United States Patent

Flournoy et al.

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[54] LOCKING MECHANISM AND ACTUATING MEANS THEREFOR

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[52] **U.S. Cl.**.....**292/302,** 292/33, 292/144, 92/117

[51] **Int. Cl.**.....**E05c 19/00,** E05b 51/02, E05c 15/00

[58] **Field of Search**.....292/302, 144, 33, 341.16, 256, 292/256.5, 365, 370; 70/264, 275; 285/308

[56] **References Cited**

UNITED STATES PATENTS

1,509,000	9/1924	Simpson	92/117 X
1,594,084	7/1926	Weymann	292/302
2,216,208	10/1940	Michon	83/701
2,688,865	9/1954	Foster et al.	70/275 X
3,004,756	10/1961	Williams	292/33 X

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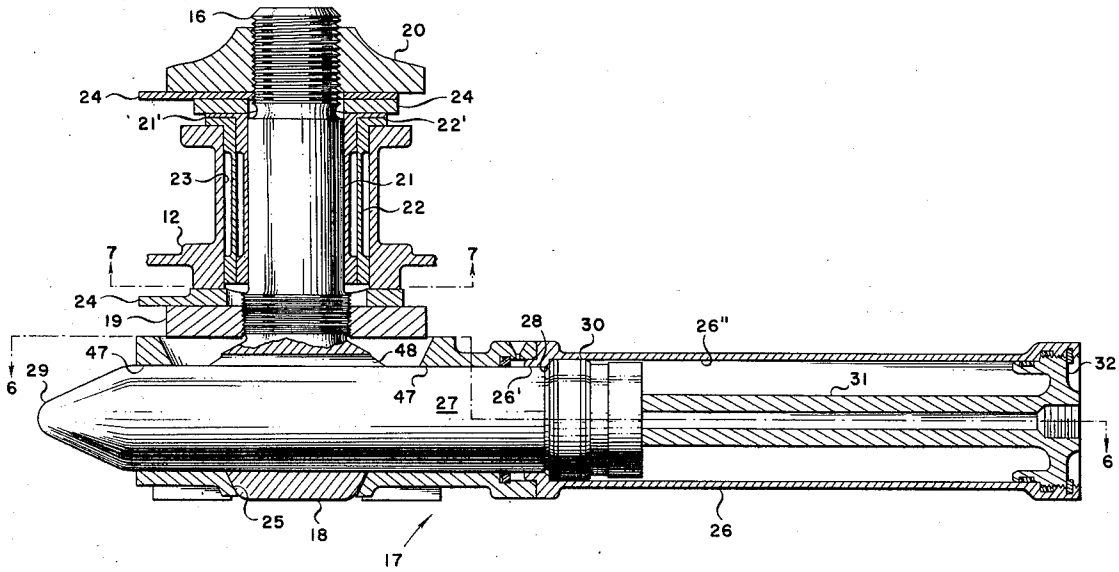
[57] **ABSTRACT**

There is provided herein a receptacle base with self-aligning conical stud which is mutually retained by a pin containing an internal, concentrically mounted hydraulic actuator to permit maximum locking and unlocking force in minimal space. Double eccentric bushings in conjunction with double axial nuts provide three mutually perpendicular adjustments for the stud and receptacle. Conical male and female lock members provide repeatability of location one member to the other which in conjunction with the three mutually perpendicular adjustments minimize the required accuracy of location of the several elements which comprise the mechanism.

9 Claims, 7 Drawing Figures



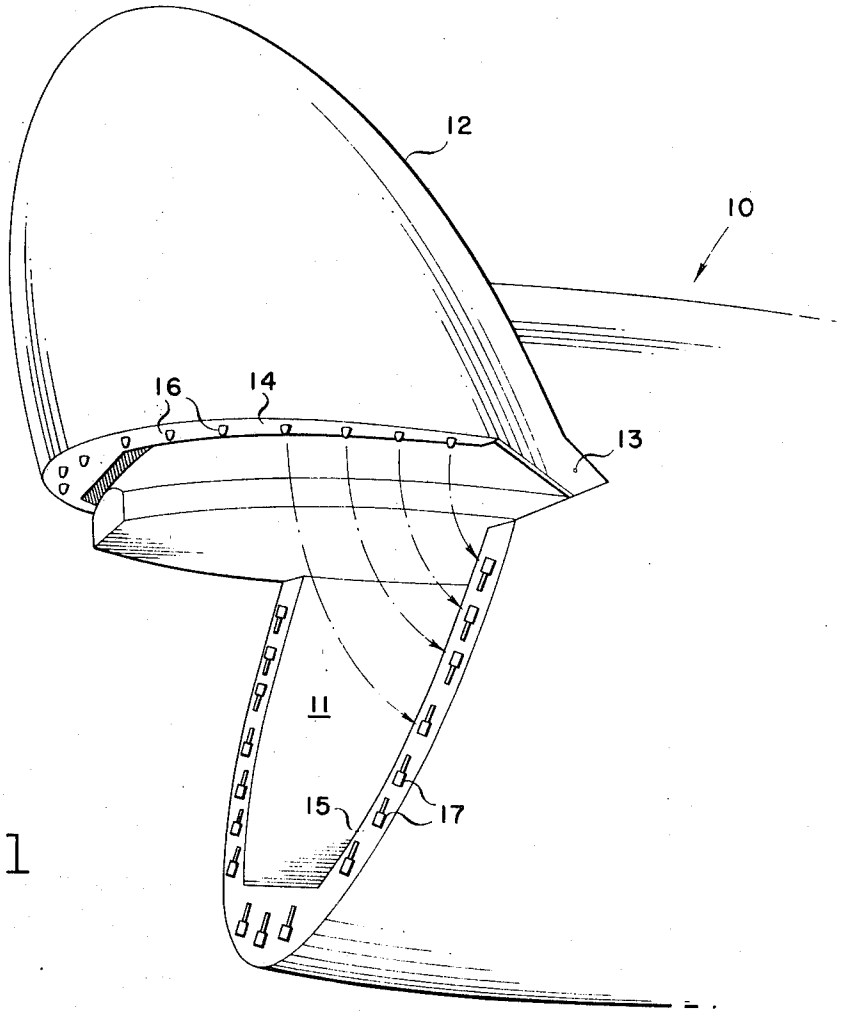
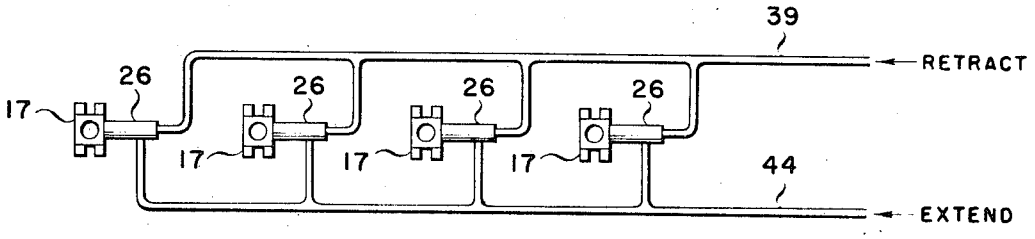


FIG. 1

FIG. 2



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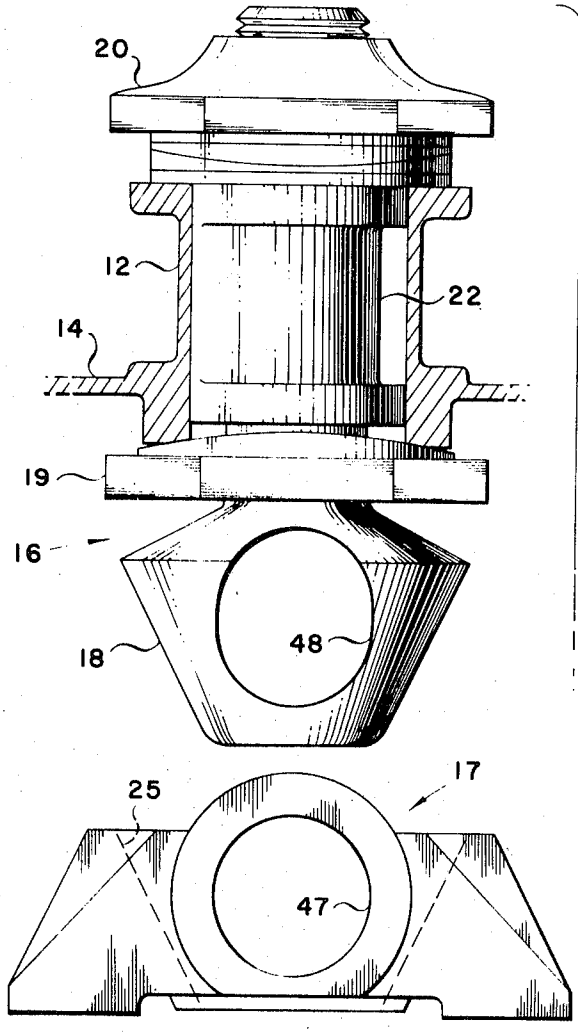
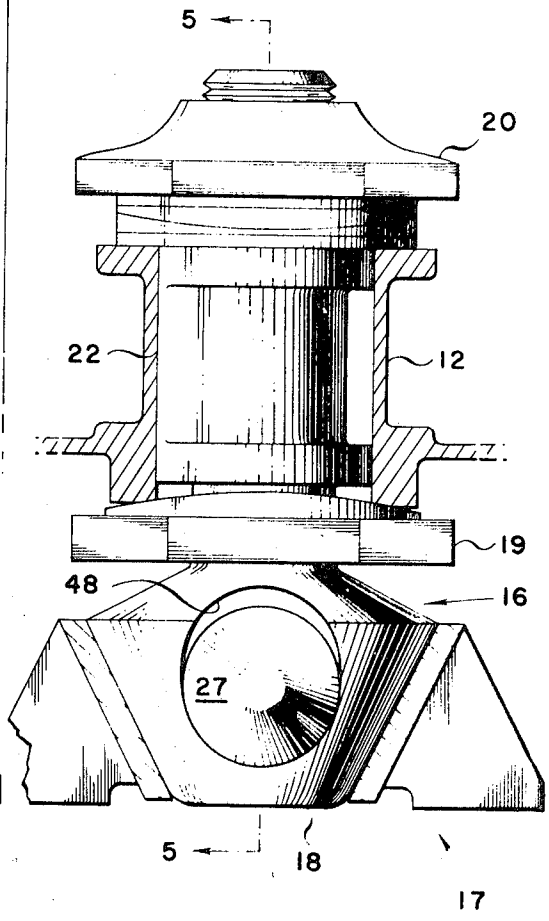


FIG. 3

FIG. 4



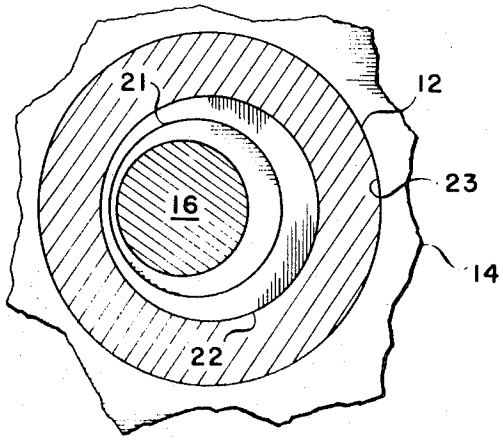


FIG. 7

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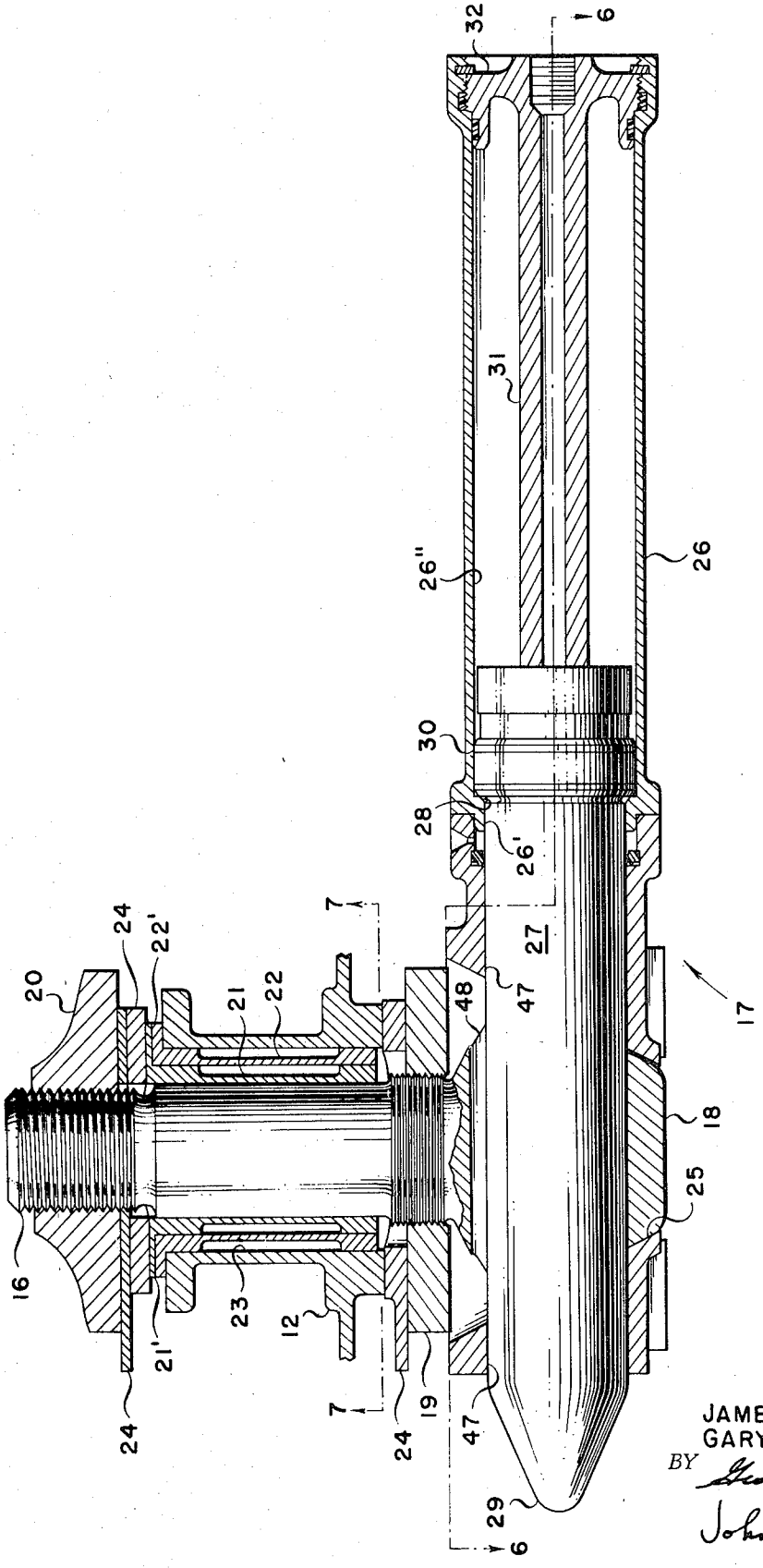

FIG. 5

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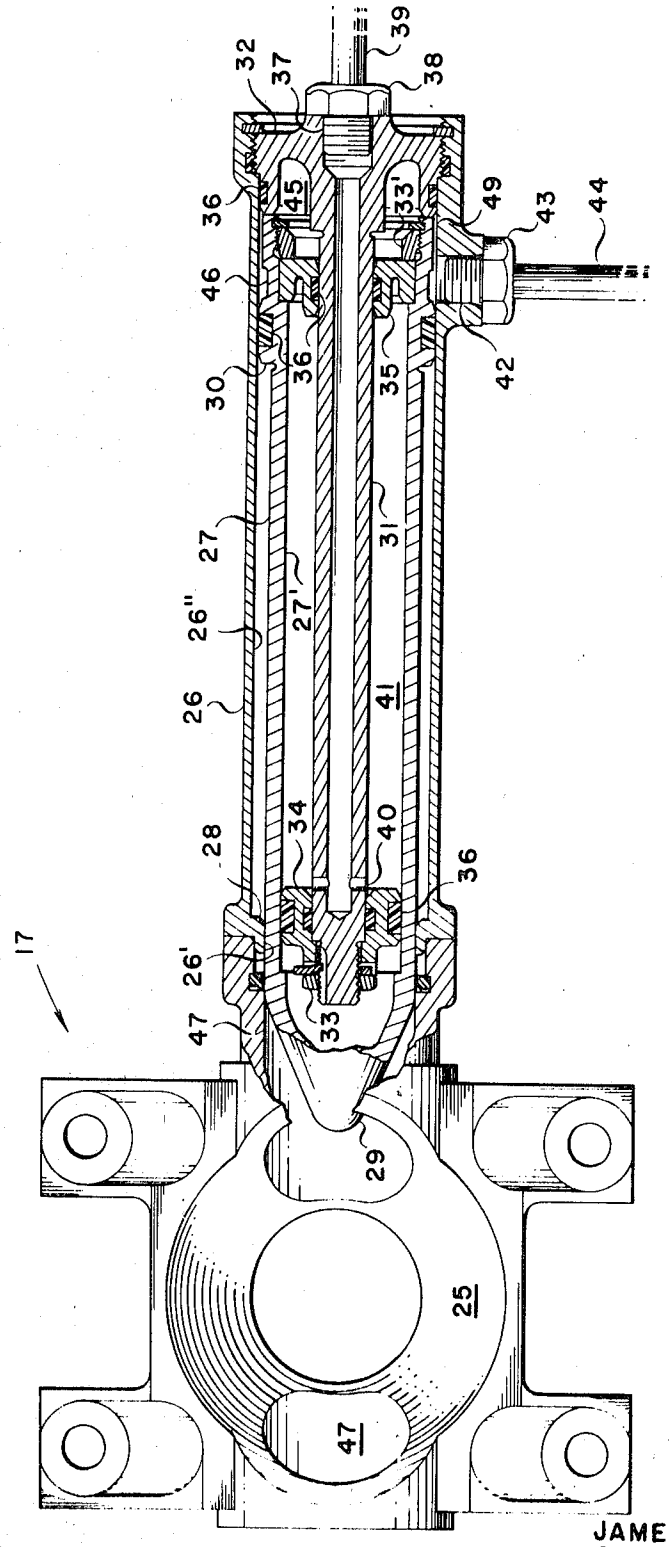

FIG. 6

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LOCKING MECHANISM AND ACTUATING MEANS THEREFOR

This invention relates to locking systems and more particularly to a locking mechanism and the actuating means therefor which is especially designed and constructed to assure against misalignment of the relatively movable associated members which it is intended to secure and release repeatedly and to be employed as multiple interconnecting units, i.e., in gang arrangement.

While the locking mechanism herein proposed is designed and intended for general application and use wherever a positive releasable connection is desired, it offers particular advantages and utility in the case where a comparatively large and massive, relatively movable member is involved. Consider, for example, the access doors of present day cargo aircraft, particularly the type disclosed in U.S. Pat. No. 3,374,972 issued Mar. 26, 1968, to James A. Webb. This patented door comprises the nose section of the fuselage which is pivotally connected at each side of the fuselage of the aircraft and adapted to swing vertically in visor fashion to and from closed and open positions where it forms an aerodynamically smooth and clean continuation of the fuselage for flight and an overhead umbrellalike extension for on-and-off loading operations.

It is, therefore, important that this visor nose door, after each opening, be closed in precisely the same manner, relocated to a preselected position and locked in a reliable fashion to assure against inadvertent opening especially in flight under pressure loads both internally and externally applied. This is complicated because of the sheer size and mass of the nose door structure, its comparatively fragile hinge supports, its generally hollow configuration, and its extended disposition from the fuselage where it is exposed to wind gusts and the resulting forces.

At the same time, because of the total length of the interface surfaces between the nose door and the fuselage, multiple points of connection are required and critical not only to assure a positive lock but also a good seal inasmuch as the interior of such aircraft is pressurized. This introduces the need for interconnecting means between said connection points to facilitate the quick operation thereof, if the demanding requirements of turnaround time, i.e., the time required to load and unload the aircraft of cargo set by the aircraft operators and airfields, are to be met.

Further complications reside due to the limited space and area available for a locking mechanism or system of interconnected locking mechanisms having such necessary attributes as those mentioned above. The weight which such a system will add to the aircraft is also a factor to be considered as is the question of inspection and maintenance.

The present invention directs itself to the above and other problems and considerations and to that end contemplates a locking mechanism of minimum size and weight to effect a lock of maximum strength in a reliable manner. Special provisions are included to facilitate the installation of this locking mechanism with allowances to permit a wide range of tolerances in the manufacture of parts (such as the nose door and fuselage in the aircraft application described above) with which it is associated. Also the interconnection of multiple such loading mechanisms assures the instantaneous operation of all in unison.

More specifically, the locking mechanism herein proposed includes mating pin and receptacle elements of tapered configuration, one carried by the relatively movable member or door and the other carried by the relatively stationary member or fuselage. One of these elements is adjustable both linearly and radially within predetermined limits to assure their totally engaged position. Thus located, passages piercing each of the elements are located in alignment and a pin or bolt corresponding in transverse dimension to that of the passages is linearly operable for insertion therein. Preferably the bolt is mounted in a container carried by and projecting from one of the elements and terminates in a generally conical end to facilitate such insertion. This bolt is power actuated by a source common to the several bolts so that all of the locking mechanisms that comprise the system are actuated simultaneously.

With the above and other objects in view as will be apparent, this invention consists in the construction, arrangement, and fabrication of parts all as hereinafter more fully described, claimed, and illustrated in the accompanying drawings wherein:

FIG. 1 is an isometric view of the forward end of an airplane having a nose visor door as disclosed in the above-mentioned patent to illustrate generally the coacting pin and receptacle elements of the present locking mechanism as they relate thereto;

FIG. 2 is a schematic diagram of the operating system for actuation of the several bolts of the locking mechanism in unison by hydraulic pressure operating thereon from a suitable source;

FIG. 3 is a front elevation of one pair of the pin and receptacle elements as illustrated generally in FIG. 1 to show the details thereof whereby they coact to perform the locking and unlocking function, the adjacent portion of the associated structure being shown in section;

FIG. 4 is a similar view showing the pin and receptacle elements in the engaged position and locked by the associated bolt, part of the receptacle element being shown in section;

FIG. 5 is a section taken along the line 5—5 of FIG. 4 to show the bolt and its actuating mechanism with the bolt secured in its locked position;

FIG. 6 is a view taken generally from the bottom of FIG. 5 as indicated by the line 6—6 and showing the bolt in its other extreme position, i.e., unlocked, the pin element of the mechanism having been removed for clarity; and

FIG. 7 is a transverse section taken along the line 7—7 of FIG. 5 to show primarily the means, i.e., the double eccentrics, for coaxially adjusting the pin and receptacle elements.

Referring more specifically to the drawings, **10** designates the forward portion of a cargo type of aircraft in which a storage compartment or hold **11** is located. An end closure **12**, hinged as at **13** to the opposite sides of the aircraft **10**, is adapted to swing with respect thereto to and from open and closed (up and down) positions with respect to the hold **11**. The adjacent edge surfaces **14** and **15** of the closure **12** and aircraft **10** respectively are adapted to abut when the hold **11** is closed so that the external or skin surfaces of the closure **12** and aircraft **10** form a smooth and continuous aerodynamically clean body during flight.

Associated with the edge surfaces **14** and **15** is a plurality of pin and receptacle elements **16** and **17** as well as connector bolts **27** therefor all of which coact to constitute locking means to secure the end closure **12** to the aircraft body **10** when it is in the closed position and the cargo hold **11** covered thereby. Preferably the pin element **16** of each of these several connectors is carried by the end closure **12** and the several coacting receptacle elements **17** and connector bolts **27** carried by the aircraft body **10**. Since each pair of these pin, receptacle, and bolt elements **16**, **17**, and **27**, respectively, is identical to each other, the specific detailed description of one set will in fact describe them all.

Each pin element **16** terminates at one end in a generally frustoconical head **18** and adjacent external threads. At its other end, the pin **16** terminates in similar external threads. A nut **19** and **20** coacts with each of these threaded ends, serving to work in opposition to each other in the mounting and retention of a pair of eccentric bushings **21** and **22** in a preselected relative angular position therebetween and to closure structure **12** by which the longitudinal centerline of the pin **16** is precisely located within a selected range of positions.

More specifically, the closure body **12** is pierced by or otherwise provided with an aperture **23** that opens on the edge surface **14**. The bushings **21** and **22** are substantially coextensive in length one with the other and with the aperture **23** being flanged as at **21'** and **22'** for abutment of the inner bush-

ing 21 against the outer bushing 22 and the outer bushing in turn against the closure structure 12 defining the aperture 23. The smaller or inner bushing 21 has an internal diameter approximately equal to the outside diameter of the pin 16 and an external diameter approximately equal to the internal diameter of the larger or outer bushing 22. The external diameter of the outer bushing 22 is approximately equal to the diameter of the aperture 23. Relative rotation of the bushings 21 and 22 thus adjusts the location of the longitudinal centerline of the pin 16 with respect to the aperture 23 to compensate for warpage, manufacturing discrepancies, or the like. Once the bushings 21 and 22 are located in the desired relative position, keying and locking devices such as washers 24 are employed between the ends thereof and the associated nuts 19 and 20 to secure them in this fixed position relative to closure structure 12.

Each receptacle 17 corresponding to one of the above-described pins 16 is fixedly secured to the abutting surface 15 of the aircraft body 10 and includes a central aperture 25 therein that is complemental to the frustoconical shape of the head 18 of the pin 16. Mounted on and projecting from one side of the receptacle 17 at substantial right angles to the aperture 25 therein is a cylindrical sleeve 26 which is adapted to receive and mount a piston 27 therein. To this end, the internal diameter of the sleeve or cylinder 26 adjacent the receptacle 17, at 26', is approximately equal to the external diameter of the piston 27 while the internal diameter of the remainder of the cylinder 26, as at 26'', is somewhat larger than the external diameter of the piston 27. A step 28 is thereby produced on the inner wall of the cylinder 26.

At its inner end with respect to the cylinder 26, the piston 27 terminates in a conical nose 29 giving it a bulletlike appearance. Adjacent its other or outer end the piston is formed or otherwise provided with a peripheral collar 30 having an overall diameter substantially equal to the larger internal diameter 26'' of the cylinder 26. Internally, the piston 27 is hollow to receive a tubular stem 31 projecting from a closure cap 32 which threadably engages the outer end of the cylinder 26 and serves as a fixed end wall thereon.

At its opposite end, located internally of the piston 27, the stem 31 is closed and externally threaded to receive and mount thereon a lock nut 33 having a stationary piston head element 34 extending therefrom in peripheral engagement with the internal cylinder wall 27'. A similar nut 33' and piston head element 35 is associated with the outer end of the piston 27 serving as a closure cap thereon and in peripheral engagement with the stem 31. The piston 27 is thereby mounted in a precise concentric position within the cylinder 26. Suitable seals 36, as appropriate, are provided between mutually adjacent portions of the piston 27 and cylinder 26, piston 27 and stationary piston head 34, piston head 35 and stem 31, and closure cap 32 and cylinder 26 to render the assembly fluid tight.

A fluid port 37 is provided in the end of closure cap 32 to which an appropriate fitting 38 is adapted to be secured connecting a fluid pressure line 39 from a suitable fluid source thereto. Thus, fluid under pressure entering the port 37 is directed through the tubular stem 31 to its closed end where it passes through a side opening or openings 40 in the stem wall and into the piston 27 filling the space 41 therein around the stem 31 and between the piston head elements 34 and 35. This serves to force the piston head elements 34 and 35 apart causing the piston 27 to telescope into the cylinder 26, i.e., contraction of the piston/cylinder assembly. The containment of the several parts 31, 34, and 35 concentrically within the piston 27 provides for a hydraulically operated retention bolt for the pin and receptacle elements 16 and 17 of minimum length and extension therefrom, as established by the cylinder 26.

A similar port 42, fitting 43 and fluid line 44 is associated with the outer end of the cylinder 26 adjacent the closure cap 32 which communicates with the interior of the cylinder 26 and around the collar 30 and into the space 45 between the piston head element 35 and the adjacent face of cap 32. To facilitate this, a peripheral groove 46 and passage 49 is provided in the peripheral surface of the collar 30. Thus, when the piston/cylinder assembly is contracted as above described, fluid in the space 45 is forced into passage 49 and groove 46 around the piston collar 30 and into the port 42 and line 44 to the source.

On the other hand, when fluid under pressure is delivered through line 44, groove 46, passage 49 and into space 45, it forces the piston head element 35 away from cap 32 extending the piston 27, i.e., causing extension of the piston/cylinder assembly. In this case fluid in the space 41 is forced through openings 40, into stem 31, port 37 and line 39 back to the source.

In order to permit this extension of the piston/cylinder assembly the sidewall of the receptacle 17 is pierced by an opening 47 having a transverse dimension greater than that of the piston 27. A similar opening 48 pierces the head 18 of the pin 16. Preferably, these openings 47 and 48 are substantially equal in diameter to the piston 27 and align one with the other when the head 18 is located in the receptacle 17. The piston 27 is thereby adapted to project into and through the pin 16 and receptacle 17 locking them against all relative movement.

As illustrated in FIG. 2, the several cylinders 26 are connected by appropriate fluid lines 39 and 44 to a common source of hydraulic pressure. Thus, actuation of the fluid pressure in one direction causes the locking of the several pin and receptacle mechanisms in unison whereas the operation of the fluid pressure in the opposite direction causes the unlocking thereof.

In view of the foregoing construction and arrangement, it is apparent that the several pins 16 are readily installed on the end section 12 in the proper position of adjustment both linearly by operation of the adjusting nuts 19 and 20 and in the two mutually perpendicular directions by adjustment of the eccentrics 21 and 22. Also, the precise engagement or home position of the several pins 16 in their respective receptacles 17 is assured by means of the conical shaping of each head 18 mating with its complemental surface 25 of the associated receptacle 17. In this home condition the several pistons 27 can be actuated in unison by operation of the hydraulic fluid pressure to lock the two against all relative movement. In this way the aircraft end section 12 is made to form a clean external aerodynamic surface or skin. The relatively movable end section 12 thus disposed is incapable of any movement until the release of the several pins 16 by operation of the hydraulic fluid system as described.

While shown and described in what is believed to be the most practical and preferred form or embodiment, it is apparent that departures from this specific structure will suggest themselves to those skilled in the art. Such departures and variations may be made without departing from the spirit and scope of the invention as covered by the appended claims.

What is claimed is:

1. A locking mechanism and actuating means therefor comprising:

a pin mounted adjacent one of its ends on a first structure and having a frustoconical head pierced by a transverse aperture adjacent its other end;

a receptacle mounted on a second structure and defined by an internal frustoconical surface complemental to said pinhead with a similar transverse aperture therethrough adapted to align with the aperture in said pin end when the pin end is located therein;

a container mounted on and projecting from one side of said receptacle and having an opening therein in alignment with the receptacle aperture aforesaid;

a bolt mounted for reciprocation in said container to and from positions totally within the container and extending therefrom through said opening therein and totally through said receptacle transverse aperture;

seals associated with the adjacent portions of said bolt and said container;

a port in said container communicating with opposite surfaces at the end of said bolt; and

a fitting mounted in each said port for the operative connection thereto of a source of fluid under pressure whereby fluid entering one of said ports forces said bolt to its extended position aforesaid through said receptacle aperture and pin aperture when the pin end is located therein while fluid entering the other of said ports forces said bolt to its contracted position totally within said container.

2. The invention of claim 1 including a plurality of eccentric bushings surrounding said pin and mounted for rotation on said first structure to thereby establish central openings having a predetermined disposition of its axis for location of the longitudinal centerline of the pin.

3. The invention of claim 1 including a pair of nuts threadably mounted on said pin on opposite sides of said first structure to establish and maintain the location of said pinhead relative to said first structure.

4. The invention of claim 1 wherein multiple of said locking and actuating mechanisms are associated one with another and connected to common fluid pressure lines whereby the actuation of all of the mechanisms occurs in unison.

5. The invention of claim 2 wherein two eccentric bushings are employed one disposed within and substantially coextensive with the other with the internal diameter of the inner bushing approximately equal to the outside diameter of said pin and the external diameter of the inner bushing approximately equal to the internal diameter of the outer bushing.

6. The invention of claim 1 wherein said first structure is pivotally mounted on said second structure for swinging movement relative thereto whereby said pinhead is located in and removed from said receptacle.

7. The invention of claim 1 wherein:

said container is a cylinder with its opening at one end thereof;

said bolt carries a piston head; and

said ports communicate with opposite sides of said piston head.

8. The invention of claim 7 wherein:

said cylinder includes an internal, stationary piston head proximate its said open end;

said bolt is tubular having a length substantially equal to that of said cylinder, an internal diameter substantially equal to the overall diameter of said stationary piston head and an effective external diameter substantially equal to the internal diameter of said cylinder; and

said bolt piston head is disposed at all times between said stationary piston head and the end of said cylinder remote from its open end.

9. The invention of claim 8 wherein one end of said tubular bolt is generally conical and disposed at all times on the opposite side of said stationary piston head with respect to said bolt piston head.

* * * * *