 129 and to cement thereon over the circular area 118 the orifice rim reinforcement 125 which may have a recessed inner flange 117. The recessing of the inner flange 117 may be formed by the rabbet portion 131.

In order to save weight and material and to promote the flush mounting and the rigidity of the cover element 121 the rear or inner surface of the cover element is provided with circularly disposed reinforcing ribs 116 and 115, and radially disposed ribs 114. The radially disposed reinforcement ribs 114 radiate from a central hub 113. The radial ribs 114 are arranged in pairs and bridging thes pairs are the guide elements 123. The greatest diameter of the cover element 121 is substantially equal to or slightly less than the greatest diameterical distance between opposed portions of the rabbet 131.

The guide elements generally indicated by numeral 123 are substantially identical and a detailed description of one will suffice for all. A guide element 123 is preferably of U-shape and thus forms a rectangular orifice 142 and side edges 144 and 145. The distance between side edges 144 and 145 is preferably slightly greater than the width of the latching fingers to permit said fingers to radially reciprocate therebetween. The radially outermost surface of the rib 115 forms a guide member 149. It may be noted at this point that the ribs 115 and 116 extend between the pairs of the radial ribs 114. The guide member 149 facilitates the insertion of the assembled cover plate within the rim reinforcement 125.

The guide elements 123 are preferably uniformly spaced about the periphery of the cover element 121 and are arranged generally perpendicularly to imaginary lines drawn through the axis of rotation of the operating element 148 and extending along the longitudinal axis of each of the latching fingers 124. The operating element serves to interconnect the inner ends of the latching fingers 124 and is preferably formed as shown in Figure 11. The operating element 148 includes a head 167 which may be provided with a groove 168 adapted to receive a screw driver, coin edge, or similar tool. The element 148 inwardly or rearwardly of the head 167 in-

cludes an axle 112 which is journaled in a suitable central orifice in the hub 113. Projecting rearwardly or inwardly from the inner end of the axle 112 is a pinion 111. The smaller terminal 171 of the operating element 148 projects from the pinion 111 and this terminal is adapted to have placed thereon a washer 170. The washer 170 has a central orifice which is of a diameter substantially equal to the greatest diameter of the terminal 171.

The latching fingers 124 are of substantially identical construction and in order to avoid repetition a detailed description of one will suffice for all. The fingers 124 are preferably composed of pieces of strip stock and may be made of any suitably resilient material as for example, spring steel or phosphor bronze. The outer terminals 127 of the fingers 124 are provided with rounded portions 172. These rounded portions are for the purpose of enabling the outer terminals of the fingers to rise upwardly as viewed in Figure 11 over the edge of the reinforcing rim 125. The fingers 124 do this when they are radially extended with relation to the operating elements 148 by a rack and pinion action. The pinion is the pinion 111 and the racks indicated by numeral 110 (see Figure 10) are integral with each of the fingers and extend from one side edge of an elongated slot 109 in the inner end 108 of the fingers 124. As will be clear from a perusal of Figure 10, when the pinion 111 is rotated in a counterclockwise direction as viewed in said figure, the finger 124 will be extended to the right or radially of the device, a limit being reached when the pinion abuts against the inner end 107 of the slot 109. A reversal in the direction of rotation of the pinion 111 will cause the finger 124 to be retracted with relation to the edge of the device which movement will be stopped when the pinion abuts against the outer end 106 of the slot 109.

The latching fingers are generally more curved before assembly than shown in the drawings so that when they are stacked and nested upon the pinion 111 and washer 170 is put in place, and the terminal 171 swaged over or riveted, the outer ends 127 exert a resilient pressure through the rounded ends 172 upon the rear or under surface 136 of the cover element 121 (downward pressure as viewed in Figure 11).

Spaced inwardly from the ends 127 each of the latching fingers 124 is bent to form an undulation or indentation 105 which is adapted to resiliently engage the surfaces or edges 143 of the guide elements 123 when the fingers are in this fully extended position thereof. In reaching the said extended position, the protuberances 104 must pass beneath the edges 143 thus providing the passing of a dead center position and a snap action as the fingers 124 reach their extended reinforcement rim engaging position.

It may thus be seen that since all of the racks 110 are in constant mesh with the pinion 111, rotation of the head 167 will cause simultaneous operation of all of the fingers 124. So then, as illustrated, clockwise rotation of head 167 (Fig. 8) will retract the fingers 124 so that the cover element 121 may be removed or opened, and clockwise rotation of the head 167 after the guide member 149 has been seated within the inner edge of the flange 117 of the rim 125, will extend the fingers 124 to latch the cover element in place in its closed position.

Turning now to the third embodiment of the invention shown in Figure 12, it will be seen that this form is generally similar to the second embodiment, but the cover element 221 is made of thin sheet material such as metal. The guide elements 223 are also made from sheet material and are secured in place by rivets 237. Other suitable fastening means may be of course, substituted for the rivets.

The guide elements 223 include an inner guide member 240 and an outer guide member 249. The guide members 240 and 249 project from an L shaped base 234. The fingers 224 penetrate the orifices 242 while the undulations or depressions 205 coact with the top edge 243 of the orifice 242. The outer guide members 249 aid in properly seating the cover element 221 within the orifice 228. Fitting of the operating element 248 for rotation is accomplished by countersinking the edge portion of the orifice 269. For the purpose of avoiding needless repetition, other parts corresponding to the second embodiment are given the same reference characters with the prefix "2".

In all three of the described embodiments, it will be noted that in the closed or latched position of the cover element, there is a resilient engaged position caused by the action of the resilient fingers 24, 124, or 224 and by the spring 64 or the protuberances 104, 204. This mode of operation enables the present port closure constructions to withstand the effects of vibration and contraction and expansion due to changes of temperature.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, because obvious modifications will occur to a person skilled in the art.

In the modification shown in Figure 15, an altered form of orifice rim reinforcement structure is shown. This construction provides for smooth air flow and easy attachment to the fuselage skin. The reinforcement 325 tapers outwardly so that the cover element 321 may lie outwardly of the outer surface 330 of the skin 329 and yet a streamlined result is obtained. In the use of this modification, the reinforcement 325 may be cemented or otherwise secured to the outer surface 330 of the skin 329 at any desired location and the skin disposed within the orifice of the reinforcement 325 is removed. The periphery 332 of the cover element 321 will then fit detachably within the circular rabbet 317. Numeral 318 indicates the cementing area. The tapered portion 300 reduces air drag to a minimum.

I claim:

1. A detachably engageable cover plate for use with a surface having a port, comprising: a cover element having a periphery; a plurality of guide elements connected to said cover element; said guide elements including an outer guide member adapted to engage the edge of said port, and an inner guide member having an orifice; a plurality of latching fingers slidably disposed within said guide members; said outer guide members acting to place and position the cover element with respect to the edge of said port; said latching fingers being shiftable outwardly to engage the edge of said port and inwardly to disengage the edge of said port.

2. A detachably engageable cover plate for use with a web having a port, comprising: a cover element having a periphery; a plurality of guide elements connected to said cover element; said guide elements including an outer guide member adapted to engage the edge of said port and an inner guide member having an orifice; a plurality of latching fingers slidably disposed within said inner guide members; said outer guide members

being positioned with respect to each other and with respect to the periphery of the cover element that they act to position the cover element with relation to the edge of said port; said latching fingers being shiftable outwardly to engage the edge of said port and inwardly to disengage the edge of said port; each of said latching fingers being composed of resilient material and having a depression adapted in the closed position of the finger to be engaged by the edge of the orifice of the inner guide member which the latching finger penetrates.

RUDOLPH FUNK.