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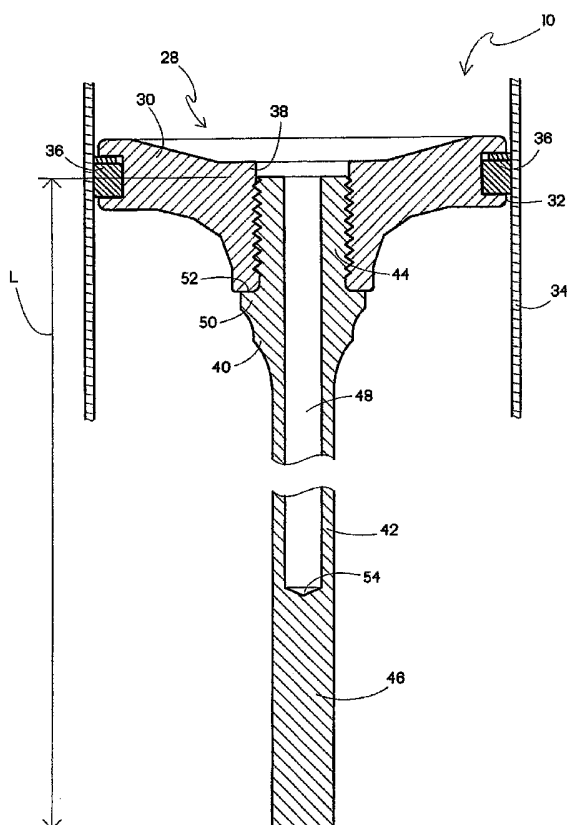
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(54) Title: DRIVER BLADE WITH AUXILIARY COMBUSTION CHAMBER FOR COMBUSTION POWERED FASTENER-DRIVING TOOL



(57) Abstract: A driver blade (40) for use in a combustion-powered fastener-driving tool (11) includes an elongate tubular body (42) having a combustion end (44) and a driving end (46), the combustion end being configured for attachment to a piston (28), and the driving end having a substantially solid cross-section. The tubular body is in fluid communication with a tool combustion chamber (10).



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## **Description**

### **DRIVER BLADE WITH AUXILIARY COMBUSTION CHAMBER FOR COMBUSTION POWERED FASTENER- DRIVING TOOL**

#### **BACKGROUND**

- [1] The present invention relates generally to fastener-driving tools used to drive fasteners into workpieces, and specifically to combustion-powered fastener-driving tools, also referred to as combustion tools.
- [2] Combustion-powered tools are known in the art, and one type of such tools, also known as IMPULSE® brand tools for use in driving fasteners into workpieces, is described in commonly assigned patents to Nikolich U.S. Pat. Re. No. 32,452, and U.S. Pat. Nos. 4,522,162; 4,483,473; 4,483,474; 4,403,722; 5,197,646; 5,263,439 and 6,145,724 , all of which are incorporated by reference herein. Similar combustion-powered nail and staple driving tools are available commercially from ITW-Paslode of Vernon Hills, Illinois under the IMPULSE® and PASLODE® brands.
- [3] Such tools incorporate a generally pistol-shaped tool housing enclosing a small internal combustion engine. The engine is powered by a canister of pressurized fuel gas, also called a fuel cell. A battery-powered electronic power distribution unit produces a spark for ignition, and a fan located in a combustion chamber provides for both an efficient combustion within the chamber, while facilitating processes ancillary to the combustion operation of the device. Such ancillary processes include: inserting the fuel into the combustion chamber; mixing the fuel and air within the chamber; and removing, or scavenging, combustion by-products. The engine includes a reciprocating piston with an elongated, rigid driver blade disposed within a single cylinder body.
- [4] Upon the pulling of a trigger switch, which causes the spark to ignite a charge of gas in the combustion chamber of the engine, the combined piston and driver blade is forced downward to impact a positioned fastener and drive it into the workpiece. The piston then returns to its original, or pre-firing position, through differential gas pressures within the cylinder. Fasteners are fed magazine-style into the nosepiece, where they are held in a properly positioned orientation for receiving the impact of the driver blade.
- [5] Conventional combustion fastener driving tools employ straight magazines holding approximately 30 fasteners each. In some operational applications, particularly commercial construction projects, there is a need for a tool which is capable of driving a greater number of fasteners in a shorter period of time. The use of coil magazines with greater fastener capacities is common in electrically or pneumatically powered

fastener driving tools, but for various reasons, such magazines have not become acceptable with combustion tools. Reasons for the undesirability of such high capacity magazines in these tools include the additional weight of the fasteners causing premature operator fatigue, and the additional energy required to operate the coil magazine fastener advance has not proved reliable.

- [6] Aside from the size of the magazine of conventional combustion tools, the weight, balance and overall ergonomics of conventional tools have not been suitable for high volume commercial construction applications, among others. In addition, when more rapid firing rates are contemplated for such tools, care must be taken to ensure that at the conclusion of each firing cycle, the piston returns to its prefiring position before the next firing cycle begins. Failure of the piston to properly return has been known to cause tool jams and other operational difficulties.

- [7] Thus, there is a need for a combustion-powered fastener-driving tool which is capable of operating reliably with high capacity magazines, including but not limited to coil magazines. There is also a need for a combustion-powered fastener-driving tool which is designed for driving fasteners from such a magazine at a relatively high rate.

#### **BRIEF SUMMARY**

- [8] The above-listed needs are met or exceeded by the present driver blade, preferably provided associated with a piston. The driver blade is generally hollow, which reduces weight, thus reducing overall tool weight and also requiring less energy to return to the prefiring position. In addition, the substantially hollow configuration increases the volume of the combustion chamber, thus increasing the firing power of the tool. A lower end of the driver blade is provided with a solid cross-section for facilitating the fastener driving operation.

- [9] More specifically, a driver blade for use in a combustion-powered fastener-driving tool includes an elongate tubular body having a combustion end and a driving end, the combustion end being configured for attachment to a piston, and the driving end having a substantially solid cross-section.

- [10] In another embodiment, a combined piston and driver blade for a combustion powered fastener-driving tool includes a piston head having an outer periphery configured for slidably engaging a cylinder and defining a central aperture, an elongate driver blade tubular body having a combustion end and a driving end, the combustion end being configured for attachment to the piston, and the driving end having a substantially solid cross-section.

- [11] In still another embodiment, a combustion chamber for a fastener-driving tool includes a cylinder head, a valve sleeve, a piston defining a central aperture, a driver blade secured to the piston and having a tubular body defining a closed chamber in fluid communication with the piston.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

- [12] FIG. 1 is a fragmentary front vertical section of a combustion-powered fastener-driving tool suitable for incorporating the present driver blade; and
- [13] FIG. 2 is a fragmentary vertical section of the present piston and driver blade assembly.

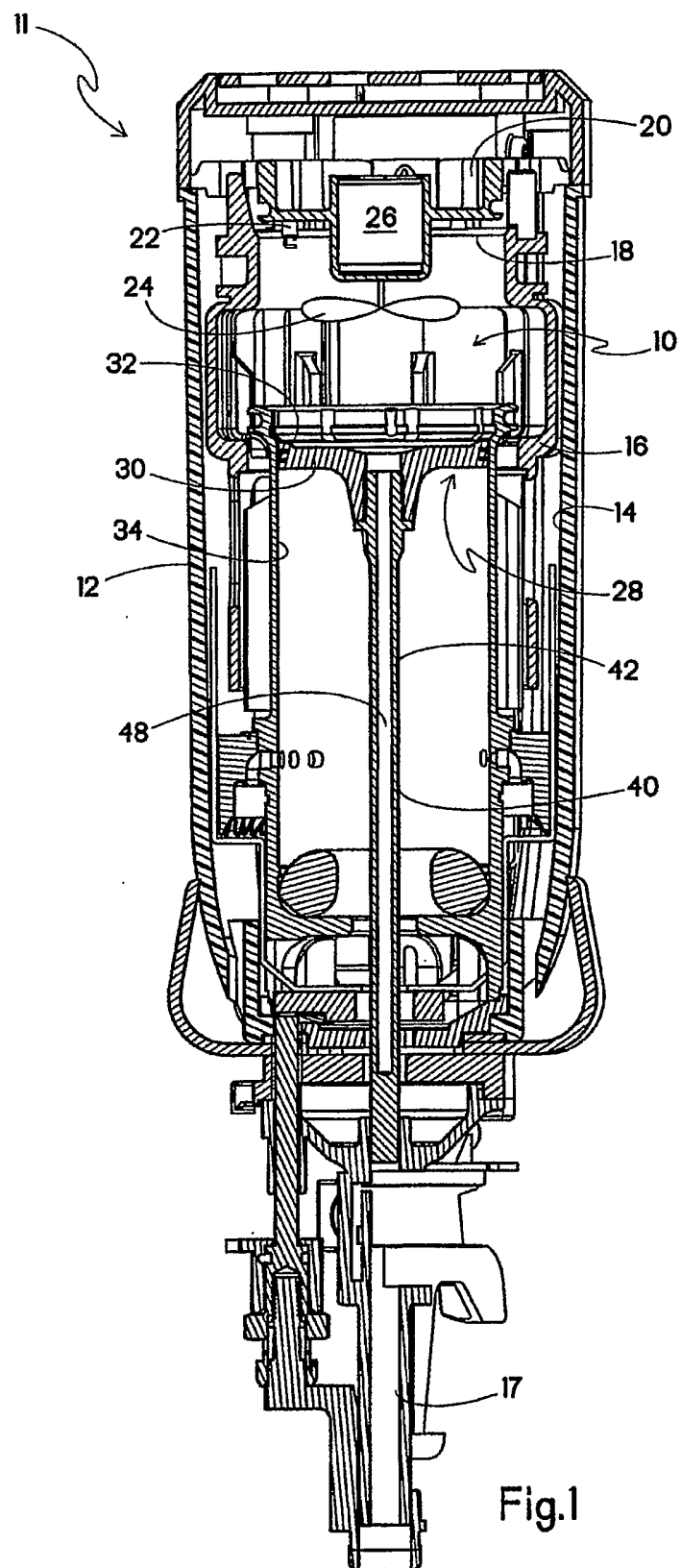
## DETAILED DESCRIPTION

- [14] Referring now to FIG. 1, a combustion chamber for a combustion-powered fastener-driving tool incorporating the present invention is generally designated 10. The present combustion chamber 10 and associated components is suitable for use in any type of combustion-powered fastener-driving tool, generally designated 11, including but not limited to the general type described in detail in the patents listed above and incorporated by reference in the present application. A housing 12 of the tool 11 encloses the combustion chamber 10 within a housing main chamber 14.
- [15] The combustion chamber 10 is defined on the sides by a generally cylindrical reciprocating valve sleeve 16, which as is known in the art, reciprocates between an open or exhaust position (shown here) when the tool is at rest or between firings, and a closed or combustion position just prior to and during the firing portion of the tool cycle. The closed position is achieved by pressing the tool against a workpiece, which depresses a biased nosepiece workpiece contact element 17. At an upper end 18, the combustion chamber 10 is defined by a cylinder head 20. While other configurations are contemplated, the cylinder head 20 is provided with a spark plug 22 and a fan 24 which depends into the combustion chamber. A motor 26 powers the fan 24.
- [16] Referring now to FIGS. 1 and 2, a lower end of the combustion chamber 10 is defined by a piston, generally 28, in an uppermost or prefiring position. The piston 28 has a body or head 30 which is circular when viewed from above and has an outer peripheral edge 32 configured for slidably engaging a cylinder 34. As is known in the art, piston rings 36 (various configurations of which are depicted) are typically provided on the piston head 30 to maintain an operational seal and reduce wear on the sliding components. The piston head 30 defines a central aperture 38 which is preferably threaded or provided with some other fastening formation. It will be seen that the central aperture 38 defines a portion of the lower end of the combustion chamber 10.
- [17] A driver blade 40 is secured to the piston 28 and reciprocates with the piston in the cylinder 34 for driving fasteners into workpieces as is well known in the art. While conventional driver blades are solid to maximize impact force and maintain structural integrity after repeated firing cycles, an important feature of the present driver blade 40 is that it is substantially hollow. It has been found that in some applications, strength is

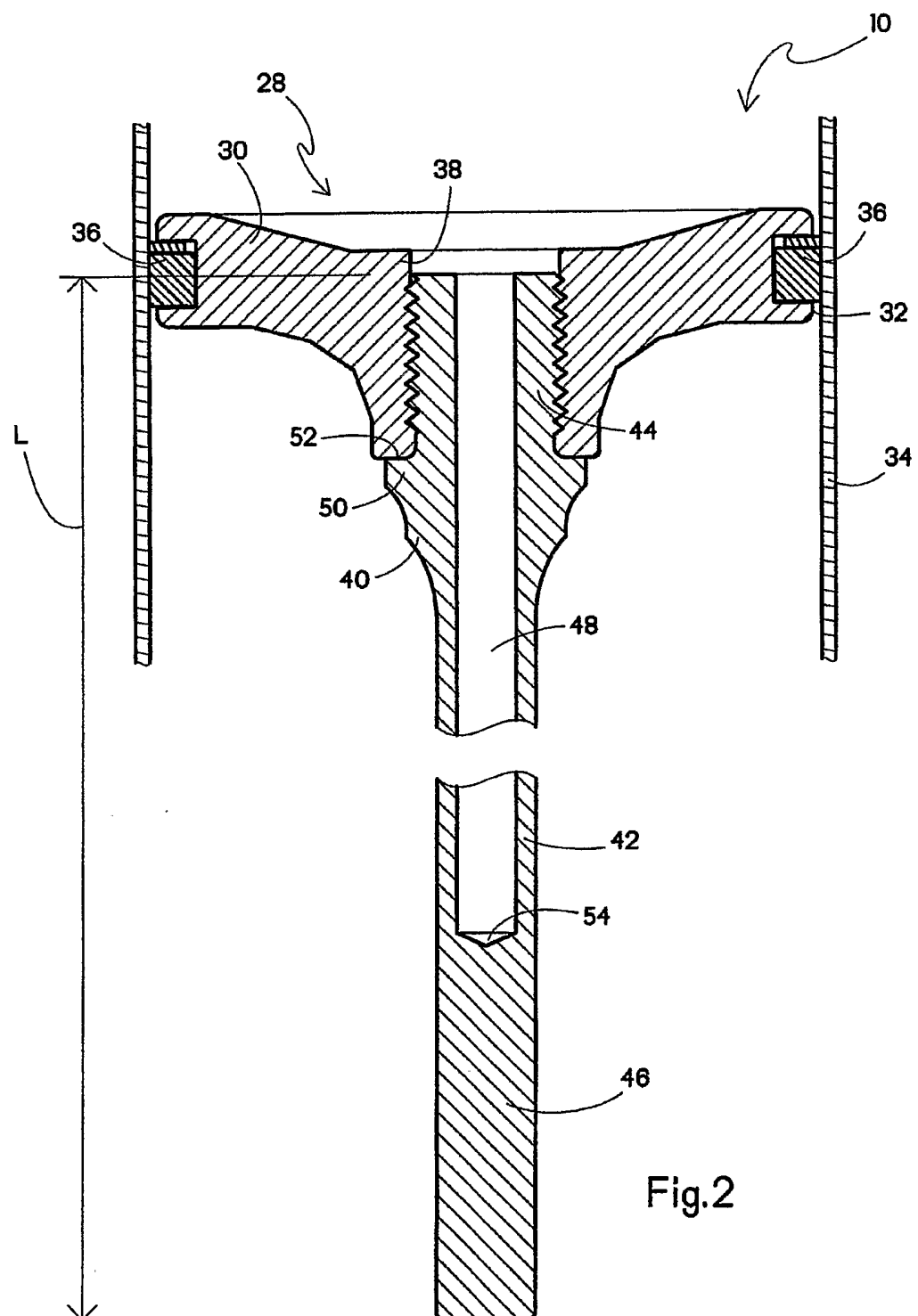
- not sacrificed, but a lighter weight component is obtained. Also, by being substantially hollow, the driver blade 40 increases the volume of the combustion chamber 10. This increased volume provides more fastener driving power and a more rapid, yet reliable return of the driver blade 40 to the prefiring position.
- [18] More specifically, the driver blade 40 has an elongate, generally tubular body 42 having a combustion end 44 and a driving end 46 opposite the combustion end. For best results, the combustion end 44 is open to ambient. The body 42 has a hollow interior and defines a driver blade chamber 48 which, through the combustion end 44, is in fluid communication with the central aperture 38 of the piston 28 and ultimately, the combustion chamber 10. As such, the driver blade chamber 48 becomes an auxiliary combustion chamber.
- [19] The combustion end 44 is configured for attachment to the piston 28, and in the preferred embodiment is externally threaded to threadably engage the threaded central aperture 38. Other known fastening technologies are contemplated, including welding, chemical adhesives, spring locks, bayonet lugs and grooves and the like. For additional strength and positive engagement with the piston 28, the driver blade 40 is provided with a radially thickened portion 50 near the combustion end 44 defining a shoulder 52. Opposite the combustion end 44, a closed end 54 of the driver blade chamber 48 is preferably conically shaped (seen in FIG. 2) for facilitated fabrication and/or distribution of combustion forces.
- [20] For achieving a positive driving action when contacting fasteners, the driving end 46 has a substantially solid cross-section. Beneficial results have been found when the solid driving end 46 takes up approximately 15% of the total length of the body 42, and the driver blade chamber 48 represents the remainder of the total length L of the body, or approximately 85%. Thus, in one particular exemplary embodiment, the total length of the body 42 is 7.5 inches, and the driver blade chamber 48 is 6.38 inches. The above-described percentages and lengths are exemplary only, and may vary to suit the application, power level of the tool and type of fastener being driven, among other parameters known to skilled practitioners.
- [21] While a particular embodiment of the present driver blade with auxiliary combustion chamber for a combustion-powered fastener-driving tool has been described herein, it will be appreciated by those skilled in the art that changes and modifications may be made thereto without departing from the invention in its broader aspects and as set forth in the following claims.

## Claims

- [1] A driver blade for use in a combustion-powered fastener-driving tool, comprising:  
an elongate tubular body having a combustion end and a driving end;  
said combustion end being configured for attachment to a piston;  
said driving end having a substantially solid cross-section.
- [2] The driver blade of claim 1 wherein said combustion end is open to ambient, and said tubular body defines an inner chamber in fluid communication with said open end, forming an auxiliary combustion chamber.
- [3] The driver blade of claim 1 wherein said tubular body extends approximately 85% of a length of said body.
- [4] The driver blade of claim 1 wherein said combustion end is threaded.
- [5] The driver blade of claim 1 wherein said combustion end has a radially thickened portion for engaging the piston.
- [6] A combined piston and driver blade for a combustion powered fastener-driving tool, comprising:  
a piston head having an outer periphery configured for slidably engaging a cylinder, and defining a central aperture;  
an elongate driver blade tubular body having a combustion end and a driving end;  
said combustion end being configured for attachment to said piston; and  
said driving end having a substantially solid cross-section.
- [7] The combination of claim 6 wherein said aperture is threaded and said combustion end is threaded to engage said aperture.
- [8] A combustion chamber for a fastener-driving tool, comprising:  
a cylinder head;  
a valve sleeve;  
a piston defining a central aperture; and  
a driver blade secured to said piston and having a tubular body defining a closed chamber in fluid communication with said piston.
- [9] The combustion chamber of claim 8 wherein said tubular body is defined at a lower end by a driving end having a solid cross-section.
- [10] The combustion chamber of claim 8 wherein said tubular body forms an auxiliary combustion chamber in fluid communication with said combustion chamber.







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A. CLASSIFICATION OF SUBJECT MATTER  
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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)  
B25C

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)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 109 165 A (VELAN ET AL) 29 August 2000 (2000-08-29) column 5, lines 42-67 column 6, lines 1-27 column 9, lines 53-67; figures 1,2,6-10	1-10
X	US 6 145 724 A (SHKOLNIKOV ET AL) 14 November 2000 (2000-11-14) column 4, lines 61-67 column 5, lines 1-35; figures 1,2	1,4-7
A	EP 0 560 049 A (ILLINOIS TOOL WORKS, INC; ILLINOIS TOOL WORKS INC) 15 September 1993 (1993-09-15) column 5, lines 13-47; figures 1-3 ----- -/--	1,4-9

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 102 270 A (ROBINSON ET AL) 15 August 2000 (2000-08-15) column 4, lines 49-67 column 5, lines 1-26; figure 2 -----	1,4-9
A	US 3 615 049 A (ALLEN R. OBERGFELL ET AL) 26 October 1971 (1971-10-26) column 4; figures 2,3 -----	1,6,8-10
A	US 6 155 472 A (DEZIEL ET AL) 5 December 2000 (2000-12-05) columns 6,7; figures 1,6-9 -----	1,6,8-10

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IB2005/052813

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6109165	A	29-08-2000	AT 234176 T	15-03-2003
			AU 689060 B2	19-03-1998
			AU 1779297 A	06-11-1997
			AU 5943498 A	28-05-1998
			CA 2200159 A1	03-11-1997
			DE 69719590 D1	17-04-2003
			DE 69719590 T2	09-10-2003
			EP 0805001 A1	05-11-1997
			ES 2193330 T3	01-11-2003
			JP 10044060 A	17-02-1998
			NZ 314672 A	29-03-1999
			US 5860580 A	19-01-1999
US 6145724	A	14-11-2000	AU 703870 B1	01-04-1999
			BR 9804258 A	21-12-1999
			CA 2250457 A1	30-04-1999
			CN 1217967 A	02-06-1999
			EP 0913234 A2	06-05-1999
			JP 11216684 A	10-08-1999
			NZ 332544 A	26-05-2000
			TW 426589 B	21-03-2001
			US 5909836 A	08-06-1999
EP 0560049	A	15-09-1993	AU 3288793 A	16-09-1993
			BR 9300813 A	14-09-1993
			CA 2088837 A1	10-09-1993
			DE 69309999 D1	28-05-1997
			DE 69309999 T2	06-11-1997
			JP 2018821 C	19-02-1996
			JP 6008158 A	18-01-1994
			JP 7036985 B	26-04-1995
			MX 9300973 A1	01-09-1993
			NZ 247074 A	26-03-1996
			US 5197646 A	30-03-1993
US 6102270	A	15-08-2000	NONE	
US 3615049	A	26-10-1971	NONE	
US 6155472	A	05-12-2000	NONE	