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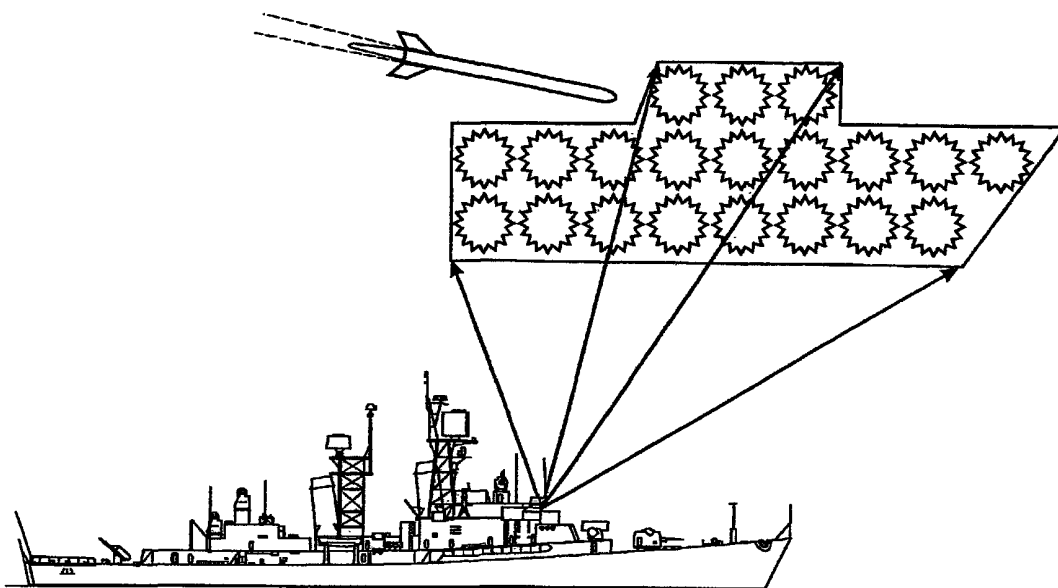
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(54) Title: DECOY



(57) Abstract: A method of decoying an incoming missile from a target by forming a temporary image said method including the steps of arranging a plurality of projectiles in each of one or more barrel assemblies wherein said projectiles include image forming matter for mimicking a homing characteristic of the target, firing a predetermined number of the plurality of projectiles from selected barrel assemblies, and deploying the image forming matter to form a temporary image and decoy the incoming missile from the target.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DECOY

This invention relates to forming temporary airborne images. In particular, this invention relates to forming temporary airborne images that may act as decoys for homing missiles and the like.

5 Large targets, such as war ships, are prone to damage by attack from airborne missiles provided with homing capabilities that may include thermal or image sensing devices for maintaining the missile on target to impact the target. War ships are generally provided with defensive weaponry for combating incoming missiles by targeting the incoming missile with multiple rounds of munitions such as by a phalanx
10 system. However such missiles may prove difficult targets and even a successful encounter with an incoming missile may be very costly in terms of resources and operational personnel.

 We have now found a method of forming a temporary airborne image that acts as a decoy for homing missiles and the like. Accordingly the present invention
15 provides a method of decoying an incoming missile from a target by forming a temporary image said method including the steps of arranging a plurality of projectiles in each of one or more barrel assemblies wherein said projectiles include image forming matter for mimicking a homing characteristic of the target, firing a predetermined number of the plurality of projectiles from selected barrel assemblies,
20 and deploying the image forming matter to form a temporary image and decoy the incoming missile from the target.

 This invention may utilise barrel assemblies capable of firing a controlled rapid fire sequence of mortar like projectiles and being of the general type described and/or illustrated in our earlier International Patent Applications such as
25 PCT/AU94/00124, PCT/AU00/00296 and PCT/AU00/00297. In at least some of these earlier applications, including the earliest filed International Application No

PCT/AU94/00124 there are described arrangements for grouping barrels each containing a plurality of projectiles so that a large number of projectiles can be fired in rapid-fire succession. In such arrangements barrels may be formed from a cylindrical shell having a plurality of projectiles axially disposed within the shell for operative sealing engagement with the bore of the shell and discrete propellant charges for propelling respective projectiles.

Suitably the barrel assemblies may be of the low pressure type which fire grenade-like projectiles although high muzzle pressure barrel assemblies may be used. Respective barrel assemblies may be loaded with different projectiles and the barrel assemblies may have different size bores for accommodating different size projectiles.

Suitably each projectile includes a trailing collar captively mounted to the projectile body and when stored in the barrel, extends rearwardly to wedge against the nose portion of a trailing projectile body. Suitably the wedging action is provided by a shallow wedge whereby, in use, the trailing end of the collar is expanded into operative sealing engagement with the barrel.

The trailing collar may be mounted for limited axial movement relative to the projectile body and the leading end of the collar formed with an annular sealing face engageable with a complementary face formed on the projectile body whereby rearward movement of the projectile body resulting from the reaction of propellant gases thereon forces the its complementary face into sealing engagement with the annular sealing face at the leading end of the collar.

The complementary face and the annular sealing face may extend substantially radially and be formed with complementary sealing features thereon. However it is preferred that these faces are complementary part-conical sealing faces

which wedge into tight sealing engagement with one another. The leading end part may also be expandable into operative sealing engagement with the barrel. Suitably however the wedging between the part-conical faces are relatively steep faces whereby the leading end of the collar is not expanded into operative sealing
5 engagement with the barrel by the wedging action.

Preferably, each projectile is associated with a high pressure propellant chamber which exhausts to respective low pressure propulsion chambers formed between the adjacent projectiles for efficient low muzzle velocity operation. The high pressure propellant chambers may be formed integrally with the projectile body or the
10 trailing collar or be provided at the exterior of the barrel to communicate therewith through ports provided through the barrel wall.

The image forming matter may include, for example, explosive matter, incendiary matter, incandescent or luminous matter or other matter to provide a highly visible temporary image and/or a thermal image for mimicking a homing
15 characteristic of the target. For example, in order to decoy a thermal image homing missile a thermal image may be provided to deceive the incoming missile to detonate on the thermal image of the target leaving the target substantially in tact.

Alternatively, the image forming matter may include smoke, gas, particles or sheets or strips, such as in the nature of chaff, or other material capable of being
20 dispersed to form, an image. The image forming matter may also include means for slowing its descent from its dispersed position, such as a parachute and the like.

The projectiles are arranged in the barrel assemblies such that once fired and the image forming matter deployed, the desired temporary airborne image is formed. Projectiles containing different image forming matter may be sequentially
25 loaded into each barrel assembly.

The projectiles may be electronically fired at an infinitely variable frequency up to the maximum rate of fire. For firing from a barrel assembly according to an aspect of this invention and arranged for low pressure, low muzzle velocity, the rate of firing is limited by the time taken for each projectile to leave the barrel and by the
5 time necessary for the gas pressure in the barrel to drop sufficiently to enable the firing of the next projectile.

The predetermined number of the plurality of projectiles may be fired from selected barrel assemblies at a rate selected to obtain the desired temporary airborne image. The firing of the projectiles may preferably be controlled by a
10 microprocessor to permit the accurate firing of the projectiles at the selected rate.

The image forming matter may be deployed, for example, by explosive means, by stored energy or by separation of separable parts of the projectile to expose the image forming matter or by any other suitable dispersing means.

A timing mechanism to control the deployment may be of any suitable type
15 and may be clock based or based on a flight characteristics of the projectile such as the number of spins of a projectile fired from a rifled barrel or it may be based on the ambient atmospheric conditions at the selected display position. Alternatively, the timing mechanism may selectively control the timing of deployment of parachutes associated with the image forming matter.

20 The image may be formed as an upright image or a horizontal image and may include either or both image forming matter which leaves a visible trail during descent and image forming matter which does not leave a visible trail during descent. The former may be used to provide a coloured background or a stripe or the like while the latter may provide feature within the image such as a bright star-like image.

The projectiles may be configured to disperse the image forming matter at a set time from firing and the firing may be controlled for trajectory or barrel exit velocity so that upon dispersal of the image forming matter the desired displayed is achieved. Alternatively a barrel assembly may contain respective projectiles adapted to
5 produce different image effects and the desired image may be controlled by selectively firing the projectiles to assemble an in-air compilation of different image effects to achieve the desired image.

For the purpose of a decoy image the projectiles may be fired to provide a general zone having either the necessary extent or thermal or visual characteristics
10 so as to trigger a missile directed at the vessel or installation being defended. Alternatively the projectiles may be fired to produce a shape which mimics the shape of the vessel or installation being defended so as appear to the missile to be the vessel or installation being defended.

A bank of barrel assemblies may be utilised containing respective image
15 forming matter which may be selectively fired and, if desired at a desired trajectory or timing, the barrel assemblies being controlled remotely such as from a computer keyboard and screen which may show a preview of the image to be formed and enabling an operator to "print" a desired or random airborne pattern. The image may be a two or three dimensional image as desired. Different banks of barrel
20 assemblies may be utilised and/or placed so as to form a respective unique portion of the image being formed.

A direction control means may be provided in a bank of barrel assemblies and may permit uniform pivoting of the barrel assemblies so that the inclination of the axes of the barrel assemblies relative to the axis of a pod containing the bank of
25 barrel assemblies may be selectively varied to enable a target position relative to the

pod to be varied. The direction control means may permit individual pivoting of each barrel assembly so that the inclination of each barrel axis relative to a pod axis may be individually varied to enable a target position or individual target positions relative to the pod to be varied. Such individual control may be associated with individual firing control of each barrel assembly if desired.

The direction control means may alternatively permit a controlled splaying of all barrel assemblies so that the area covered at the target zone may be selectively varied. Alternatively the direction control means may permit all or some of the above variations to be achieved individually or collectively as required.

The pod housing may be of any suitably configuration and may taper towards its base to enable barrel assemblies to be supported in a splayed attitude. The support means may be fold out legs which may be adjustable if desired. In one form the pod has a rectangular pod housing for economy or ease of storage and/or transport and the base thereof constitutes the support means.

A pod of barrel assemblies may be fired from a marine platform. The pod may also be fired from an aircraft, or from a number of aircraft flying in formation and if desired, with the firing coordinated between the aircraft by a suitable electronic link. The image could be formed parallel to the firing path, such as by projecting projectiles different distances so as to span the length of the image to be formed. Alternatively, the image could be created at right angles to the firing path by splaying projectiles to deploy across the desired span of the desired image. Thus even though there may not be a clear line of sight between a deck mounted pod containing the barrel assemblies utilised to create the image and an incoming missile, the image can be created at right angles to the incoming path of the missile.

In order that this invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a typical embodiment of the invention and wherein:-

FIG. 1 is a diagrammatic view of a temporary airborne image fired from a ship for protecting the ship against a homing missile;

FIG. 2 is a diagrammatic view of a temporary airborne images fired from an aircraft for protecting a ship against a homing missile, and

FIG. 3 is a diagrammatic side view of a barrel assembly not being of the type described but suitable for firing projectiles for forming a temporary airborne image.

FIG. 4 diagrammatically illustrates typical barrel assemblies for use in this invention;

Referring to Fig. 1 of the drawings it will be seen that a barrel assembly of the type described loaded with mortar-like projectiles which explode mid air at a set distance and trajectory from the barrel assembly or barrel assemblies supported on the vessel will provide a thermal image of similar size and shape to the vessel. This is intended to provide an airborne thermal image at an elevated position at a safe distance from the vessel which will attract an incoming missile and either cause it to explode upon reaching the image or at least to cause the missile to divert sufficiently from its travel path to the vessel so the it will miss the vessel.

The image is suitably formed to one side of the vessel and at a position which will minimise the chance of the guidance system returning the missile to an on-target flight. Preferably the image is formed between the missile and the vessel being protected and slightly to one side and at a relatively low elevation so that the misguided missile will be descending toward the decoy image and impact the water

away from the vessel. This arrangement also partly shields the vessel to be protected and thus eliminates a target choice for the incoming missile.

In the embodiment illustrated in Fig 2 the barrel assemblies from which the projectiles are fired are supported on an aircraft, which may be an unmanned remote controlled aircraft if desired. As such an aircraft has sufficient mobility to defend a
5 variety of targets, it is preferred that the barrel assemblies be controlled for selective discharge of the projectiles in respect of sequence and trajectory, whereby a variety of shapes or images may be selectively formed to suit the target being attacked.

Thus a single aircraft or a fleet of circling aircraft flying in picket formation
10 about the fleet to be protected may provide a fleet of aircraft with cover against attack by incoming missiles even if those missiles are target specific as the images may be instantly specified to suit the target to be defended. This can be achieved without the need to preconfigure the groups of projectiles for each specific vessel or installation to be defended providing a significant benefit in versatility.

Referring to Fig 3 it will be seen that an alternate barrel assembly 20 may
15 include a plurality of projectiles 21 arranged in an axial abutting relationship in a barrel 22, the projectiles including a leading projectile 23 and following projectiles 24, only one of which is illustrated. Each following projectile 24 includes an outer case 25 of a suitable plastic or other suitable material and supporting therein a leading
20 propellant charge 26 for propelling the projectile preceding it in the barrel, a separator disc 19 separating the leading propellant charge from the remainder of the projectile interior which supports a pyrotechnic charge 27 which burns/explodes in the atmosphere to provide a respective portion of the airborne image to be created.

A controlled rate burn link 28 extends through the back wall 29 of the case
25 25. This receives its ignition from the burning propellant as it exits the barrel 22 and

detonates the pyrotechnic material when it burns fully through the back wall 29. The base of the barrel 22 supports a separate propellant charge 30 for propelling the last of the following projectiles 24 from the barrel 22.

The initiation means for detonating the propellant charges 26 and 30 may be
5 via an external barrel mounted primer or be achieved electrically through spaced annular contacts extending about the case 25 and contacting respective sets of contacts in the barrel 22. As illustrated the front wall 31 of the case 22 is relatively thin so that it will be easily ruptured by detonation of the propellant 26 for propelling the preceding projectile 21 from the barrel. In this action the separator 19 will
10 prevent back burning into the pyrotechnic charge 27 and expansion of the cylindrical side wall 32 into tight engagement with the barrel, thus preventing bypass about the projectile containing the propellant being detonated to a trailing projectile 24.

The barrel assembly 40 illustrated in Fig. 3 includes wedge sealing angles α and β between the trailing sleeve 36 and the grenade housing 42. In this
15 embodiment which is more suited to low pressure low muzzle velocity applications, the opposed ends of the trailing sleeve 36 formed by the sealing angles α and β of between 30° and 55° are sufficiently blunt as to resist outward splaying into sealing engagement with the barrel under the influence of propellant pressures. Typically these would be in the order of 3000psi to 5,000psi with muzzle velocities of about
20 70m/sec and 250m/sec respectively.

It will be seen that the bulbous nose part 43 of the projectile body 42 is hollow for carrying image forming matter. The propellant 37 in the high pressure chamber 46 is selectively ignited to expel high pressure gases through the trailing ports 39 into the low pressure chamber 53 by a detonator 16 triggered through an
25 electrical circuit which uses the projectile column as one part of the circuit, the barrel

41 being made of insulating material or so lined and with the circuit completed by an imbedded insulated wire 38 leading from the primer 16 to a contact 38 on the projectile surface which is aligned when loaded, with a complementary contact 44 supported in the barrel 41.

5 Alignment of the contacts can be achieved in a barrel and projectile located by rifling grooves during the loading process. In a non rifled design, the use of a annular contact in the barrel wall can achieve a similar result.

It will of course be realised that the foregoing description has been given only by way of illustrative example of this invention and that all such and other modifications and
10 variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as is herein set forth.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of decoying an incoming missile from a target by forming a temporary image said method including the steps of arranging a plurality of
5 projectiles in each of one or more barrel assemblies wherein said projectiles include image forming matter for mimicking a homing characteristic of the target, firing a predetermined number of the plurality of projectiles from selected barrel assemblies, and deploying the image forming matter to form a temporary image and decoy the incoming missile from the target.

10

2. A method of decoying an incoming missile from a target according to claim 1 wherein the one or more barrels are formed from a cylindrical shell having a plurality of projectiles axially disposed within the shell for operative sealing engagement with the bore of the shell and discrete propellant charges for propelling respective
15 projectiles.

15

3. A method of decoying an incoming missile from a target according to claim 2 wherein each projectile includes a trailing collar captively mounted to the projectile body and when stored in the barrel, extends rearwardly to wedge against the nose
20 portion of a trailing projectile body whereby the trailing end of the collar is expanded into operative sealing engagement with the barrel.

20

4. A method of decoying an incoming missile from a target according to any one of claims 1 to 3 wherein each projectile is associated with a high pressure propellant

chamber which exhausts to respective low pressure propulsion chambers formed between the adjacent projectiles.

5. A method of decoying an incoming missile from a target according to any one of claims 1 to 4 wherein the image forming matter includes explosive matter, incendiary matter, incandescent matter or luminous matter, smoke, gas, particles or sheets or strips.

6. A method of decoying an incoming missile from a target according to any one of claims 1 to 5 wherein the projectiles are electronically fired.

7. A method of decoying an incoming missile from a target according to any one of claims 1 to 6 wherein the image forming matter is deployed by explosive means, by stored energy or by separation of separable parts of the projectile.

DATED THIS 17TH DAY OF NOVEMBER 2000

METAL STORM LIMITED

BY

PIZZEYS PATENT & TRADE MARK ATTORNEYS

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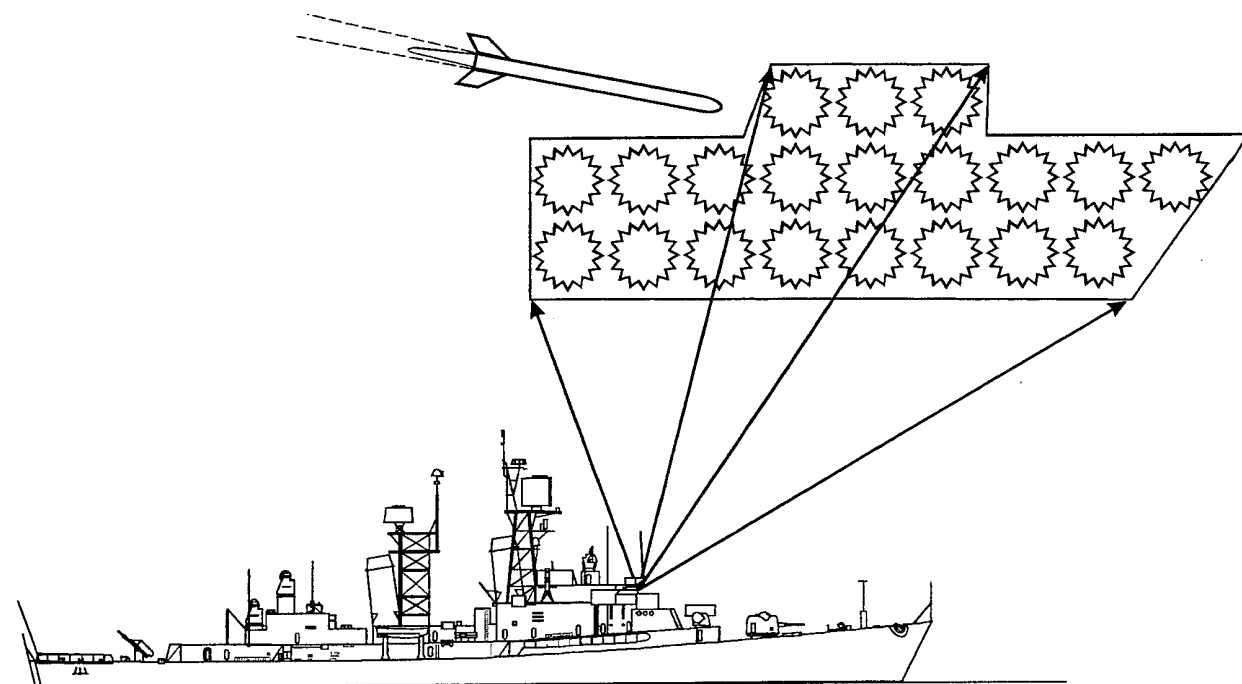


Fig. 1

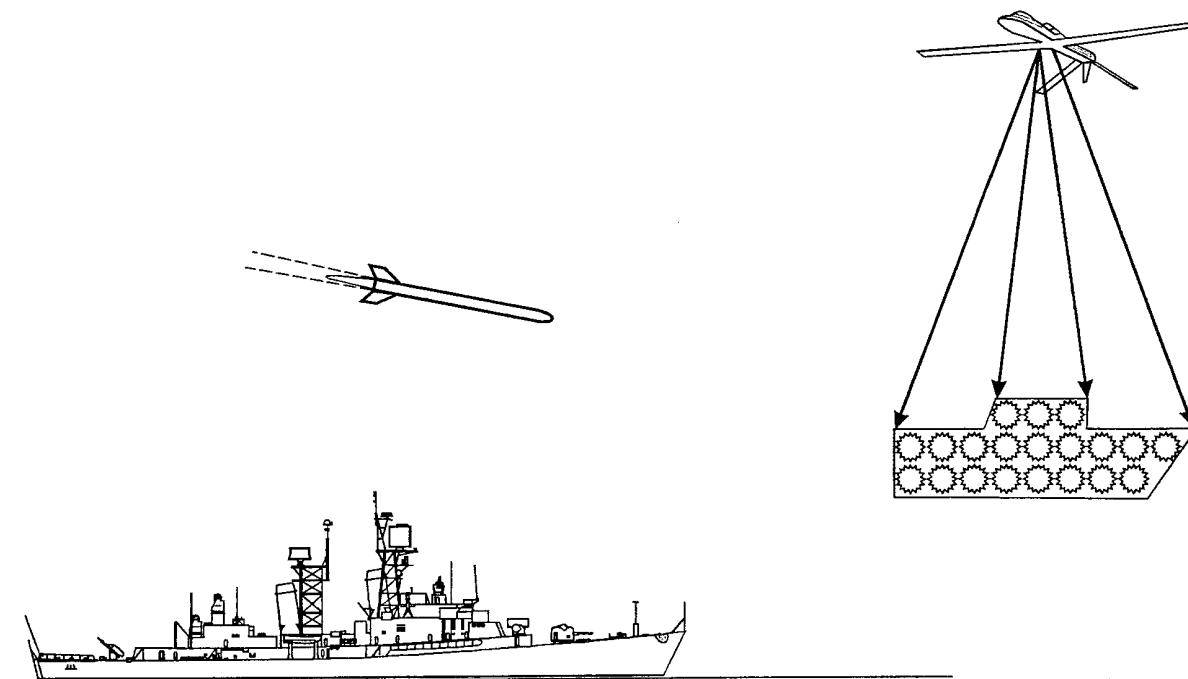


Fig. 2

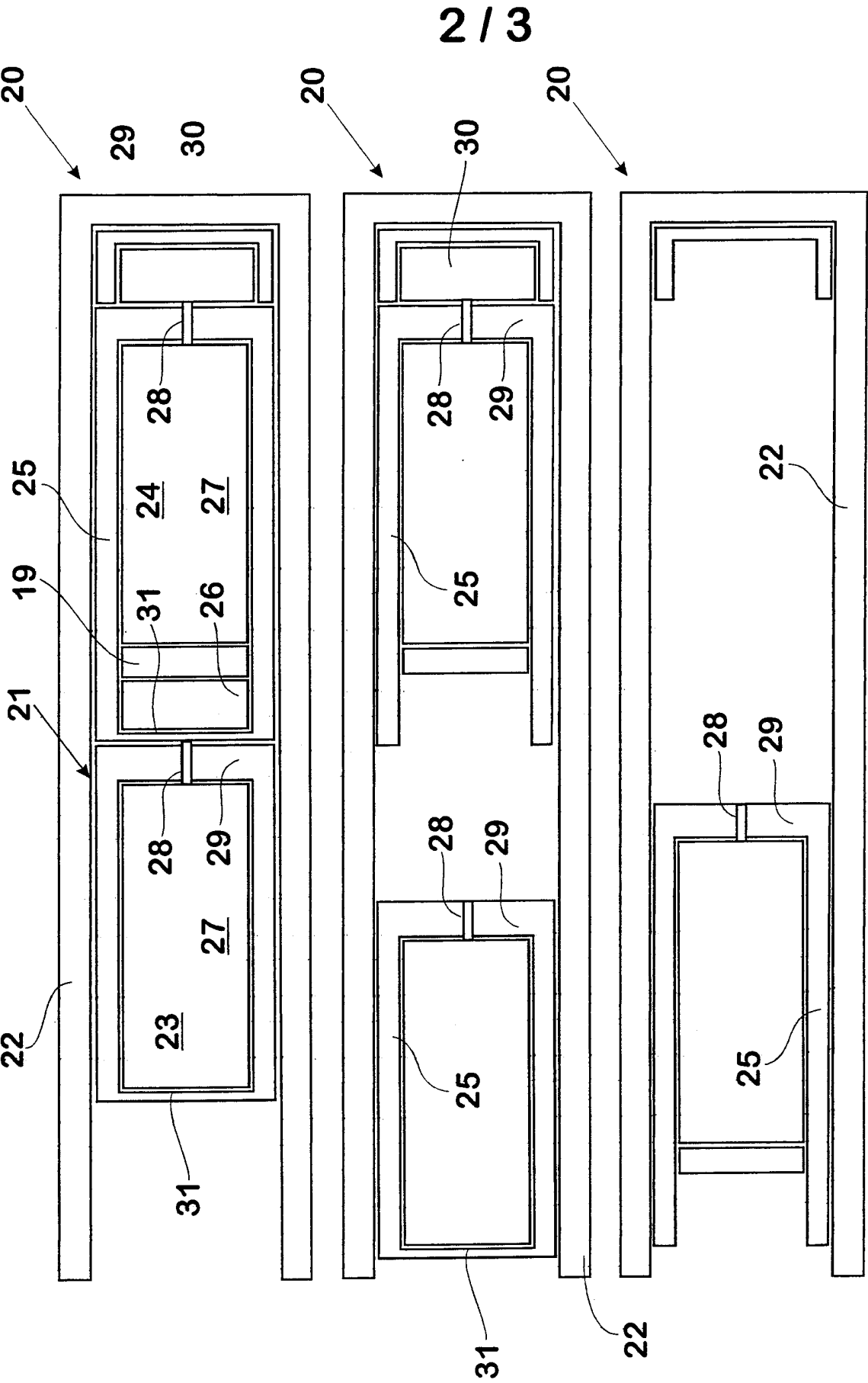


Fig. 3

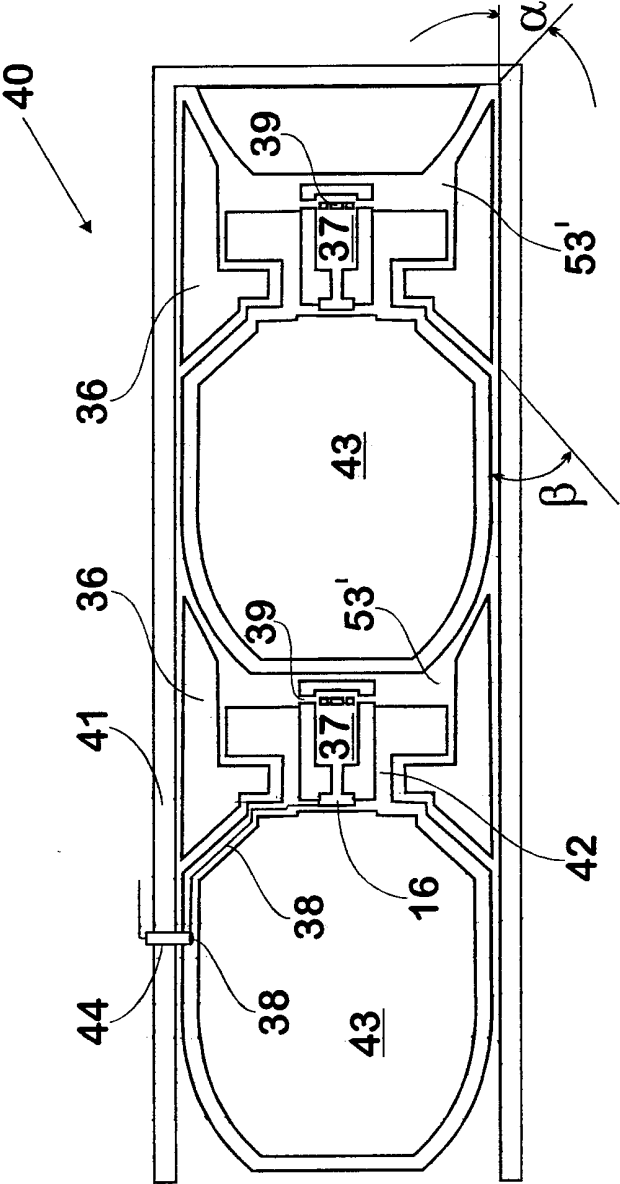


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/01406

A. CLASSIFICATION OF SUBJECT MATTERInt. Cl. ⁷: F41H 11/02; F42B 12/70, 5/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F41H 11/00, 11/02; F42B 5/00, 5/15, 5/145, 5/16, 12/70, 13/42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI with keywords

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 43323/85 A (BUCK CHEMISCH-TECHNISCHE WERKE GmbH & Co.) 19 December 1995 Whole document	1, 2, 4-7 3
Y	Whole document	
P, Y	AU 45232/00 A (METAL STORM LIMITED) 14 November 2000 Page 6, lines 5-26; Figure 3	3
X	EP 124183 A (SVENSKA PHILIPSFÖRETAGEN AB) 7 November 1984 Whole document	1, 2, 5-7

☒ Further documents are listed in the continuation of Box C
 ☒ See patent family annex

* Special categories of cited documents:		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/01406

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2327116 A (ISRAEL MILITARY INDUSTRIES LTD) 13 January 1999 Whole document	1, 2, 5-7
X	US 4135455 A (WALLACE) 23 January 1979 Whole document	1, 2, 5-7
X	AU 43322/85 A (BUCK CHEMISCH-TECHNISCHE WERKE GmbH & Co.) 19 December 1985 Whole document	1, 2, 5-7

International application No.
PCT/AU00/01406

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
AU	43323/85	BR	8502806	CA	1276835	DE	3421708
		DK	2578/85	EP	164732	IN	165136
		NO	852348	US	4621579		
AU	45232/00	WO	00/62005				
EP	124183	CA	1253392	IL	71777	JP	60-000298
		SE	8302510	SE	8402109	US	4586439
GB	2327116	DE	19830134	FR	2765961		
US	4135455	BE	863653	BE	884638	DE	2804713
		FR	2379792	GB	1594401	IL	53963
		NL	7801276	US	4313379		
AU	43322/85	BR	8502805	DE	3421734	DK	2557'85
		EP	173008	NO	852347		