



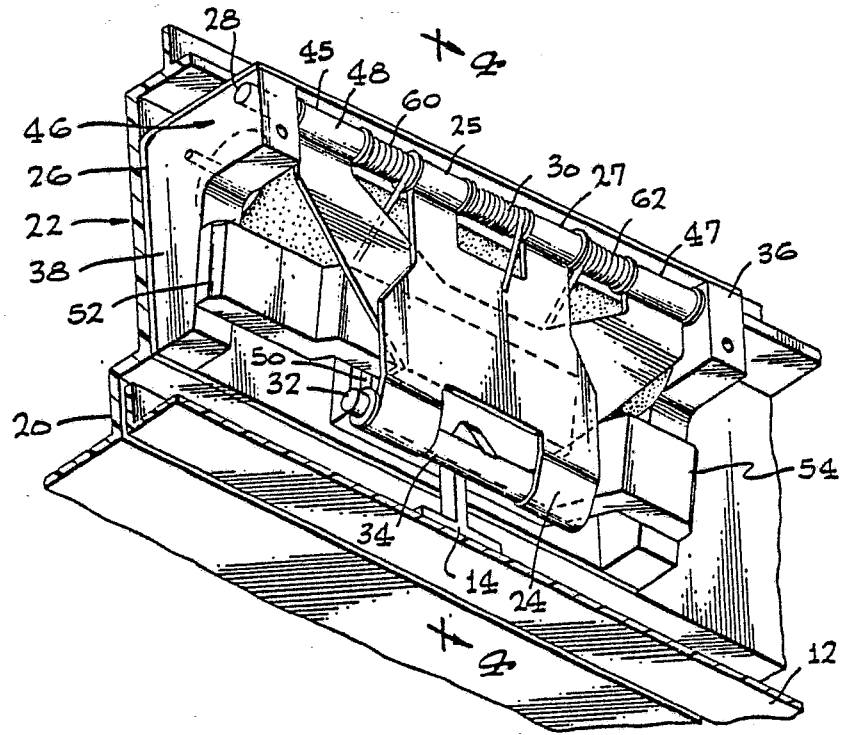
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/US82/01270 (22) International Filing Date: 16 September 1982 (16.09.82) (71) Applicant: LOCKHEED CORPORATION [US/US]; 2555 North Hollywood Way, Burbank, CA 91520 (US). (72) Inventor: LEVINE, Harold, Henry ; 10131 Viking Avenue, Northridge, CA 91324 (US). (74) Agent: KEIICHIRO, Imai; P.O. Box 551, Burbank, CA 91520 (US). (81) Designated States: CH (European patent), DE (European patent), FR (European patent), GB, GB (European patent), JP, NL (European patent), SE (European patent).</p>		<p>Published <i>With international search report. With amended claims.</i></p>

(54) Title: LATCHING ASSEMBLY

(57) Abstract

A latching assembly comprising first and second mechanically engageable latch members (14, 24), biasing means (60, 62) for causing the latch members (14, 24) to assume a disengaged position, a permanent magnet (50) for overcoming the force of the biasing means, the permanent magnet (50) being isolated from the latch members (14, 24) when the latch members (14, 24) are in an engaged position, and an electromagnet (46) having a polarity when energized opposing the permanent magnet (50) for overcoming the force thereof and thereby permitting the biasing means (60, 62) to cause the latch members (14, 24) to assume the disengaged, unlatched position. The assembly is also designed so that the biasing means (60, 62) and the electromagnet (46) are isolated from the latch members (14, 24) when the latch members (14, 24) are in an engaged position.



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1 Latching Assembly

2

3 Technical Field

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5 The invention relates to the field of latching assemblies
6 and, in particular, to latching assemblies utilizing
7 permanent magnets and electromagnets in the operation
8 thereof.

9

10 Background Art

11

12 Latching assemblies, and in particular magnetic latching
13 assemblies, are in widespread use in modern aircraft for
14 latching doors or closure panels on compartments containing
15 oxygen equipment and masks and other emergency supplies for
16 the passengers. In such magnetic latching assemblies, a
17 permanent magnet is employed in maintaining the door in a
18 closed or latched position and an electromagnet is used to
19 cause the door to open or become in an unlatched position.
20 Normally, the unlatching is accomplished by actuation of the
21 electromagnet by the pilot of the aircraft. It has been
22 found, however, that due to certain loading forces on the
23 doors, the latching assemblies will either refuse to open
24 when they are commanded to do so or will open automatically
25 when they are not supposed to. These loading forces consist
26 of flight loads due to twists of the airplane, vibration
27 frequencies of different resonances between two mating
28 parts, handling forces due to human causes, and
29 gravitational loads caused by rapid aircraft acceleration or
30 deceleration.

31

32 A latching assembly designed to overcome the above
33 problems is shown in U.S. Patent No. 3,635,511, entitled
34 "Latching Assembly with Magnetic Latching", issued to H. A.
35 Waller. In Waller, a first latching subassembly, including
36 an electromagnet, is fastened to the inside surface of a



1 compartment doorjamb and a second latching subassembly,
2 including a latch lever and a permanent magnet latch bar
3 mounted on the latch lever, is mounted adjacent the upper
4 edge of the inside surface of the compartment door. When
5 the latching assembly is closed, the permanent magnet
6 mechanically engages the pole pieces of the first latching
7 assembly and stays in position due to the magnetic
8 attraction between itself and the metallic first latching
9 assembly. Upon actuation of the electromagnet, the magnet
10 and the latch to which it is coupled is repelled from the
11 mechanical engagement and pivots out of latching position
12 assisted by a spring. Thus, the permanent magnet both
13 maintains or holds the latched position and acts as the
14 mechanical latching engagement, until repelled by the
15 electromagnet. Another latching assembly is shown in U.S.
16 Patent No. 3,860,277, entitled "Latching Assembly with
17 Magnet Locking", issued to W. S. Wang. In a first
18 embodiment of Wang, an electromagnet is positioned on the
19 inside surface of a compartment top wall. A first latching
20 lever, having a permanent magnet thereon, is pivotally
21 mounted adjacent the electromagnet and coupled to the top
22 wall. A second latch lever is mounted on a door and is
23 biased open by a spring. The latch levers are held in
24 mechanical engagement by the permanent magnet against the
25 force of the bias spring. Upon activation of the
26 electromagnet, the permanent magnet is repelled, causing the
27 latch levers to unlatch. In a second embodiment, a
28 spherical latch member or ball is held in mechanical
29 engagement by a circumferentially spaced array of latch
30 balls which are operable to engage the spherical latch
31 member. A latch plunger which causes the latch balls to
32 engage the spherical latch member is biased to a rearward
33 unlatched position by a coil spring. The plunger is
34 normally maintained in a forward latched position by means
35 of a permanent magnet mounted on the plunger which attracts
36 the poles of an electromagnet and overcomes the bias of the



1 coil spring and a C-shaped spring which normally causes the
2 latch balls to be in an expanded state. When the
3 electromagnet is actuated, the force of the permanent magnet
4 is overcome and the bias spring allows the latching assembly
5 to unlatch.

6
7 Severe difficulties exist, however, with the latching
8 assemblies of the above configurations. The door lever in
9 Waller is directly loaded by the permanent magnet engaging
10 the detent of the pole piece, causing a critical interface
11 where the latch members meet with difficult tolerance
12 controls. The inner latch members of Wang are also directly
13 loaded by the permanent magnet, particularly in the first
14 embodiment, again causing a critical interface where the
15 latch members meet with difficult tolerance controls. It is
16 apparent that poor quality control of the interfaces would
17 inevitably lead to premature unlatching due to forces on the
18 magnet or to lock-up due to excessive friction. In
19 addition, in the second embodiment of Wang, any door loading
20 would cause the spherical latch member to jam up against the
21 latch balls and the latch plunger and prevent the
22 electromagnet from unlatching the door since the bias spring
23 is not strong enough to overcome the frictional forces
24 between the spherical latch member, the latch balls and the
25 latch plunger. Furthermore, any other types of loads on the
26 door are directly transmitted to the permanent magnet,
27 thereby increasing the probability of premature unlatchings.

28
29 Accordingly, it is a general object of the present
30 invention to provide an improved latching assembly.

31
32 It is another object of the present invention to provide
33 a latching assembly employing a permanent magnet which is
34 not susceptible to premature unlatching or to lock-ups.

35
36



1 It is a further object of the present invention to
2 provide a latching assembly which does not have critical
3 interfaces.

4
5 It is still another object of the present invention to
6 provide a latching assembly employing a permanent magnet in
7 which the permanent magnet is disassociated from the
8 latch members.

9
10 Disclosure of Invention

11
12 A latching assembly is provided. The latching assembly
13 comprises first and second mechanically engageable latch
14 members, biasing means for causing the latch members to
15 assume a disengaged position, a permanent magnet for
16 overcoming the force of the biasing means, the permanent
17 magnet being isolated from the latch members when the latch
18 members are in an engaged position, and an electromagnet
19 having a polarity when energized opposing the permanent
20 magnet for overcoming the force thereof and thereby
21 permitting the biasing means to cause the latch members to
22 assume the disengaged, unlatched position. The assembly is
23 also designed so that the biasing means and the
24 electromagnet are isolated from the latch members when the
25 latch members are in an engaged position.

26
27 The novel features which are believed to be
28 characteristic of the invention, both as to its organization
29 and its method of operation, together with further objects
30 and advantages thereof, will be better understood from the
31 following description in connection with the accompanying
32 drawings in which a presently preferred embodiment of the
33 invention is illustrated by way of example. It is to be
34 expressly understood, however, that the drawings are for
35 purposes of illustration and description only and are not
36 intended as a definition of the limits of the invention.



1 Brief Description of Drawings

2

3 Fig. 1 is a cut-away view of a compartment showing the
4 latching assembly of the present invention; Fig. 2 is an
5 perspective view of the latching assembly of the present
6 invention; Fig. 3 is an exploded view of the latching
7 assembly of Fig. 2; Fig. 4 is a cross-sectional view taken
8 along the lines 4-4 of Fig. 2; and Fig. 5 is a perspective
9 view of a second embodiment of the latching assembly of the
10 present invention.

11

12 Best Mode for Carrying Out the Invention

13

14 In Fig. 1 a cut-away view of a compartment showing the
15 latching assembly of the present invention is illustrated.
16 The compartment 10 has a door 12 that has mounted on it a
17 latch lever 14. The door 12 pivots around point 16 and is
18 spring loaded to a open position by spring 18. The
19 compartment 10 has a doorjamb 20 upon which is mounted a
20 latch assembly 22 containing a latch lever 24 which engages
21 latch lever 14 to maintain the door 12 in a closed position.

22

23 Referring now to Figs. 2, 3 and 4, a perspective,
24 exploded and cross-sectional view of the latch assembly 22
25 is illustrated. The latch assembly 22 has a housing 26
26 which surrounds the latch assembly 22 except in a portion
27 thereof through which the latch lever 24 extends. The latch
28 lever 24 is pivotally mounted on hinge points 25, 27 on an
29 armature shaft 28 and is assisted in engaging the latch
30 lever 14 by a bias spring 30 also mounted on the armature
31 shaft 28. The latch lever 24 also includes a roller. shaft
32 32 which supports a roller 34 which engages the latch lever
33 14. The armature shaft 28 is supported by a pair of
34 electromagnet pole pieces 36, 38 which also support a iron
35 core 40 and a coil 42 surrounding the iron core 40. The
36 pole pieces 36, 38 are fastened through holes 44 to the



1 doorjamb 20. The combination of pole pieces 36, 38, core 40
2 and coil 42 comprise the electromagnet, designated by
3 numeral 46, which causes the latch levers 14, 24 to become
4 disengaged. An armature support 48 is also pivotally
5 mounted on hinge points 45, 47 on the armature shaft 28
6 which supports a permanent magnet 50 and a pair of pole
7 pieces 52, 54. A nut strip 56 is used in conjunction with
8 screws 58 and armature support 48 to contain the permanent
9 magnet 50 and the pole pieces 52, 54 in an intimate
10 supported relationship. Finally, a pair of bias springs 60,
11 62 are mounted on the armature shaft 28 and are coupled to
12 the armature support 48 to urge it toward the latch lever
13 24.
14

15 In operation, when the door 12 is in the open position,
16 the latch lever 24 is manually depressed in the direction of
17 the pole pieces 36, 38 and consequently urges the armature
18 support 48 towards the pole pieces 36, 38 until the pole
19 pieces 52, 54 of the permanent magnet 50 come into contact
20 with the pole pieces 36, 38 and magnetically hold the
21 armature support 48 in position against the opposing forces
22 of the springs 60, 62. The door 12 is then closed, with the
23 bias spring 30 assisting the latch lever 24 to engage the
24 latch lever 14. It should be noted that the bias spring 30
25 does not keep the door 12 closed or the latch levers 14, 24
26 together but only facilitates their engagement. The latch
27 levers 14, 24 are kept in engagement mainly by the weight of
28 the door 12, the force of the door spring 18, the weight of
29 the contents pressing on the door 12, and the weight of the
30 latch lever 14 on the door 12. The bias spring 30 is,
31 however, useful for maintaining the engagement of the latch
32 levers 14, 24 in the event of negative G forces. When it is
33 desired to unlatch the door 12, the electromagnet 46 is
34 actuated through wires 64 and, being of an opposing polarity
35 to the permanent magnet 50, causes the pole pieces 36, 38 to
36 overcome the attractive force of the pole pieces 52, 54



1 caused by the permanent magnet 50. Since the magnetic
2 attractive force is substantially nullified, the bias
3 springs 60, 62 cause the armature support 48 to pivot
4 against the latch lever 24 and disengage it from the latch
5 lever 14. In a particular embodiment, the magnet 50 was
6 designed to assert 7-10 pounds of attractive force, the bias
7 springs 60, 62 were designed to assert 2-3 pounds of
8 opposing force, while the electromagnet 46 was designed to
9 reduce the attractive force of the magnet 50 to
10 approximately .2 pounds. Thus even before the electromagnet
11 46 substantially nullified the force of the magnet 50, the
12 bias springs 60, 62 would cause the armature support 48 to
13 pivot towards the latch lever 24 and disengage the latch
14 levers 14, 24. If desired, the electromagnet 46 could be
15 designed to generate a net repulsive force on the pole
16 pieces 52, 54 of the permanent magnet 50. In the particular
17 embodiment, the magnet 50 consisted of samarium-cobalt and
18 the minimum voltage applied to the coil 42 needed to cause
19 the armature support 48 to rotate was 15.3 volts, with 23
20 volts being generally available in airplane circuitry. The
21 bias spring 30 was designed to provided .25 pounds of return
22 force for the latch lever 24.

23

24 It is thus seen that in the present invention, although
25 the latching assembly is extremely compact, the permanent
26 magnet is totally disassociated from the latch members and
27 that the latching engagement is provided merely by the
28 interaction of the latch levers 14, 24, with some assist
29 being provided, when desired, from bias spring 30. Thus the
30 actual mechanical engagement of the latch levers 14, 24 can
31 be optimized independently of the electromagnetic circuit
32 used for disengaging the latch assembly. In a like manner,
33 the permanent magnet 50 and its associated pole pieces 52,
34 54 can be designed in conjunction with the electromagnet 46
35 and its associated pole pieces 36, 38 and the bias springs
36 60, 62 to optimize the holding force of the permanent



1 magnet 50 so that the door 12 will not become unlatched
2 until the combination of the opposing forces of the
3 electromagnet 46 and the bias springs 60, 62 actually
4 causes the door 12 to become unlatched and rotate into the
5 open position. This total disassociation of the magnet 50
6 from the latch levers 14, 24 reduces significantly the
7 problems of critical interfaces, frictional lock-up
8 engagements and premature unlatching.

9
10 In Fig. 5, a second embodiment of the latching assembly
11 of the present invention is illustrated. In this embodi-
12 ment, the armature 48' is shown having one center hinge
13 point 66 instead of two outer hinge points 45, 47 as shown
14 in Fig. 2. The attachment of the armature support 48' to
15 the armature shaft 28 by a single center hinge point 66
16 allows the armature 48' to flex and thus allows the pole
17 pieces 52, 54 to better align with the pole pieces 36, 38,
18 thereby reducing the size of the permanent magnet 50 needed
19 to overcome the force of the bias springs 60, 62. As shown
20 in Fig. 5, latch lever 24' has been reconfigured to have its
21 hinge points 25', 27' astride the center hinge point 66 of
22 armature 48' and to have two bias springs 30', 30".

23
24 Having thus described the invention, it is obvious that
25 numerous modifications and departures may be made by those
26 skilled in the art; thus, the invention is to be construed
27 to be limited only by the spirit and scope of the appended
28 claims.

29
30 Industrial Applicability

31
32 The latching assembly is useful for latching doors or
33 closure panels on aircraft compartments.

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- 1 7. The latching assembly of Claim 6 wherein said permanent
2 magnet means is rotatably coupled to said doorjamb
3 member and said biasing means rotatably urges said
4 permanent magnet means toward said second latch member
5 to cause said latch members to assume said disengaged
6 position.
7
- 8 8. The latching assembly of Claim 7 wherein said
9 electromagnet means includes spaced pole piece means
10 coupled to said doorjamb means.
11
- 12 9. The latching assembly of Claim 8 wherein said permanent
13 magnet means includes pole piece means coupling said
14 permanent magnet means therebetween, said pole piece
15 means being configured to engage said pole piece means
16 of said electromagnet means.
17
- 18 10. The latching assembly of Claim 7 further comprising
19 shaft means coupled to said doorjamb means and
20 rotatably supporting said second latch member and said
21 permanent magnet means.
22
- 23 11. The latching assembly of Claim 10 wherein said shaft
24 means supports said biasing means in engagement with
25 said permanent magnet means.
26
- 27 12. The latching assembly of Claim 10 wherein said
28 electromagnet means includes spaced pole piece means
29 coupled to said doorjamb means, said pole piece means
30 being adapted to support said shaft means.
31
- 32 13. The latching assemble of Claim 12 wherein said spaced
33 pole piece means contains therebetween elongated core
34 means and annular coil means mounted thereon.
35
36

- 1 14. The latching assembly of Claim 10 wherein said shaft
2 means supports a second biasing means for assisting
3 said latch members to assume said engaged position,
4 said second biasing means being supported in engagement
5 with said second latch member.
6
- 7 15. The latching assembly of Claim 1 wherein said second
8 latch member includes roller means adapted to engage
9 said first latch member.
10
- 11 16. The latching assembly of Claim 1 wherein said
12 electromagnet means is configured to repel said
13 permanent magnet means.
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AMENDED CLAIMS

(received by the International Bureau on 18 February 1983 (18.02.83))

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2
3 k. (amended)
4 A latching assembly comprising a first latch member
5 movable from an engaged position to a disengaged
6 position; a second latch member adapted to be mechanically
7 engageable with said first latching member when said
8 first latch member is in said engaged position; a
9 magnetic pole subassembly; a magnetic armature
10 subassembly, said magnetic armature subassembly being
11 moveable relative to said magnetic pole subassembly and
12 relative to said first latch member from a first position
13 wherein said armature subassembly completes a magnetic
14 circuit across said magnetic pole subassembly to a second
15 position wherein said magnetic armature subassembly is in
16 contact with said first latch member; biasing means for
17 providing a bias force to said magnetic armature
18 subassembly tending to cause said armature subassembly
19 to move away from said magnetic pole subassembly and into
20 contact with said first latch member and thereby to cause
21 said first latch member to be moved to said disengaged
22 position; permanent magnetic means for applying an
23 attractive magnetic force between said armature sub-
24 assembly and said pole subassembly sufficient to overcome
25 said bias force when said magnetic armature subassembly
26 is in said first position in contact with said magnetic
27 pole subassembly and said magnetic circuit is thereby
28 completed; and electromagnetic means associated with said
29 magnetic circuit and responsive to the application of an
30 electrical voltage for reducing said magnetic attraction
31 between said armature subassembly and said pole subassembly
32 to the point where said biasing means will cause said
33 armature subassembly to move into contact with said first
34 latch member whereupon it will cause said first latch
35 member to move to its said disengaged position wherein it
36 will be disengaged from said second latch member.



- 1 2. (amended)
2 The latching assembly of Claim 1 wherein said biasing
3 means is isolated from said first and second latch
4 members when said first latch member is in said engaged
5 position.
6
- 7 3. (amended)
8 The latching assembly of Claim 1 wherein said electro-
9 magnet means is isolated from said first and second
10 latch members when said first latch member is in said
11 engaged position.
12
- 13 4. (amended)
14 The latching assembly of Claim 1 further comprising
15 second biasing means for assisting said first latch
16 member to assume said engaged position.
17
- 18 5. (amended)
19 The latching assembly of Claim 1 wherein said second
20 latch member is fixedly coupled to a door member.
21
- 22 6. (amended)
23 The latching assembly of Claim 1 wherein said second
24 latch member is coupled to a door member and said first
25 latch member is rotatably coupled to a doorjamb member.
26
- 27 7. (amended)
28 The latching assembly of Claim 6 wherein said magnetic
29 armature subassembly is rotatably coupled to said
30 doorjamb member and said biasing means rotatably urges
31 said magnetic armature subassembly toward said second
32 latch member to cause said first latch member to assume
33 said disengaged position.
34
- 35 8. (amended)
36 The latching assembly of Claim 7 wherein said magnetic



1 pole subassembly is fixedly coupled to said doorjamb
2 means.

3
4 9. (amended)

5 The latching assembly of Claim 8 wherein said magnetic
6 armature subassembly includes a pair of pole pieces
7 coupling a permanent magnet therebetween, said pole
8 pieces being configured to engage said magnetic pole
9 subassembly.

10

11 10. (amended)

12 The latching assembly of Claim 7 further comprising
13 shaft means coupled to said doorjamb means and rotatably
14 supporting said first latch member and said magnetic
15 armature subassembly.

16

17 11. (amended)

18 The latching assembly of Claim 10 wherein said shaft
19 means supports said biasing means in engagement with
20 said magnetic armature subassembly.

21

22 12. (amended)

23 The latching assembly of Claim 10 wherein said magnetic
24 pole subassembly includes a pair of spaced pole pieces
25 coupled to said doorjamb means and adapted to support
26 said shaft means.

27

28 13. (amended)

29 The latching assembly of Claim 12 wherein said spaced
30 pole pieces are coupled therebetween by elongated
31 core means and annular electromagnetic coil means
32 mounted thereon.

33

34 14. (amended)

35 The latching assembly of Claim 10 wherein said shaft
36 means supports a second biasing means for assisting



1 said first latch member to assume said engaged position,
2 said second biasing means being supported in engagement
3 with said first latch member.

4

5 15. (amended)

6 The latching assembly of Claim 1 wherein said first
7 latch member includes roller means adapted to engage
8 said second latch member.

9

10 16. The latching assembly of Claim 1 wherein said electro-
11 magnet means is configured to repel said permanent
12 magnet means.

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FIG. 1

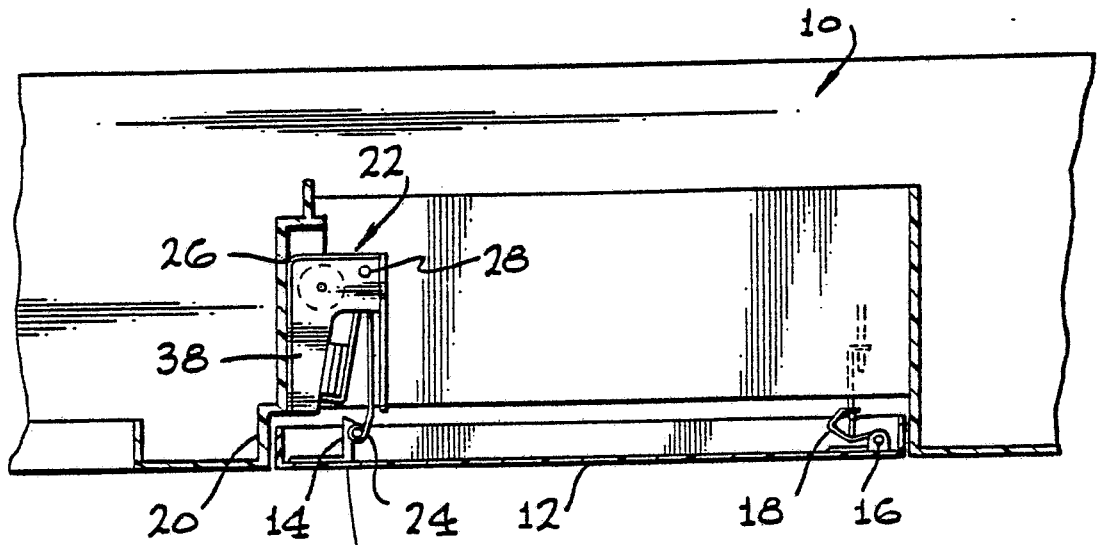
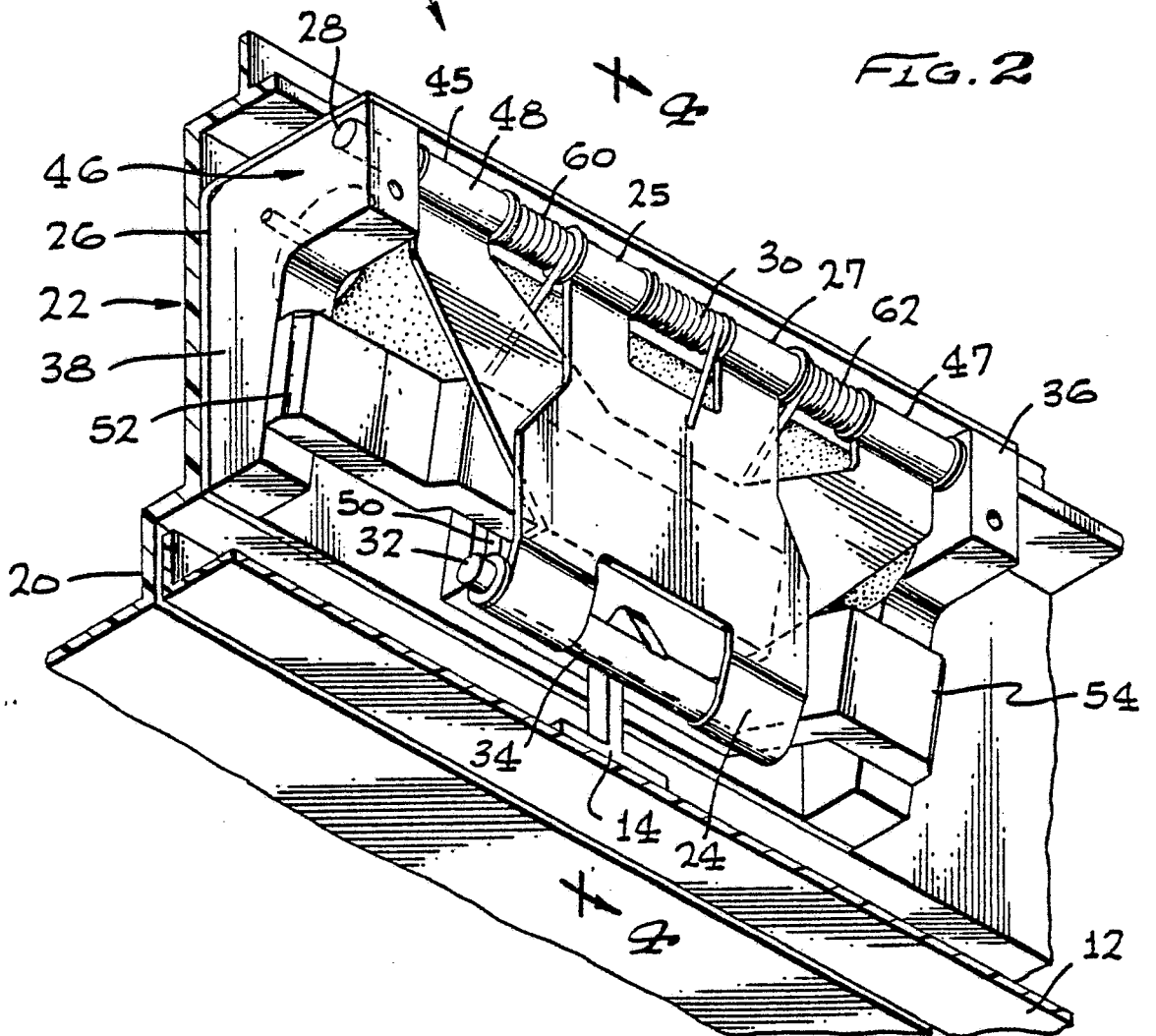


FIG. 2



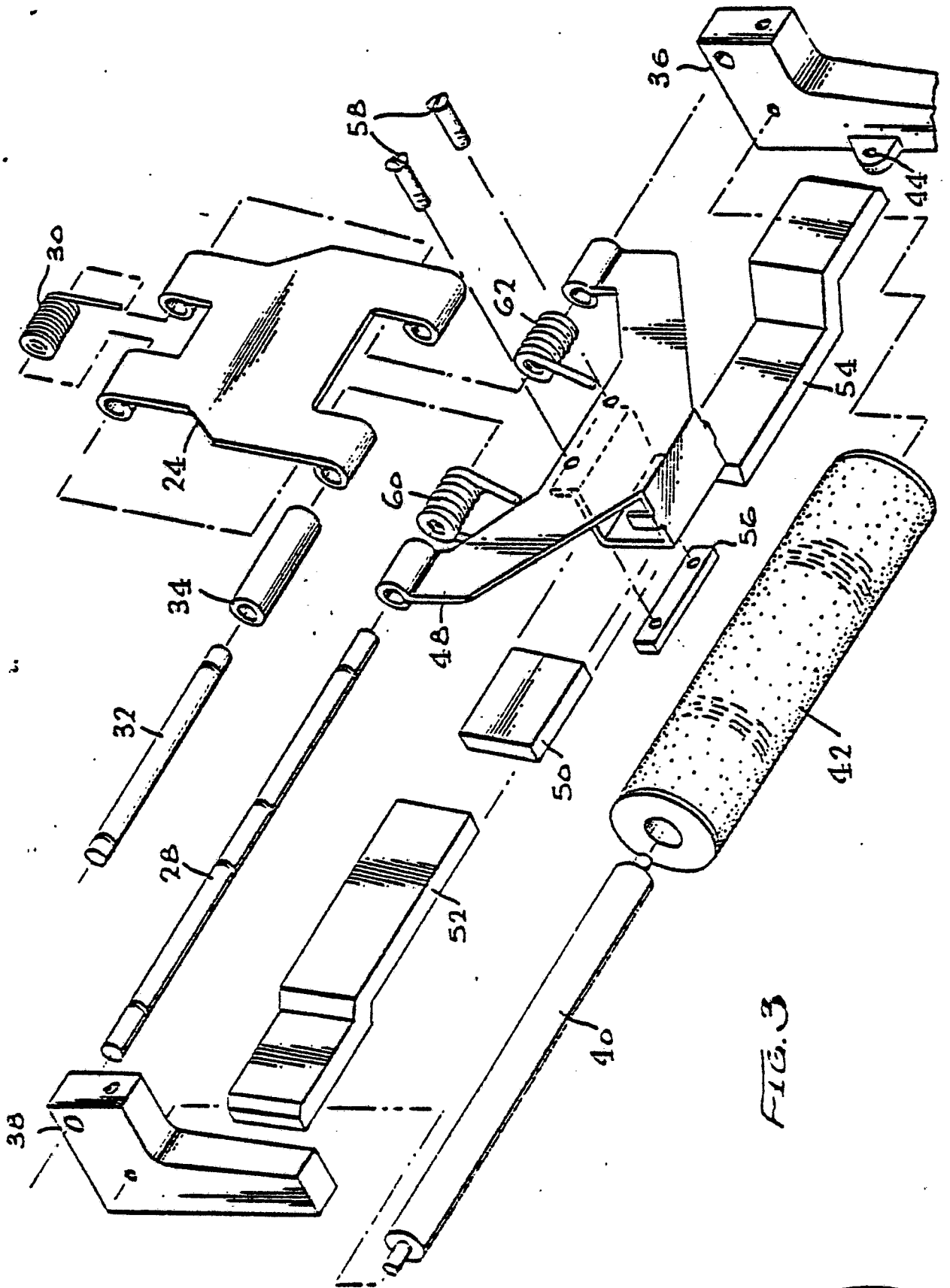


FIG. 3

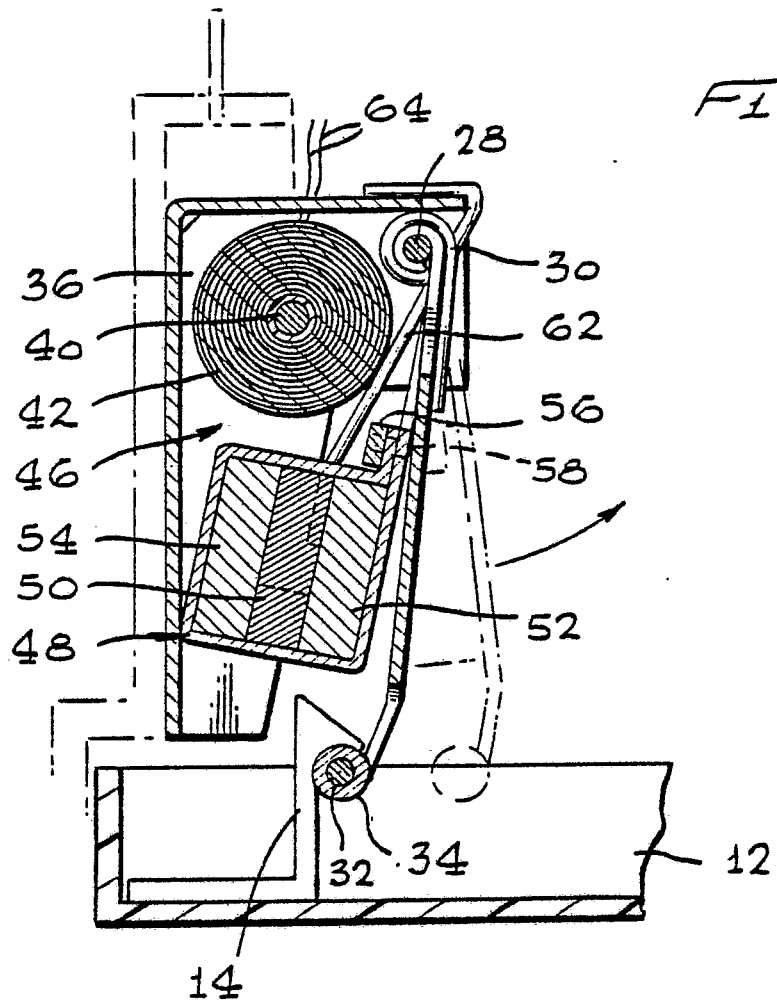


FIG. 4

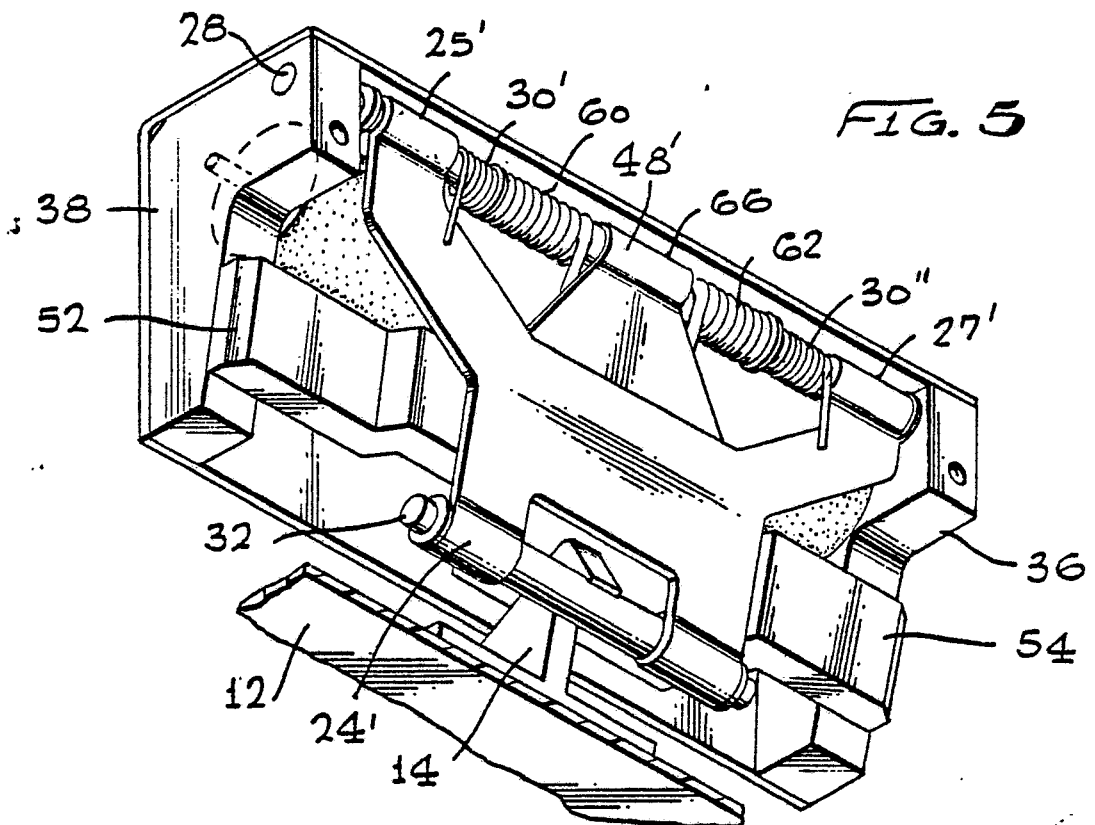
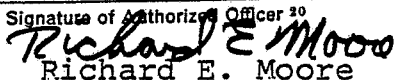


FIG. 5



INTERNATIONAL SEARCH REPORT

International Application No **PCT/US82/01270**

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC INT. CL. ³ E05B 47/02 U.S. CL. 292/201		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
U.S.	292/144, 201, 229, 246, 251.5	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category [*]	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	US, A, 3,819,199, published 25 June 1974 Smolka et al	1-16
A	US, A, 3,860,277, published 14 January 1975 Wang	1-16
A	US, A, 3,635,511, published 18 January 1972 Waller	1-16
A	US, A, 3,620,560, published 16 November 1971 Peters	1-16
A	US, A, 3,937,505, published 10 February 1976 Dempsey	1-16
A	US, A, 2,440,734, published 04 May 1948 Burke	1-16
A	US, A, 3,831,986, published 27 August 1974 Kobayashi	1-16
<p>[*] Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ²	
17 December 1982	23 DEC 1982	
International Searching Authority ¹	Signature of Authorized Officer ²⁰	
ISA/US	 Richard E. Moore	