



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : F41B 11/02, 11/06	A1	(11) International Publication Number: WO 99/20971 (43) International Publication Date: 29 April 1999 (29.04.99)
(21) International Application Number: PCT/US98/20562 (22) International Filing Date: 30 September 1998 (30.09.98) (30) Priority Data: 08/941,117 30 September 1997 (30.09.97) US (71) Applicant: SMART PARTS, INC. [US/US]; 1203 Spring Street, Latrobe, PA 15650 (US). (72) Inventor: GARDNER, William, M., Jr.; 201 Elm Drive, Ligonier, PA 15658 (US). (74) Agents: WETTACH, Thomas, C. et al.; Titus & McConomy, 20th floor, Four Gateway Center, Pittsburgh, PA 15222 (CA).		(81) Designated States: CA, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>
(54) Title: PNEUMATICALLY OPERATED PROJECTILE LAUNCHING DEVICE		
(57) Abstract		
<p>The pneumatically operated projectile launching device is preferably comprised of three principal elements: a body (40) which houses and interconnects all of the pneumatic components and also houses the electrical power source (33), a grip mounted to the body which includes an electrical switch (30) that activates a launching sequence, and an electrical control unit housed within both the body and the grip which directs flow between the pneumatic components to load, cock and fire the gun. The body preferably contains a plurality of chambers (1) in communication with each other including a chamber (2) containing and distributing pressurized gas, a chamber (11) containing a compressed gas storage chamber and mechanisms (12, 13) for filling the storage chamber with gas and releasing gas from the storage chamber to fire the projectile, and a chamber (3) containing mechanisms for loading and launching the projectile (41). The electrical control unit preferably includes an electrical power source (33) which activates an electrical timing circuit (34) when the electrical switch (30) is closed, and two electrically operated pneumatic flow distribution devices (35, 36, 37) which are sequentially energized by the electrical timing circuit to enable the loading of a projectile (41) for launching and to release compressed gas from the storage chamber (11) to fire the projectile, respectively.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

TITLE**PNEUMATICALLY OPERATED PROJECTILE LAUNCHING DEVICE****CROSS REFERENCE**

This application is a continuation-in-part (CIP) of U.S. Patent Application Serial No. 08/783,064 filed January 15, 1997, which is a CIP of U.S. Patent Application Serial No. 08/586,960, filed January 16, 1996.

FIELD OF THE INVENTION

The present invention relates to a pneumatically operated projectile launching device. A preferred embodiment of the invention is designed for use in the recreational sport of "Paintball" (also known as "Survival" or "Capture the Flag").

BACKGROUND OF THE INVENTION

The current invention consists of a device for launching a projectile using pneumatic force. Guns using pneumatic force to propel a projectile are well known. In particular, it is well known to use pneumatic force to fire a fragile spherical projectile containing a colored, viscous substance (known as a "paintball") which bursts upon impact with a target. However pneumatically operated guns used in paintball applications (as well as existing pneumatically operated guns in general) suffer from several deficiencies affecting the accuracy of the shot which are eliminated by the present invention.

Existing pneumatically operated guns invariably use a spring mechanism in some fashion to aid in generating the propellant force necessary to fire the projectile at the desired velocity from the gun. The use of a spring creates a non-linear transformation of energy from a pneumatically stored potential form into kinetic acceleration of the projectile, since the spring releases continuously less energy as it expands from its

maximum deformation to its undeformed natural state. In the case of any flexible projectile in general and particularly in the case of paintballs, this non-linear transformation of energy causes some deformation in the shape of the projectile that alters the ballistic forces created upon it in flight, adversely affecting the accuracy with which the projectile can be fired to strike its intended target. The adverse ballistic effects stemming from projectile deformation are particularly felt at the low projectile velocities required in paintball applications for player safety. Given the spring forces used in the existing state of the art, it is necessary to fire a paintball at the highest pneumatic pressures possible in order to eliminate these adverse ballistic effects. This has caused development of a thicker paintball shell to eliminate paintball breakage within the firing chamber of the gun. This increased thickness has in turn created a problem with paintball breakage as it impacts its target. To eliminate all of these problems without sacrificing player safety, it has become necessary in paintball applications to find a way to minimize projectile deformation at low pneumatic pressure levels, in order to permit the accurate sighting and firing of a low velocity shot.

The present invention solves all of these problems by eliminating the use of spring mechanisms in the transfer of energy to the projectile during the launching sequence. The invention uses a launching sequence which results in only the application of pneumatic force to the projectile. This creates a linear change in the amount of energy that is applied to the projectile as the pneumatically stored energy undergoes expansion and decompression upon release. This in turn minimizes the physical deformation of the projectile during the launching sequence, increasing the accuracy of the shot. In paintball applications, this linear application of force contributes greatly to increased accuracy, since a non-linear transfer of force at the low pressures required to limit paintball

velocities to safe levels exaggerates the adverse ballistic effects on the paintball, due to its low velocity. A preferred embodiment of the present invention optionally provides electro-pneumatic control for both the projectile cocking and reloading operations to optimize firing sequence timing.

The accuracy of the present invention has been proven through testing at the projectile velocity levels used in paintball applications. Ten shot clusters from a conventional hand held paintball gun that is fired from a target distance of 60 yards typically exhibits an average maximum inaccuracy of 15 inches for projectile velocities in the 290 to 300 feet per second range. The same conventional paintball gun shot under the same conditions from a rigid mount typically exhibits an average maximum inaccuracy of 10 inches. In contrast, the present invention exhibited an average maximum inaccuracy of less than 8 inches when fired from a hand held position, and an average maximum inaccuracy of 4 inches when rigidly mounted.

The invention also provides increased aiming accuracy through the use of a cam shaped trigger and electrical switch arrangement to initiate the projectile launching sequence. This arrangement minimizes the pull force necessary to engage the switch by contact with the trigger, due to the mechanical advantage provided by the transfer of force through the cam. This in turn minimizes the amount of hand and arm movement experienced upon pulling the trigger, which increases firing accuracy.

Finally, the present invention also provides a significant accuracy advantage over all prior art spring-loaded guns at all pneumatic operating pressures, due to the minimized recoil experienced after a shot is fired. Typical spring-loaded guns exhibit greater recoil than does the invention, due to the non-linear reaction forces created on the gun body by the expansion of the spring. In contrast, the elimination of spring loading in the present

invention eliminates these non-linear forces, minimizing the amount of recoil experienced and thus allowing greater accuracy over all types of existing spring-loaded gun designs in the firing of a shot.

Accordingly, it is an object of the present invention to provide a projectile launching device that uses only pneumatic force to propel a projectile.

It is also an object of the present invention to provide a projectile launching device for use in the recreational and professional sport of paintball that uses only pneumatic force to propel the paintball.

It is also an object of the present invention to provide a projectile launching device which can be aimed and fired with greater accuracy than all types of spring-loaded guns at all pneumatic operating pressures.

It is also an object of the present invention to provide a projectile launching device for use in the recreational and professional sport of paintball which can be aimed and fired with greater accuracy than existing paintball guns at low pneumatic operating pressures.

It is also an object of the present invention to provide a projectile launching device that uses electro-pneumatic control to release the pneumatic force that propels the projectile.

It is also an object of the present invention to provide a projectile launching mechanism that uses electro-pneumatic control for both the projectile cocking and reloading operations to optimize firing sequence timing.

It is also an object of the present invention to provide a projectile launching device for use in the recreational and professional sport of paintball that uses electro-pneumatic control to release the pneumatic force that propels the projectile.

SUMMARY OF THE INVENTION

The pneumatically operated projectile launching device is preferably comprised of three principal elements: a body which houses and interconnects all of the pneumatic components and also houses the electrical power source, a grip mounted to the body which includes an electrical switch that activates a launching sequence, and an electrical control unit housed within both the body and the grip which directs flow between the pneumatic components to load, cock and fire the gun.

The body preferably contains a plurality of chambers in communication with each other including a chamber containing and distributing pressurized gas, a chamber containing a compressed gas storage chamber and mechanisms for filling the storage chamber with gas and releasing gas from the storage chamber to fire the projectile, and a chamber containing mechanisms for loading and launching the projectile. The electrical control unit preferably includes an electrical power source which activates an electrical timing circuit when the electrical switch is closed, and at least two and preferably three electrically operated pneumatic flow distribution devices which are sequentially energized by the electrical timing circuit to enable the loading of a projectile for launching and to release compressed gas from the storage chamber to fire the projectile, respectively.

Before the initiation of a launching sequence the compressed gas storage chamber is filled with compressed gas while the projectile launching mechanism is disabled. Filling of the compressed gas storage chamber is preferably accomplished automatically by actuation of the compressed gas filling mechanism. When the electrical switch is closed to initiate the launching sequence after the projectile is first loaded into the launching mechanism by electrical timing circuit actuation of the first electrically operated pneumatic flow distribution device. The projectile is then fired when the electrical timing

circuit actuates the second electrically operated pneumatic flow distribution device to release gas from the compressed gas storage chamber into the launching mechanism. In the preferred embodiment, the third electrically operated pneumatic flow distribution device allows the reloading of a new projectile into the launching mechanism following the firing of the projectile. Additionally, the optional use of a venturi permits increasing the number of projectiles launched by a given volume of stored compressed gas due to the reduced volume of gas used to launch each projectile.

The present invention eliminates the use of spring mechanisms in the transfer of energy to the projectile during the launching sequence. The invention uses a launching sequence which results in only the application of pneumatic force to the projectile. This creates a linear change in the amount of energy that is applied to the projectile as the pneumatically stored energy undergoes expansion and decompression upon release. This in turn minimizes the physical deformation of the projectile during the launching sequence, increasing the accuracy of the shot. In paintball applications, this linear application of force contributes greatly to increased accuracy, since a non-linear transfer of force at the low pressures required to limit paintball velocities to safe levels exaggerates the adverse ballistic effects on the paintball, due to its low velocity.

The accuracy of the present invention has been proven through testing at the projectile velocity levels used in paintball applications. Ten shot clusters from a conventional hand held paintball gun that is fired from a target distance of 60 yards typically exhibits an average maximum inaccuracy of 15 inches for projectile velocities in the 290 to 300 feet per second range. The same conventional paintball gun shot under the same conditions from a rigid mount typically exhibits an average maximum inaccuracy of 10 inches. In contrast, the present invention exhibited an average maximum inaccuracy

of less than 8 inches when fired from a hand held position, and an average maximum inaccuracy of 4 inches when rigidly mounted.

The invention also provides increased aiming accuracy through the use of a cam shaped trigger and electrical switch arrangement to initiate the projectile launching sequence. This arrangement minimizes the pull force necessary to engage the switch by contact with the trigger, due to the mechanical advantage provided by the transfer of force through the cam. This in turn minimizes the amount of hand and arm movement experienced upon pulling the trigger, which increases firing accuracy.

Finally, the present invention also provides a significant accuracy advantage over all prior art spring-loaded guns at all pneumatic operating pressures, due to the minimized recoil experienced after a shot is fired. Typical spring-loaded guns exhibit greater recoil than does the invention, due to the non-linear reaction forces created on the gun body by the expansion of the spring. In contrast, the elimination of spring loading in the present invention eliminates these non-linear forces, minimizing the amount of recoil experienced and thus allowing greater accuracy over all types of existing spring-loaded gun designs in the firing of a shot.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure (1) is a side view of the pneumatically operated projectile launching device.

Figure (1A) is a side view of the pneumatically operated projectile launching device as configured to load a projectile.

Figure (2) is a rear view of the pneumatically operated projectile launching device.

Figure (3) is a top view of the body of the pneumatically operated projectile launching device.

Figure (4) is a rear view of the pneumatically operated projectile launching device showing use of a venturi.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The pneumatically operated projectile launching device is preferably comprised of three principal elements: a body which houses and interconnects all of the pneumatic components and also houses the electrical power source; a grip mounted to the body which includes a trigger and an electrical switch that activates the launching sequence; and an electrical control unit housed within both the body and the grip which directs flow between the pneumatic components to load, cock and fire the gun.

As shown in Figure (2), the body preferably has three pneumatic chambers with axes that are preferably parallel to the longitudinal axis of the gun body **40**. The gun body **40** can be made of materials suitable in the art for withstanding the force of the launching sequence such as metal or plastic. The first chamber **1** contains compressed gas and is preferably sealed by a removable fitting **5** which is removed to inject the gas. The first chamber **1** is preferably in communication with the second chamber **2** and the third chamber **3** through a series of ported passageways **6a** and **6b**, respectively, bored through the interior of the gun body **40**. As shown in Figure (3), the second chamber **2** houses the compressed gas storage chamber **11**, the compressed gas filling mechanism **12** and the compressed gas releasing mechanism **13**. The third chamber **3** is also preferably in communication with both the first chamber **1** and the second chamber **2** through a series of ported passageways **6b** and **6c**, respectively, bored through the interior of the gun body **40**. As shown in Figure (1), the third chamber **3** houses the projectile loading mechanism **14** and the projectile launching mechanism **15**.

As shown in Figure (3), the compressed gas storage chamber **11** is bordered by the interior walls of the second chamber **2** and by the compressed gas filling mechanism **12** on one end and by the compressed gas releasing mechanism **13** on the end opposite the compressed gas filling mechanism **12**. The compressed gas storage chamber **11** is filled with compressed gas from the first chamber **1** by means of the interconnections **6a** between the first chamber **1** and the second chamber **2** when the compressed gas filling mechanism **12** is actuated. The compressed gas storage chamber **11** releases stored gas to the projectile launching mechanism **15** by means of the interconnections **6c** between the second chamber **2** and the third chamber **3** when the compressed gas releasing mechanism **13** is actuated.

As shown in Figure (3), the compressed gas filling mechanism **12** preferably consists of a valve **16** with a metallic or plastic conically or spherically shaped plug **17** which is normally shut against a metallic, plastic, or rubber conically or concavely shaped seat **18** by the loading of a spring **19** when the compressed gas filling mechanism **12** is not in its actuated position. The plug **17** is attached to a second end **20b** of a metallic or plastic rod-shaped mechanical linkage **20** which opens the valve **16** by compressing the spring **19** when the compressed gas filling mechanism **12** is in its actuated position to create a flow path for compressed gas from the first chamber **1** to the compressed gas storage chamber **11**.

As shown in Figure (3), the mechanical linkage **20** passes through the compressed gas storage chamber **11** and has a first end **20a** which is attached to the compressed gas releasing mechanism **13**. The compressed gas releasing mechanism **13** preferably consists of a metallic or plastic piston **21** which slides along the longitudinal axis of the second chamber **2** in a space adjacent to the compressed gas storage chamber **11**. A second end

21b of the piston **21** is adjacent to the compressed gas storage chamber **11** and is connected to the first end **20a** of the mechanical linkage **20**. The second end of the piston **21b** has a flexible O-ring seal **23** made of rubber or other suitable synthetic sealing materials such as polyurethane that prevents gas leakage out of the compressed gas storage chamber **11**. Compressed gas from the first chamber **1** is applied to the second end of the piston **21b** to actuate the compressed gas releasing mechanism **13** by unseating the O-ring **23** sealing the compressed gas storage chamber **11** to allow stored gas to be released from the compressed gas storage chamber **11** into the projectile launching mechanism **15** by means of the interconnections **6c** between the second chamber **2** and the third chamber **3**. The piston **21** contains a notched area **22** adjacent to the O-ring **23** that provides a surface for applying compressed gas pressure from the first chamber **1** to unseat the O-ring **23** and actuate the compressed gas releasing mechanism **13**.

The piston **21** has a first end **21a** opposite the compressed gas storage chamber **11** which is subjected to pneumatic pressure to actuate the compressed gas filling mechanism **12** by transmitting through the mechanical linkage **20** a compression force on the spring **19** that opens the valve **16**. The opening in the valve **16** is formed when the plug **17** is separated from the seat **18** to create a flow path for compressed gas from the first chamber **1** to the compressed gas storage chamber **11** by means of the interconnections **6a** between the first chamber **1** and the second chamber **2**. Compressed gas from the first chamber **1** is applied to the first end of the piston **21a** to open the valve **16** and actuate the compressed gas filling mechanism **12**. The first end of the piston **21a** also contains a flexible O-ring seal **24** which prevents actuating pressure leakage into the compressed gas storage chamber **11** when the compressed gas filling mechanism **12** is actuated.

As shown in Figure (1), the third chamber 3 of the gun body 40 houses the projectile loading mechanism 14 and the projectile launching mechanism 15. The projectile loading mechanism 14 preferably consists of a metallic or plastic piston 25 which slides along the longitudinal axis of the third chamber 3. The projectile launching mechanism 15 preferably consists of a metallic or plastic bolt 26 which also slides along the longitudinal axis of the third chamber 3 and which has a port 27 for receiving released gas from the compressed gas storage chamber 11 to propel a projectile 41 from the gun body 40. The bolt 26 is connected to the piston 25 by a metallic or plastic rod-shaped mechanical linkage 28, which moves the bolt 26 to receive the projectile 41 by gravity loading from the projectile feed mechanism 29 when the projectile loading mechanism 14 is actuated.

As shown in Figure (1A), the projectile loading mechanism 14 is actuated when compressed gas from the first chamber 1 is applied by means of the interconnections 6b between the first chamber 1 and the third chamber 3 to a first end 25a of the piston 25 which is attached to the mechanical linkage 28. This compressed gas acts against the piston 25 and the mechanical linkage 28 to drive the bolt 26 back to the cocked position which enables the loading of a projectile 41 into engagement with the bolt 26 from the projectile feed mechanism 29. The subsequent release of stored gas from the compressed gas storage chamber 11 through the bolt port 27 will drive the projectile 41 from the gun body 40. After the launching sequence has been completed compressed gas is applied from third solenoid valve 37 to a second end 25b of the piston 25 opposite the mechanical linkage 28 to disable the bolt 26 from receiving a projectile 41 by driving the bolt 26 to the shut position. Interconnections 6c can be optionally configured with a venturi 42 as shown in Figure (4) to introduce ambient air supplementing the pressure of the stored gas

released from the compressed gas storage chamber 11 through the bolt port 27 to drive the projectile 41 from the gun body 40. The use of such a venturi permits increasing the number of projectiles launched by a given volume of gas stored in first chamber 1 due to the increased pressure and/or reduced volume of gas used to launch each projectile 41. Alternately, the venturi 42 may be placed such as to introduce ambient air directly into the gun barrel. Stored compressed gas will be prevented from escaping to the atmosphere through the venturi 42 by either use of appropriate dimensioning of the venturi 42 or by the introduction of a flow blockage device such as a check valve into the flow path of the venturi 42.

The second principal element is the grip, shown in Figure (1). The grip is mounted to the body and preferably houses three principal components, a handle 7, a trigger 8 and an electrical switch 30. The handle 7 can be made of any suitable material such as metal or plastic and is preferably shaped with a hand grip to allow the gun to be held in a pistol-like fashion. The metallic or plastic trigger 8 is attached to the handle 7 and preferably has a leading edge shaped to be pulled by two fingers with a cam shaped trailing edge to engage the electrical switch 30. A trigger guard 9 which prevents accidental trigger displacement is preferably attached to the trigger 8. A spring 10 preferably returns the trigger 8 to a neutral position after the electrical switch 30 has been contacted to initiate a launching sequence. The electrical switch 30 is preferably a two-pole miniature switch which contains a plunger 31 loaded by a spring 32.

As shown in Figure (1), the third principal element is the electrical control unit which is housed within both the body and the grip. The electrical control unit preferably consists of an electrical timing circuit 34 housed in the handle 7 along with three electrically operated 3-way solenoid valves 35, 36 and 37 housed in the gun body 40 and

an electrical battery power source **33** housed in a fourth chamber **4** of the gun body **40**. The electrical timing circuit **34** is a network of electronic components that includes two solid state integrated circuit timers which control the launching sequence by sending energizing pulses to the solenoid valves **35**, **36** and **37**, which function as electrically operated pneumatic flow distribution mechanisms. When actuated the solenoid valves **35** and **36** pass compressed gas flow from the first chamber **1** and when not actuated the solenoid valves **35** and **36** operate to vent gas from the pressurized area. Conversely, when actuated solenoid valve **37** vents compressed gas flow from pressurized area and when not actuated solenoid valve **37** passes pressurized gas from the first chamber **1**. Upon initiation of the launching sequence the electrical timing circuit **34** energizes each solenoid valve **35**, **36** or **37** separately in a timed sequence to ensure that each solenoid valve **35**, **36** or **37** either passes or vents pressurized gas at the appropriate time within the launching sequence to propel a projectile **41** from the gun body **40**. In an alternate embodiment, three-way solenoid valves **36** and **37** may be replaced if desired with a single four-way solenoid valve which is capable of accomplishing the functions provided by both three-way solenoid valves **36** and **37**.

DETAILED DESCRIPTION OF OPERATION

Before the initiation of a launching sequence the introduction of compressed gas into the first chamber **1** will preferably automatically cause pneumatic pressure to be applied to the first end of piston **21a** to cause gas flow from the first chamber **1** to the compressed gas storage chamber **11** through actuation of the compressed gas filling mechanism **12** as described above. Simultaneously pneumatic pressure will preferably be applied by third solenoid **37** to the second end of piston **25b** driving the bolt **26** to the shut position to disable the loading of a projectile **41**. When these conditions are met the

compressed gas storage chamber **11** is charged with the bolt **26** closed and the gun is ready for the initiation of a launching sequence.

Assuming that a projectile is loaded into engagement with the bolt **26** prior to initiation of the launching sequence, the launching sequence is preferably initiated when the electrical switch **30** completes a circuit between the electrical power source **33** and the electrical timing circuit **34** as the cam shaped trailing edge of the trigger **8** contacts the plunger **31** to compress the spring **32**. When contact is made the electrical power source **33** energizes the electrical timing circuit **34** which first sends an energizing pulse to actuate second solenoid valve **36** which then passes pressurized gas flow to the second end of piston **21b** to actuate the compressed gas releasing mechanism **13** to launch the projectile. Subsequently, the electrical power source **33** energizes the electrical timing circuit **34** to send an energizing pulse to actuate first and third solenoid valves **35** and **37**. When actuated the first solenoid valve **35** passes pressurized gas flow to the first end of piston **25a** to actuate the projectile loading mechanism **14** by driving the bolt **26** back to the cocked position and to enable the loading of a projectile **41** into engagement with the bolt **26** from the projectile feed mechanism **29**. Simultaneously, third solenoid valve is actuated to vent the pressurized gas from behind the second end of piston **25b** to allow the bolt **26** to be placed in the cocking position. The electrical timing circuit **34** then sends an energizing pulse to actuate the second solenoid valve **36** which then passes pressurized gas flow to the second end of piston **21b** to actuate the compressed gas releasing mechanism **13**. Simultaneously the first solenoid valve **35** returns to its non-actuated position to vent the first end of piston **25a**. This venting in combination with the actuation of the compressed gas releasing mechanism **13** allows the stored gas released into the bolt port **27** from the compressed gas storage chamber **11** to drive the projectile

41 from the gun body **40**. After the launching sequence has been completed the cocking sequence described above takes place automatically prior to a subsequent firing of the trigger to launch the next projectile.

The launching sequence may then be repeated as many as nine times per second. The volume of the compressed gas storage chamber **11** and the chamber interconnections **6** are preferably sized to produce projectile velocities in the 290 to 300 feet per second range at an operating gas pressure of approximately 125 pounds per square inch gauge pressure. However, the 1.5 cubic inch volume of the compressed gas storage chamber **11** and the 0.0315 square inch area of the chamber interconnection orifices **6** will allow operation of the preferred embodiment at gas pressures of up to 175 pounds per square inch gauge pressure. As will be obvious to one skilled in the art, these parameters may be varied in order to allow for a differing operating gas pressure or projectile velocity.

While presently preferred embodiments have been shown and described in particularity, the invention may be otherwise embodied within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A pneumatically operated device for launching a projectile comprising:
 - A. a body having a plurality of chambers including:
 - (i) a first chamber containing compressed gas;
 - (ii) a second chamber in communication with said first chamber
having:
 - (a) a compressed gas storage chamber for storing said
compressed gas;
 - (b) a compressed gas filling mechanism for filling said
compressed gas storage chamber;
 - (c) a compressed gas releasing mechanism for releasing
said compressed gas from said compressed gas storage chamber to fire said projectile;
 - (iii) a third chamber in communication with said first chamber
and said second chamber having:
 - (a) a projectile launching mechanism for launching said
projectile;
 - (b) a projectile loading mechanism for in communication
with a source of projectiles for loading said projectiles into said projectile launching
mechanism;
 - B. a grip including an electrical switch;
 - C. an electrical control unit comprising:
 - (i) an electrical timing circuit electrically connected to said
electrical switch for actuation thereby;

(ii) first and third electrically operated pneumatic flow distribution mechanisms electrically connected to said timing circuit for actuation thereby, said first and third distribution mechanisms each being positionable between:

(a) a first position in which said projectile launching mechanism is prevented from receiving said projectile;

(b) a second position which enables said projectile launching mechanism to receive said projectile;

(iii) a second electrically operated pneumatic flow distribution mechanism electrically connected to said timing circuit for actuation thereby, said second distribution mechanism being positionable between:

(a) a first position which enables said compressed gas storage chamber to be filled with said compressed gas;

(b) a second position which enables release of said compressed gas from said compressed gas storage chamber to launch said projectile;

(v) an electrical power source connected to said electrical switch.

2. The pneumatically operated gun of Claim 1 wherein:

A. said first electrically operated pneumatic flow distribution mechanism is actuated by said timing circuit from said first position to said second position to direct said compressed gas from said first chamber such that:

(i) said projectile loading mechanism is disabled to prevent said projectile launching mechanism from receiving said projectile when said first electrically operated pneumatic flow distribution mechanism is in said first position;

(ii) said projectile loading mechanism is actuated to enable said projectile launching mechanism to receive said projectile when said first electrically operated pneumatic flow distribution mechanism is in said second position;

B. said second electrically operated pneumatic flow distribution mechanism is actuated by said timing circuit from said first position to said second position to direct said compressed gas from said first chamber such that:

(i) said compressed gas filling mechanism is actuated to fill said compressed gas storage chamber when said second electrically operated pneumatic flow distribution mechanism is in said first position;

(ii) said compressed gas releasing mechanism is actuated to release said gas from said compressed gas storage chamber into said projectile launching mechanism to launch said projectile when said second electrically operated flow distribution mechanism is in said second position by redirecting said compressed gas away from said projectile loading mechanism; and

C. said third electrically operated pneumatic flow distribution mechanism is actuated by said timing circuit from said first position to said second position to direct said compressed gas from said first chamber such that:

(i) said projectile loading mechanism is disabled to prevent said projectile launching mechanism from receiving said projectile when said third electrically operated pneumatic flow distribution mechanism is in said first position;

(ii) said projectile loading mechanism is actuated to enable said projectile launching mechanism to receive said projectile when said third electrically operated pneumatic flow distribution mechanism is in said second position;.

3. A pneumatically operated device for launching a projectile comprising:
 - A. a body having a plurality of chambers including:
 - (i) a first chamber containing compressed gas;
 - (ii) a second chamber in communication with said first chamberhaving:
 - (a) a compressed gas storage chamber for storing said compressed gas;
 - (b) a compressed gas filling mechanism for filling said compressed gas storage chamber;
 - (c) a compressed gas releasing mechanism for releasing said compressed gas from said compressed gas storage chamber to fire said projectile;
 - (iii) a third chamber in communication with said first chamber and said second chamber having:
 - (a) a projectile launching mechanism for launching said projectile;
 - (b) a projectile loading mechanism for in communication with a source of projectiles for loading said projectiles into said projectile launching mechanism;
 - B. a grip including an electrical switch;
 - C. an electrical control unit comprising:
 - (i) an electrical timing circuit electrically connected to said electrical switch for actuation thereby;

(ii) a first electrically operated pneumatic flow distribution mechanism electrically connected to said timing circuit for actuation thereby, said first distribution mechanism being positionable between:

(a) a first position in which said projectile launching mechanism is prevented from receiving said projectile;

(b) a second position which enables said projectile launching mechanism to receive said projectile;

(iii) a second electrically operated pneumatic flow distribution mechanism electrically connected to said timing circuit for actuation thereby, said second distribution mechanism being positionable between:

(a) a first position which enables said compressed gas storage chamber to be filled with said compressed gas;

(b) a second position which enables release of said compressed gas from said compressed gas storage chamber to launch said projectile; and

(iv) an electrical power source connected to said electrical switch; wherein said first electrically operated pneumatic flow distribution mechanism is a four-way valve.

4. The pneumatically operated gun of Claim 3 wherein:

A. said first electrically operated pneumatic flow distribution mechanism is actuated by said timing circuit from said first position to said second position to direct said compressed gas from said first chamber such that:

(i) said projectile loading mechanism is disabled to prevent said projectile launching mechanism from receiving said projectile when said first electrically operated pneumatic flow distribution mechanism is in said first position;

(ii) said projectile loading mechanism is actuated to enable said projectile launching mechanism to receive said projectile when said first electrically operated pneumatic flow distribution mechanism is in said second position;

B. said second electrically operated pneumatic flow distribution mechanism is actuated by said timing circuit from said first position to said second position to direct said compressed gas from said first chamber such that:

(i) said compressed gas filling mechanism is actuated to fill said compressed gas storage chamber when said second electrically operated pneumatic flow distribution mechanism is in said first position;

(ii) said compressed gas releasing mechanism is actuated to release said gas from said compressed gas storage chamber into said projectile launching mechanism to launch said projectile when said second electrically operated flow distribution mechanism is in said second position by redirecting said compressed gas away from said projectile loading mechanism.

5. The pneumatically operated gun of Claim 1 or 3 wherein said compressed gas filling mechanism comprises:

A. a valve adjacent to said compressed gas storage chamber having a plug and having a spring which loads said plug to shut said valve when said compressed gas filling mechanism is not actuated; and

B. a mechanical linkage having a first end passing through said compressed gas storage chamber and having a second end attached to said plug which opens said valve when said compressed gas filling mechanism is actuated to create a flow path for said compressed gas from said first chamber to said compressed gas storage chamber.

6. The pneumatically operated gun of Claim 5 wherein said compressed gas releasing mechanism is comprised of a first piston which slides longitudinally within said second chamber adjacent to said compressed gas storage chamber wherein:

A. said first piston has a first end which is pressurized by said compressed gas from said first chamber to actuate said compressed gas filling mechanism wherein:

(i) said first end has a flexible seal that prevents gas leakage into said compressed gas storage chamber from said first end;

B. said first piston has a second end adjacent to said compressed gas storage chamber which is pressurized by said compressed gas from said first chamber to actuate said compressed gas releasing mechanism wherein:

(i) said second end has a flexible seal that prevents gas leakage out of said compressed gas storage chamber from said second end;

(ii) said second end of said first piston is attached to said first end of said mechanical linkage such that said compressed gas filling mechanism is actuated when said first end of said first piston is pressurized by said compressed gas from said first chamber.

7. The pneumatically operated gun of Claim 1 or 3 wherein said projectile launching mechanism is comprised of a bolt which slides longitudinally within said third chamber wherein said bolt has at least one port for receiving said release of said gas from said compressed gas storage chamber to launch said projectile.

8. The pneumatically operated gun of Claim 7 wherein said projectile loading mechanism is comprised of a second piston which slides longitudinally within said third chamber wherein:

A. said second piston has a first end mechanically linked to said bolt which is pressurized by said compressed gas from said first chamber to actuate said projectile loading mechanism;

B. said second piston has a second end which is pressurized by said compressed gas from said first chamber to disable said projectile loading mechanism.

9. The pneumatically operated gun of Claim 1 or 3 wherein said electrically operated pneumatic flow distribution mechanisms comprise solenoid valves.

10. The pneumatically operated gun of Claim 1 or 3, wherein said communication between said chambers comprises ported passageways through the interior of said body.

11. The pneumatically operated gun of Claim 1 or 3, wherein said gun is operated at gas pressures from about 125 pounds per square inch to about 175 pounds per square inch.

12. The pneumatically operated gun of Claim 1 or 3 further comprising a removable means for sealing said first chamber after the insertion of compressed gas into said first chamber.

13. The pneumatically operated gun of Claim 1 or 3 wherein said grip further comprises:

A. a handle; and

B. a trigger attached to said handle and operably connected to said electrical switch to actuate said electrical switch.

14. The pneumatically operated gun of Claim 13 wherein said grip further comprises a spring to separate said trigger from said electrical switch when said trigger is released.

15. A method for pneumatically launching a projectile from a launching device having at least first and second interconnected chambers, comprising the following steps:

- A. filling said first chamber of said launching device with compressed gas having a selected pressure;
- B. launching said projectile from said second chamber by releasing said compressed gas from said first chamber into said second chamber; and
- C. loading a projectile into said second chamber.

16. The method of Claim 15, wherein said filling step and said loading step are performed simultaneously, followed by said launching step.

17. The method of Claim 15, wherein said loading step is followed by said launching step followed by said filling step.

18. The method of Claim 15, 16 or 17, wherein said steps are repeated continuously.

19. The method of Claim 15, wherein said selected gas pressure is between about 125 pounds per square inch and 175 pounds per square inch.

20. The pneumatically operated gun of Claim 1 or 3, wherein at least two said chambers are in communication with each other by means of at least one venturi-like device for supplementing gas flow between said chambers.

21. The pneumatically operated gun of Claim 20, wherein said at least two chambers comprise said second chamber and said third chamber.

22. The pneumatically operated gun of Claim 10, wherein said ported passageways of at least two said chambers comprise at least one venturi-like device for supplementing gas flow between said chambers.

23. The pneumatically operated gun of Claim 22, wherein said at least two chambers comprise said second chamber and said third chamber.

24. The pneumatically operated gun of Claim 1 or 3, wherein said gun further comprises at least one venturi-like device in communication with the barrel of said gun for supplementing gas flow to propel said projectile from said gun.

25. The pneumatically operated gun of Claim 10, wherein said gun further comprises at least one venturi-like device in communication with the barrel of said gun for supplementing gas flow to propel said projectile from said gun.

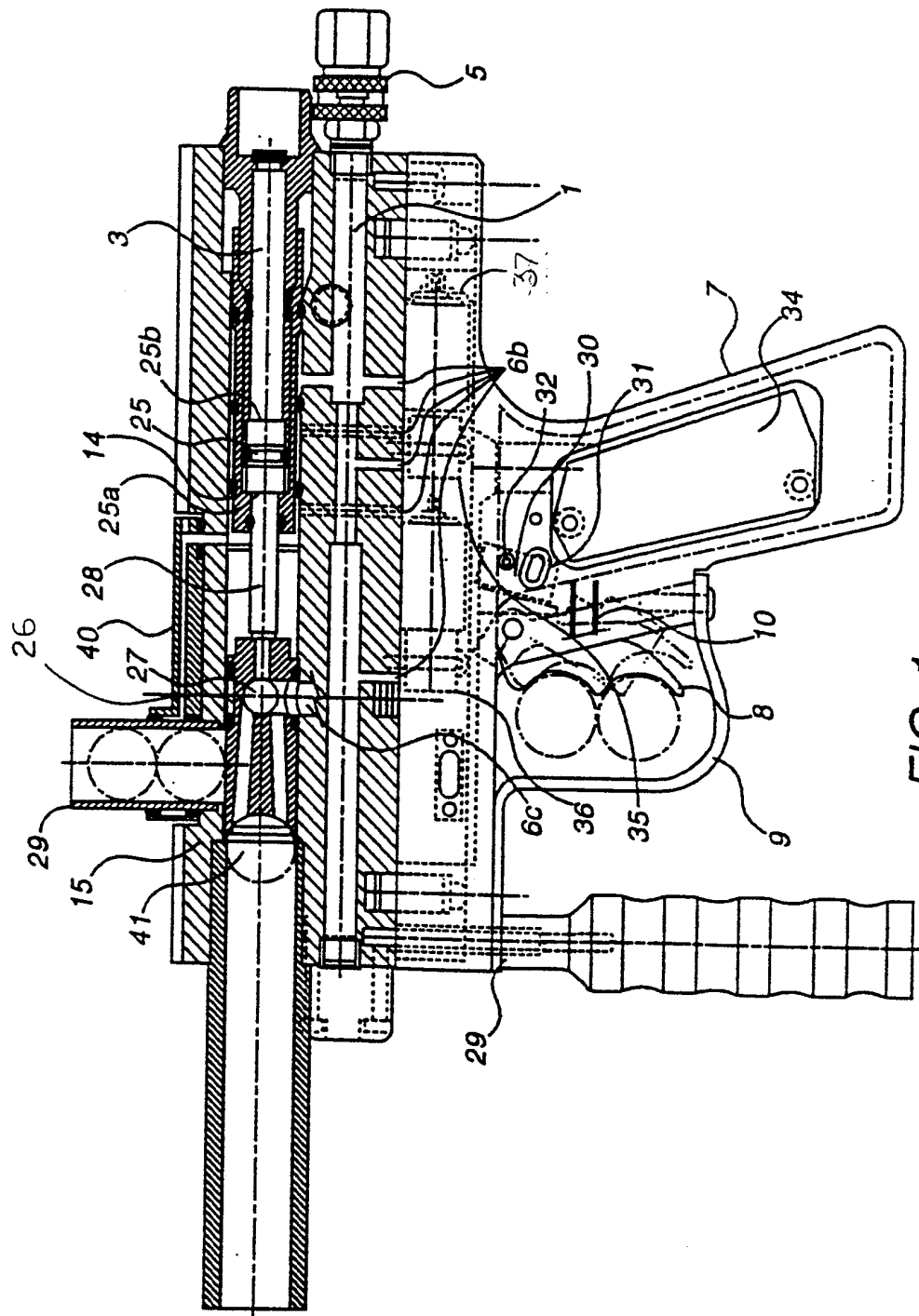


FIG. 1

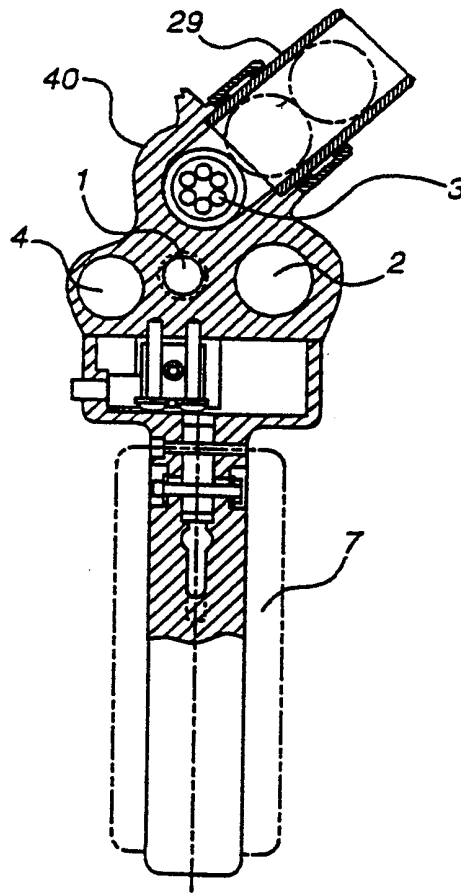


FIG. 2

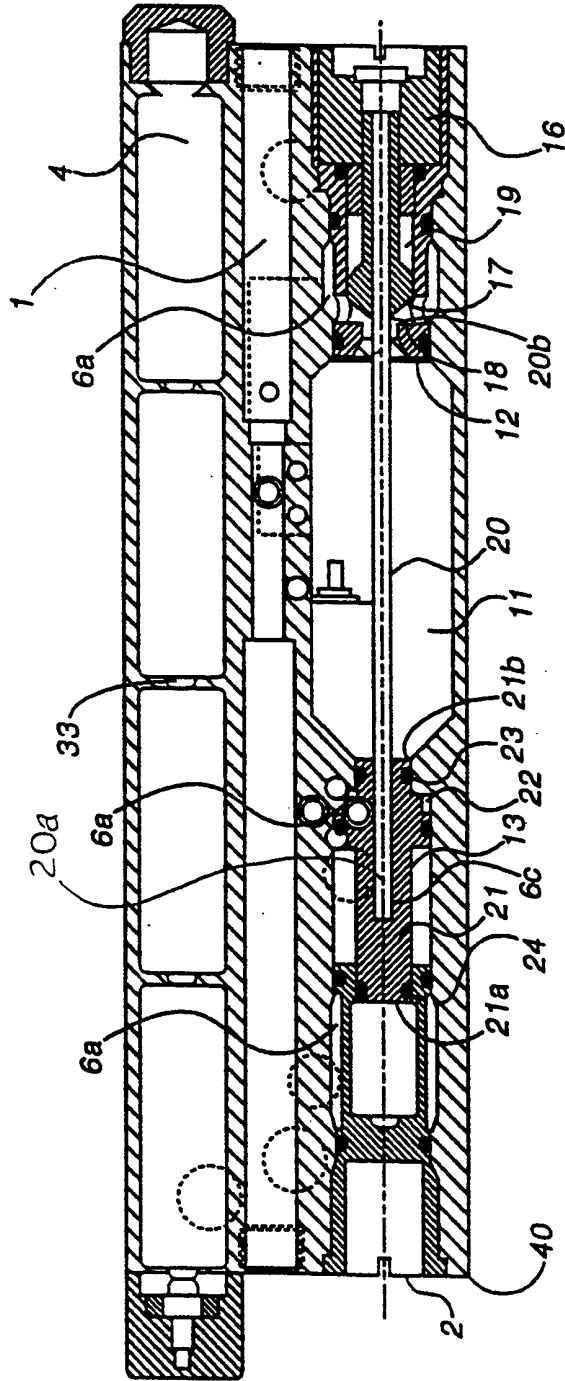


FIG. 3

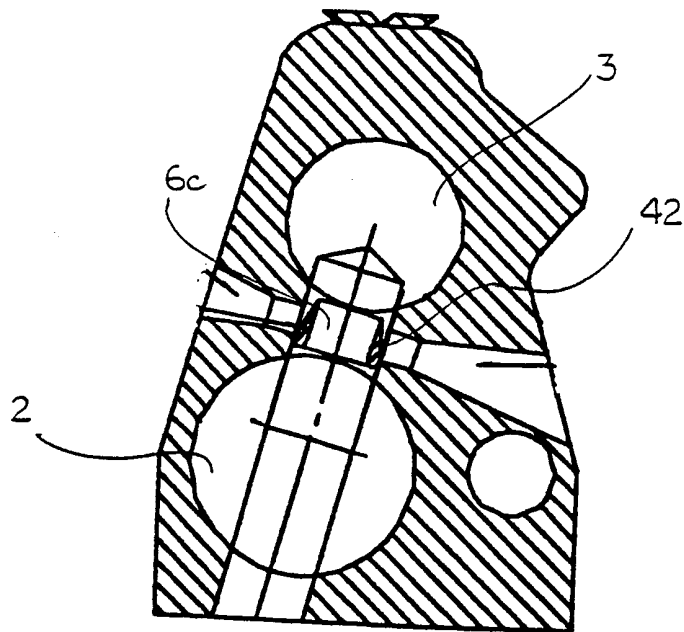


FIGURE 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/20562

A. CLASSIFICATION OF SUBJECT MATTER IPC 6 F41B11/02 F41B11/06		
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 6 F41B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 26498 A (SMART PARTS INC ;PNEUVENTURES INC (US)) 24 July 1997 see claims 13-31; figures see page 13, paragraph 2 - page 15, paragraph 1	1-19
X	US 2 554 116 A (R. J. MONNER) 22 May 1951 see figure 1 see column 3, line 19 - line 66	15-19
X	US 4 936 282 A (DOBBINS JERROLD M ET AL) 26 June 1990 see abstract; figures 3-6 see column 2, line 24 - line 38 see column 5, line 35 - column 6, line 62	15-19
A	--- -/--	1,3
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.		
<input checked="" type="checkbox"/> Patent family members are listed in 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 document 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	
"P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search <p style="text-align: center; font-weight: bold;">27 January 1999</p>	Date of mailing of the international search report <p style="text-align: center; font-weight: bold;">03/02/1999</p>	
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer <p style="text-align: center; font-weight: bold;">Schwingel, D</p>	

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 98/20562

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 462, 19 October 1989 & JP 01 179898 A (KANSAI SEIKI SEISAKUSHO), 17 July 1989 see abstract -----	1,3
A	US 4 094 294 A (SPEER RICHARD) 13 June 1978 see abstract; figures 1,3,4 see column 7, line 5 - line 35 -----	20,22, 24,25

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 98/20562

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9726498 A	24-07-1997	AU 1951597 A CA 2214364 A EP 0815408 A	11-08-1997 24-07-1997 07-01-1998
US 2554116 A	22-05-1951	NONE	
US 4936282 A	26-06-1990	GB 2226626 A	04-07-1990
US 4094294 A	13-06-1978	DE 2804098 A GB 1599095 A JP 53097531 A	03-08-1978 30-09-1981 25-08-1978