



(51) International Patent Classification:

F41A 21/08 (2006.01) F41A 21/34 (2006.01)
F41A 21/24 (2006.01) F41A 21/48 (2006.01)

(21) International Application Number:

PCT/US2017/023013

(22) International Filing Date:

17 March 2017 (17.03.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

15/000,293 19 January 2016 (19.01.2016) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:

US 15000293 (CON)
Filed on 19 January 2016 (19.01.2016)

(72) Inventor; and

(71) Applicant : ABBOTT, Brian F. [US/US]; 2261 W 670 S, Pleasant Grove, Utah 84062 (US).

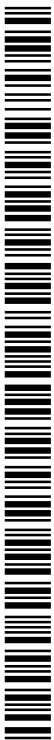
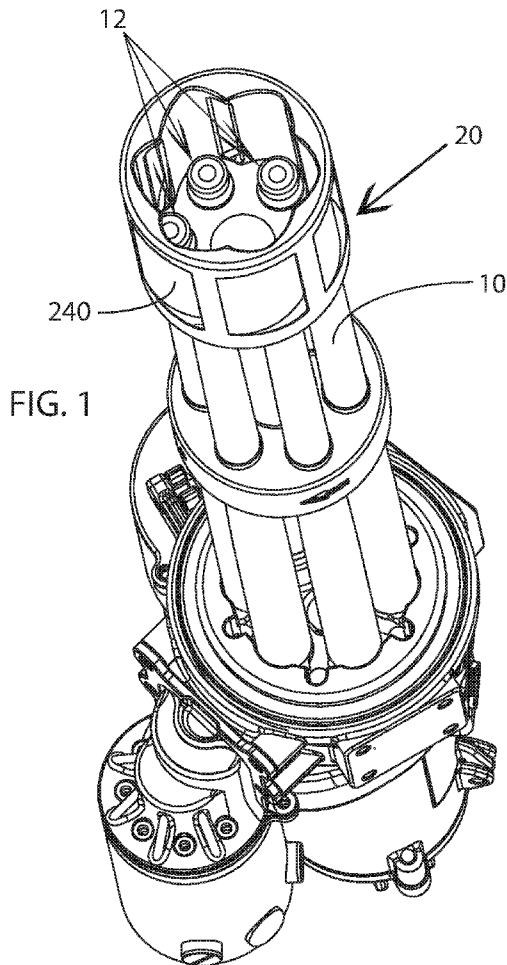
(74) Agent: DOBBIN, Geoffrey E.; 2250 S Redwood Road, Suite 5, West Valley City, Utah 84119 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

[Continued on next page]

(54) Title: BARREL CLAMP

(57) Abstract: A barrel clamp (20) for a Gatling-style firearm, or mini-gun, provides vanes (240) for the direction of fresh air currents into the muzzle area of the firearm. The directed air streams contribute to cooling the barrels (10) while in the firing cycle and also towards the disruption of fuel-rich gasses around the barrel muzzles (12) which contribute to muzzle flash.



WO 2017/156554 A1



HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
- with information concerning request for restoration of the right of priority in respect of one or more priority claims (Rules 26bis.3 and 48.2(b)(vii))

BARREL CLAMP

CROSS-REFERENCES TO RELATED APPLICATIONS

This Application claims priority as a continuation of U.S. Pat. App. No. 5 15/000,293, filed January 19, 2016, and incorporates the same by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to the field of firearms and more particularly 10 relates to a barrel clamp for a multiple barreled rotary firearm.

BACKGROUND OF THE INVENTION

The modern "mini-gun," or M-134, can trace its origins to the original Gatling gun of the mid-nineteenth century. It is a machine gun which fires 15 projectiles in an automatic fashion. In the process of firing these projectiles, the gun utilizes a plurality of barrels (usually six) which consecutively rotate in a circular circuit into a single position which allows for the firing of a projectile. Each barrel, then, is only used to fire one-sixth of the projectiles, spending the remaining time cooling in an air current caused by the rotation of the barrels. 20 Over time, many improvements have been made to the original Gatling gun, resulting in the modern M-134. However, each variant of the M-134 has always featured the rotatable barrels which are the signature characteristic of this family of firearms.

Muzzle flash is a problem for many firearms, and the M-134 and other multi-barreled firearms are no exception. Muzzle flash is a complex phenomenon with a number of components. Two primary components of muzzle flash are unburnt powder/explosive and the mixing of ambient air and gasses from the firing explosion. Hot, fuel-rich gasses mix with ambient air in the latter case, causing an explosive flash. In the case of the former, the unburnt powder sparks as it leaves the barrel, causing a source of light and heat. In the case of a multi-barreled firearm such as an M-134, the problem of muzzle flash is compounded by ammunition being rapidly fired. This presents not only more opportunity for muzzle flash, but also a potential for component build-up leading to larger and more noticeable muzzle flashes.

Many strategies have been developed in the past to combat muzzle flash, in particular with the M-134 and its variants. One of the most common is to attempt to hide the flash with a large collar around the barrels; but, this method really does not solve the problem as muzzle flash still occurs and may be seen at certain angles outside of a target zone. Other mechanical methods of reducing muzzle flash, specifically using flash suppressors and muzzle brakes, have also been attempted. These devices tend to disrupt the flow of propulsive gasses, in particular the initial shock wave from the explosion, which contribute to the muzzle flash. However, this strategy would require a suppressor on each barrel of an M-134 or other rotary multi-barreled weapon. Another strategy is to add chemical compounds, usually salts, to the powder so as to neutralize the fuel-rich gasses. However, this strategy tends to increase both smoke and residue.

The present invention is a barrel clamp for a Gatling-style, multi-barreled, rotary firearm, such as the M-134, which not only serves to support the barrels of the firearm, but also features vanes which direct airflow inward in a manner to lessen muzzle flash and also assist in cooling barrels after use in the firing cycle.

5 Prior art barrel clamps and muzzle brakes have used vanes in an effort to direct airflow associated with firing a mini-gun, however these structures were used to deflect the expanding muzzle gasses outward, reducing pressure around the barrels and contributing torque to the system in an effort to assist the rotation of the barrels. Directing fresh air into the system increases torque against the

10 rotation of the barrels and is counter-intuitive to traditional designs.

The present invention represents a departure from the prior art in that the barrel clamp of the present invention directs fresh air currents onto the barrels of the firearm and doing so in a manner to disrupt the accumulation of fuel-rich gasses from the act of firing ammunition, thus reducing muzzle flash.

15

SUMMARY OF THE INVENTION

In view of the foregoing disadvantages inherent in the known types of barrel clamps and muzzle flash suppression devices, a barrel clamp for a multi-barreled firearm, such as for an M-134, may direct fresh air into proximity of firing barrels,

20 thereby disrupting the mixture of firing gasses and dissipating unburnt explosive residue before they can produce muzzle flash. Such a barrel clamp should be easily installed and effective as a barrel clamp on existing and newly developed platforms, effective in the dissipation of combustible by-products which

contribute to muzzle flash, intuitive in use and operation, and robust in construction.

To accomplish these objectives, the barrel clamp may comprise a brace plate with a central support tube extending therefrom. A muzzle housing may
5 reside at an end of the support tube opposite the base plate, surrounding the muzzle ends of the multiple barrels of the firearm. The barrel housing may feature at least one vane, which may serve to direct ambient, fresh air directly onto one or more muzzles and associated barrels. By directing fresh air inwards and onto the barrels, the barrel clamp would directly contribute to both the
10 cooling of the barrels and to the dispelling of left over explosive gasses from firing each round of ammunition. This, in turn, would reduce muzzle flash and allow for more rapid rates of fire. Ideally, there could be at least one vane for each barrel as this would evenly distribute fresh air for the cooling effect of the barrel clamp.

15 The more important features of a barrel clamp serving as one embodiment of the invention thus been outlined in order that the more detailed description that follows may be better understood and in order that the present contribution to the art may better be appreciated. Additional features of the invention will be described hereinafter and will form the subject matter of the claims that follow.

20 Many objects of this invention will appear from the following description and appended claims, reference being made to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other 5 embodiments and of being practiced and carried out in various ways. Also it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing 10 of other structures, methods, and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an M-134 variant machine gun with a barrel clamp that exemplifies one embodiment of the present invention.

Figure 2 is a perspective view of the machine gun of FIG. 1, in broken line, highlighting the barrel clamp.

20 Figure 3 is a side elevation of the barrel clamp of FIG. 2.

Figure 4 is a perspective view of the barrel clamp of FIG. 2.

Figure 5 is an alternate perspective view of the barrel clamp of FIG. 2

Figure 6 is an alternate perspective view of the barrel clamp of FIG. 2.

Figure 7 is an alternate perspective view of the barrel clamp of FIG. 2, emphasizing the muzzle area.

Figure 8 is a front elevation of the barrel clamp of FIG. 2.

Figure 9 is a sectional view of the barrel clamp of FIG. 7, taken along line A–
5 A in FIG. 3.

Figure 10 is a sectional view of the barrel clamp of FIG. 8, taken along line
A–A in FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

10 With reference now to the drawings, the preferred embodiment of the barrel clamp is herein described. It should be noted that the articles “a”, “an”, and “the”, as used in this specification, include plural referents unless the content clearly dictates otherwise.

With reference to FIGS. 1 and 2, the barrel clamp 20 is a part of a
15 comprehensive rotating, multi-barrel weapon system that directly supports barrels 10 at two locations along their length, near muzzles 12 and at some point further along the length of the barrel 10 as determined by the manufacturer. As seen in FIGS. 3 and 4, the barrel clamp is a simple construction. It features a base plate 210 at one end of a support tube 220 and a muzzle housing 230 at the
20 support tube’s opposite end. The base plate 210 and muzzle housing 230 each feature paired holes 215, 235, one of each pair being located on the muzzle housing 230 and one located on the base plate 210, through which the barrels 10 extend (FIGS. 5 and 6). The barrel clamp 20 helps maintain position of the barrels 10 relative to each other and the weapon system as a whole. This is the primary
25 function of any barrel clamp.

With reference to FIGS. 5–10, the muzzle housing 230 of the barrel clamp 20 also features a plurality of vanes 240 and associated vents 245. The vanes 240 are positioned such that rotation R of the barrels 10 and the associated barrel clamp 20 will direct fresh air through the vents 245 and over the barrels 10 of the 5 weapon (FIG. 10). The barrels 10 are therefore constantly bathed in streams of fresh air 250 while the barrels 10 are in motion. This directly aids in the cooling of those barrels 10, particularly in the vicinity of the muzzles 12. The constant air currents 250 also interrupt the accumulation of fuel-rich exhaust gasses from the constant explosions of projectiles being fired from the barrels 10. These gasses 10 are forced to leave the higher-pressure area inside the muzzle housing 230 and are thus dissipated, reducing their presence and ability to cause muzzle flash.

In the best mode, the support tube 220 is hollow, providing a possible egress for exhaust gasses. The use of a tube also reduces the weight of the clamp 20 and the associated system. However, it is conceivable that a solid rod 15 may be used in place of a tube.

Ideally, the air currents 250 are directed on the barrels 10 of the weapon (or towards holes 235, representing the position of barrels 10 when the barrel clamp is installed thereon) as this aids in cooling the barrels 10. The vanes 240 should direct the air currents 250 such that a maximal amount of the barrels 10 are 20 covered by the air currents 250. Also, the number of vanes 240 should comport with the number of barrels 10 (usually 6), in either having that number or a whole number multiple thereof, such that each barrel has at least one air current 150 directed upon it. However, any number of vanes 240 will at least contribute to the dissipation of exhaust gasses and have some cooling effect on the barrels.

Given the nature of the use of the barrel clamp, it is readily understood that strong, supportive materials, such as metals, are preferred. However, any material of sufficient strength, such as a composite or polymers, may also be utilized. It is also to be understood that while this barrel clamp has been
5 described with reference to the modern M-134 and its current variants, the principals of this invention may be applied to any multi-barreled, rotary firearm in existence or later developed and is not unique to an M-134 platform.

INDUSTRIAL APPLICABILITY

The barrel clamp may be made in industry and is useful in the field of
10 firearms. Although the present invention has been described with reference to preferred embodiments, numerous modifications and variations can be made and still the result will come within the scope of the invention. No limitation with respect to the specific embodiments disclosed herein is intended or should be inferred.

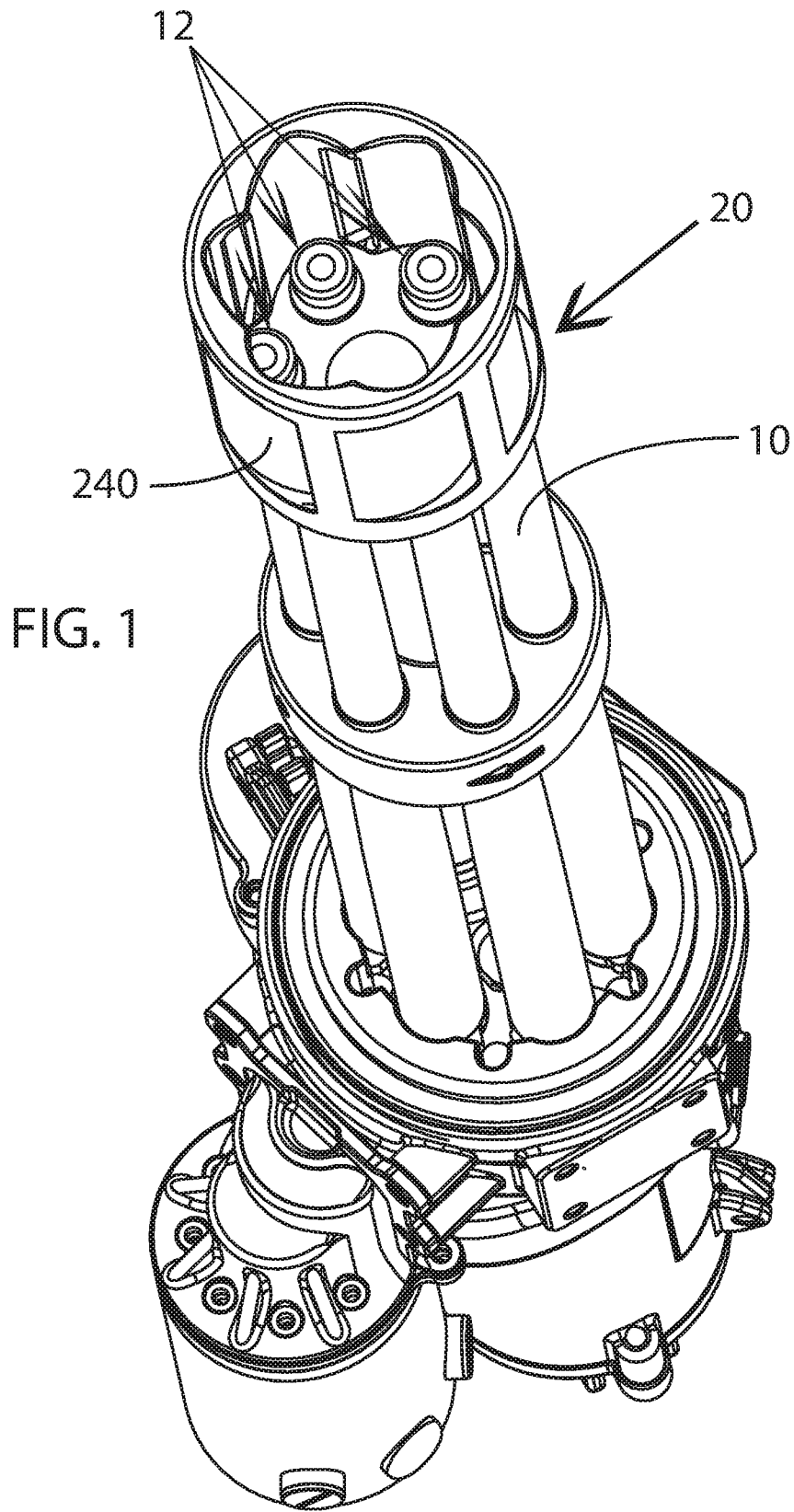
15

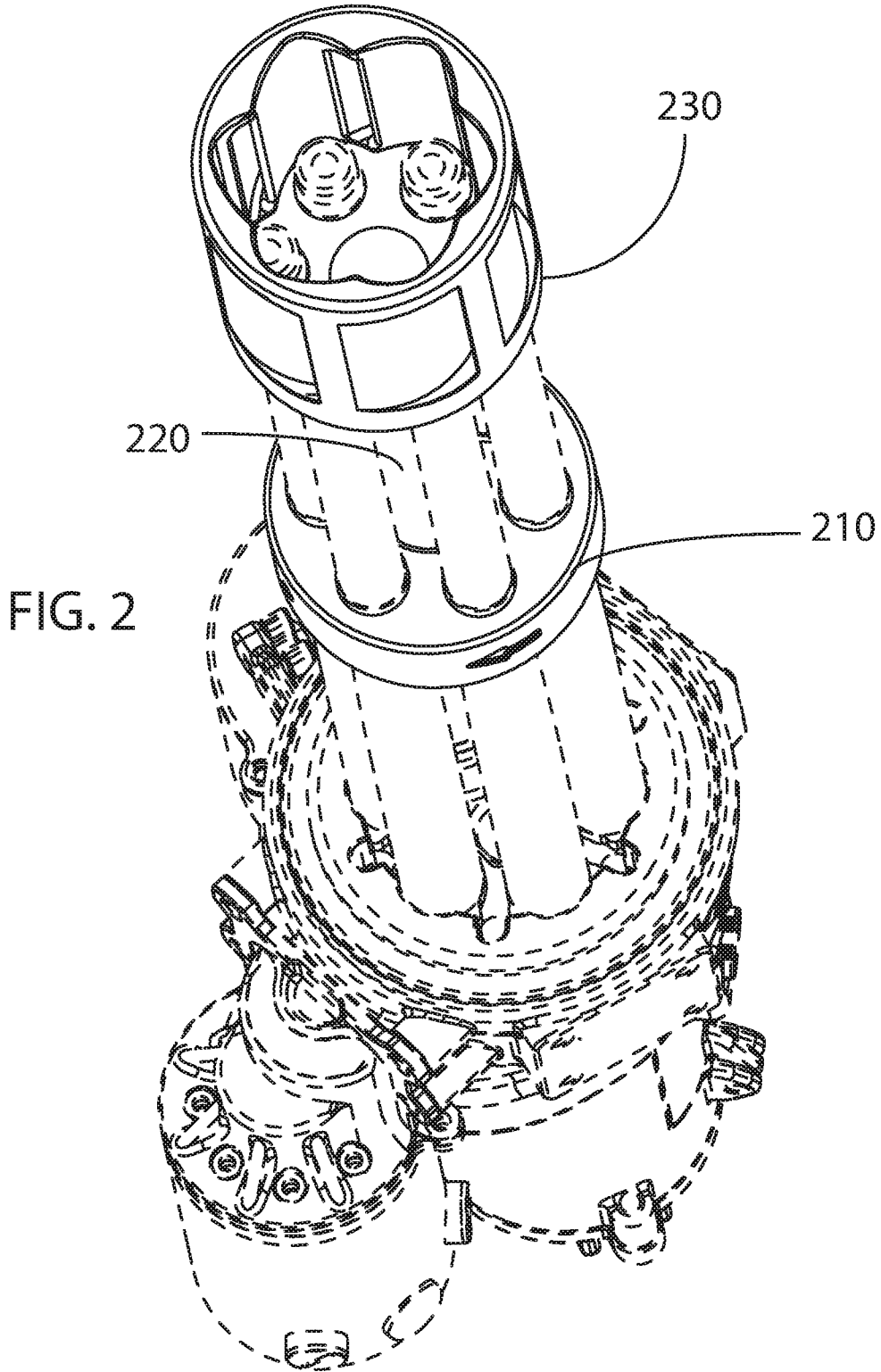
What is claimed is:

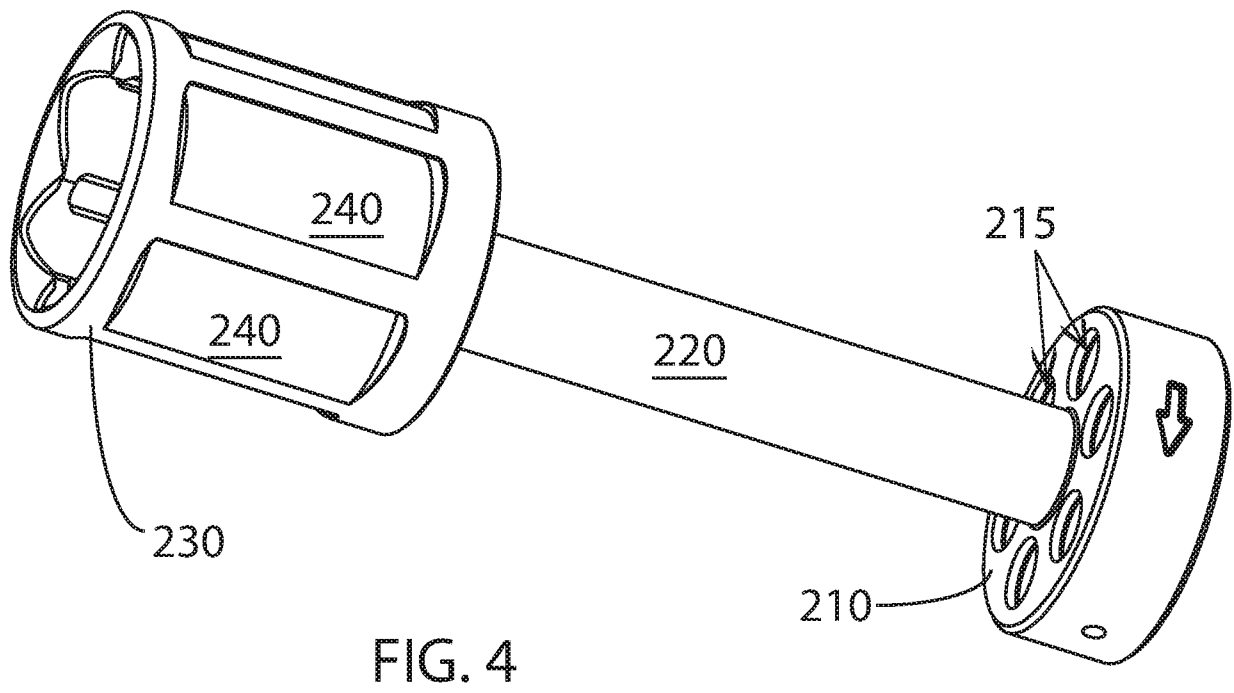
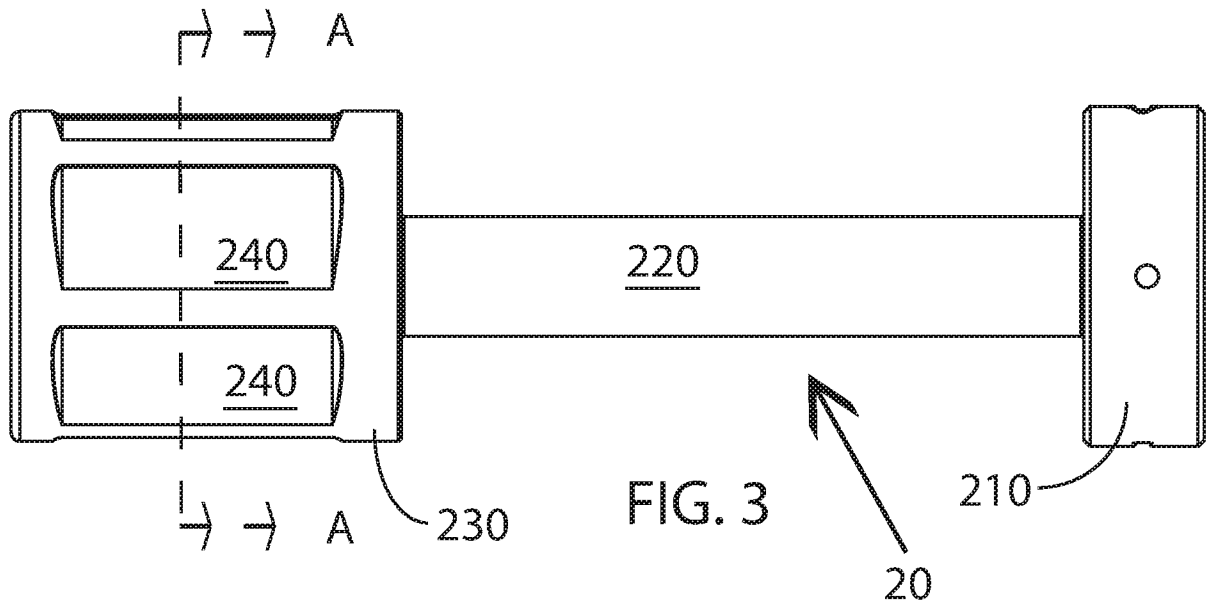
1. A barrel clamp comprising:
 - a. a base plate;
 - b. a central support structure defining an axis; and
 - 5 c. a muzzle housing, said muzzle housing further comprising a plurality of vanes, each with at least one associated vent, each vent positioned to direct airflow into a central chamber of the muzzle housing when the barrel clamp is rotated about the axis,wherein the base plate and said muzzle housing each have a plurality of
10 paired orifices, one of each pair on each of the base plate and said muzzle housing, through which barrels may be inserted, with each orifice on said muzzle housing being within the central chamber
2. The barrel clamp of claim 1, the number of said vanes equals the number of said paired orifices.
- 15 3. The barrel clamp of claim 2, each said vane and each said vent being positioned in a manner to direct airflow over at least one of the orifices in the muzzle housing.
4. The barrel clamp of claim 1, each said vane and each said vent being
20 positioned in a manner to direct airflow over at least one of the orifices in the muzzle housing.
5. The barrel clamp of claim 1, the support structure being a tube with an opening in the central chamber of the muzzle housing, said opening serving as a vent.

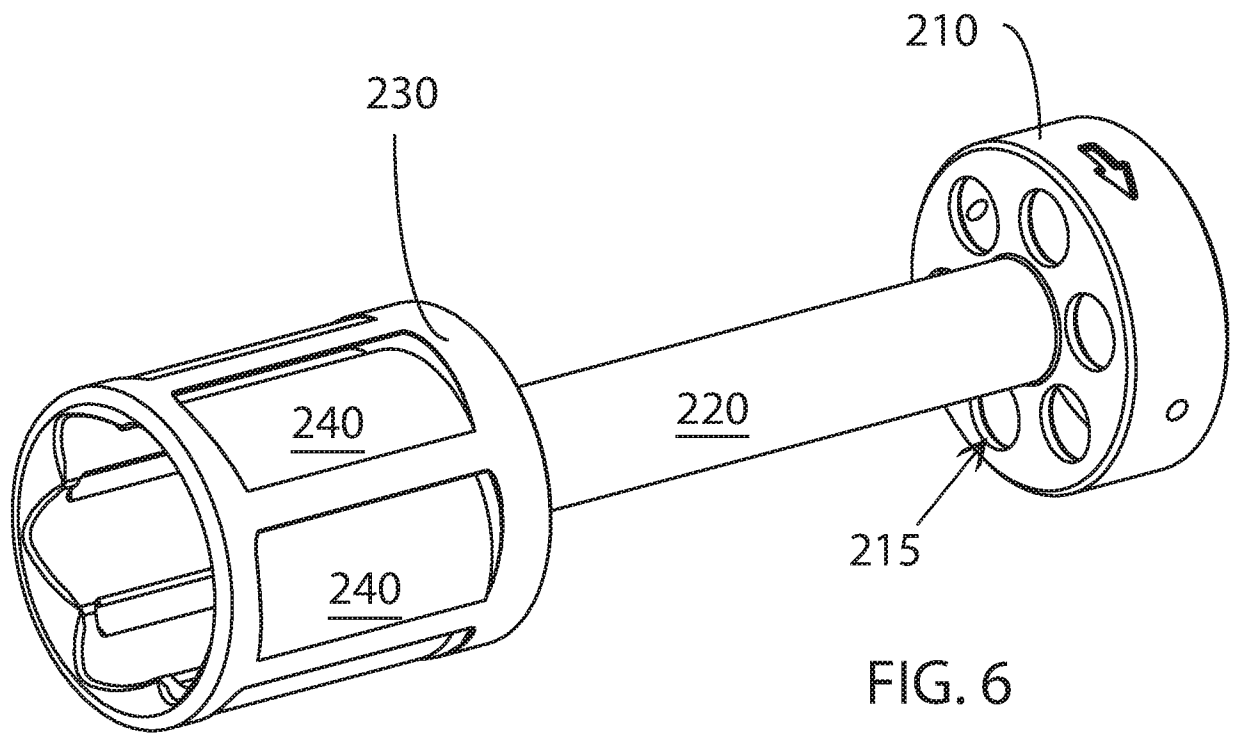
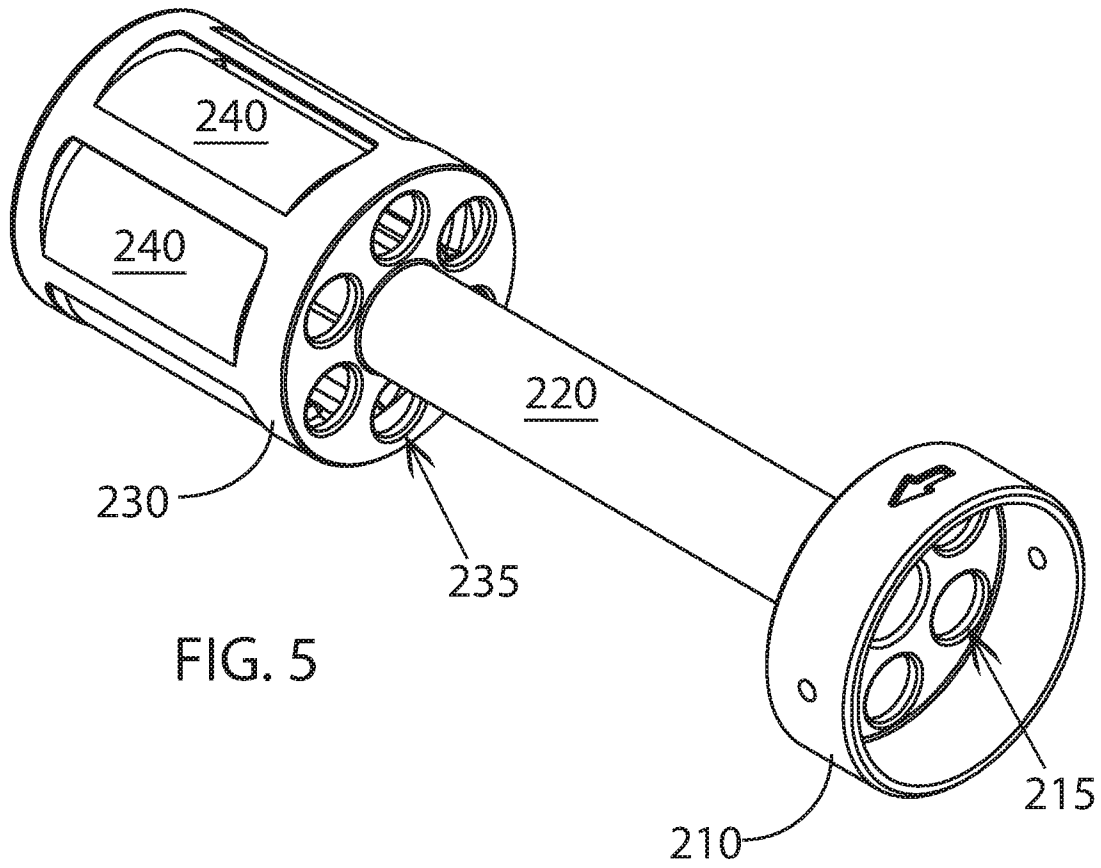
6. The barrel clamp of claim 5, the number of said vanes equals the number of said paired orifices.
7. The barrel clamp of claim 6, each said vane and each said vent being positioned in a manner to direct airflow over at least one of the orifices in
5 the muzzle housing.
8. The barrel clamp of claim 5, each said vane and each said vent being positioned in a manner to direct airflow over at least one of the orifices in the muzzle housing.

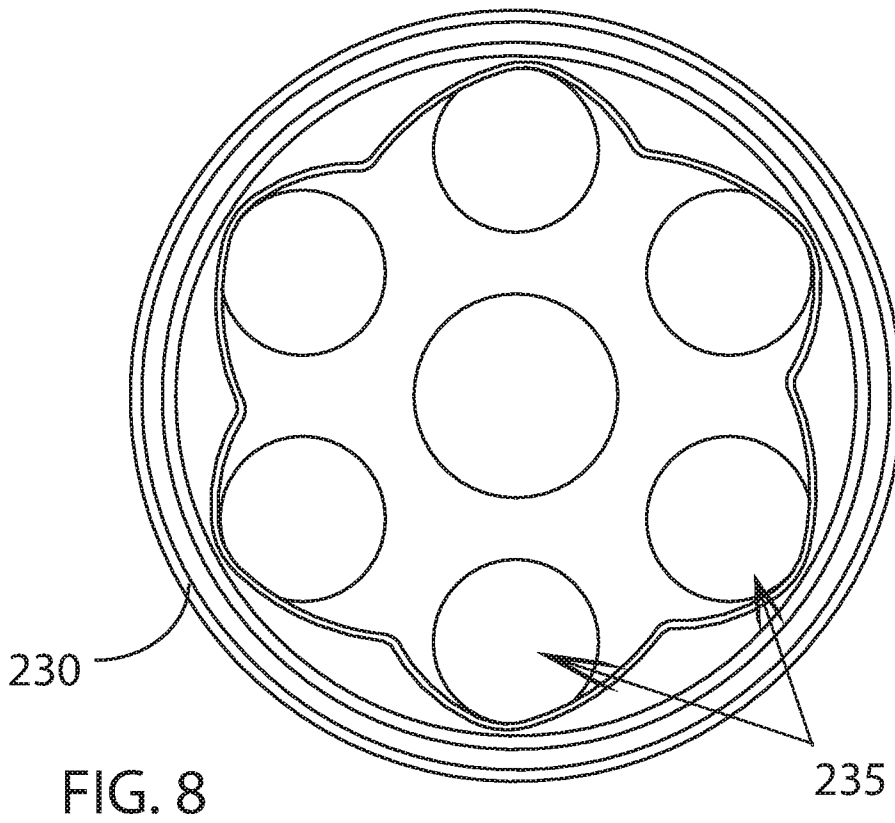
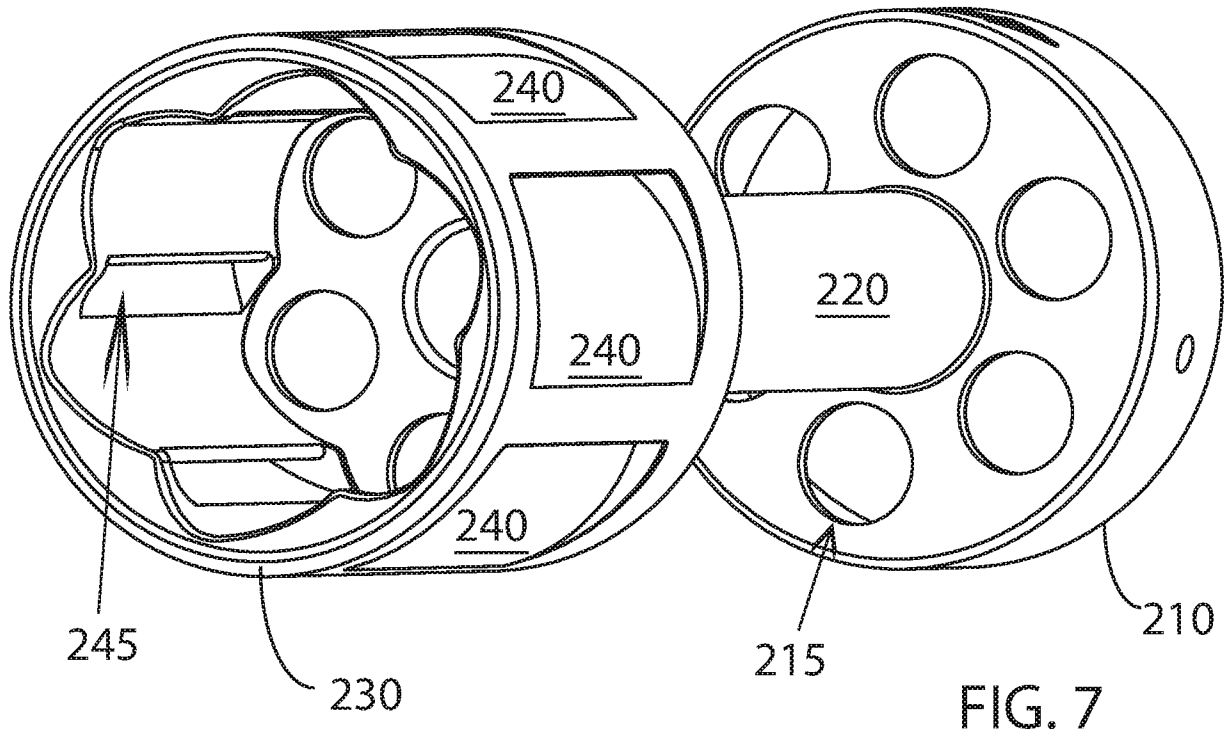
1/6











6/6

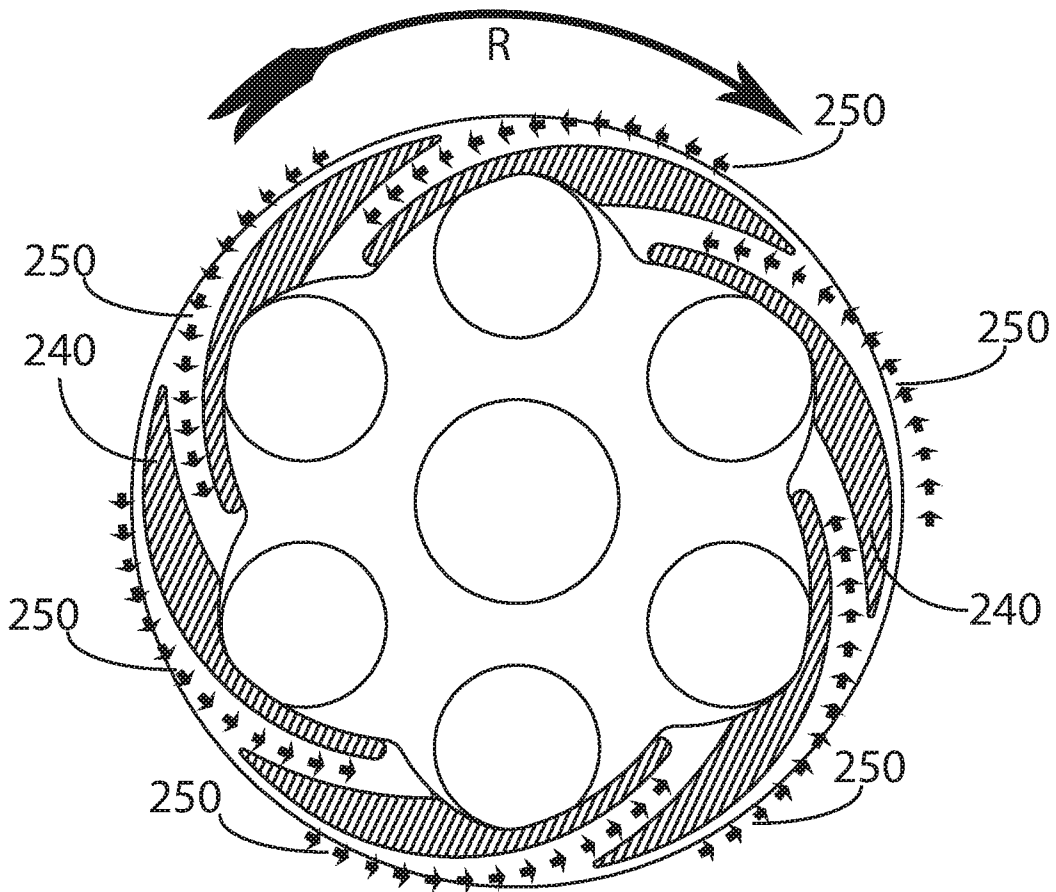
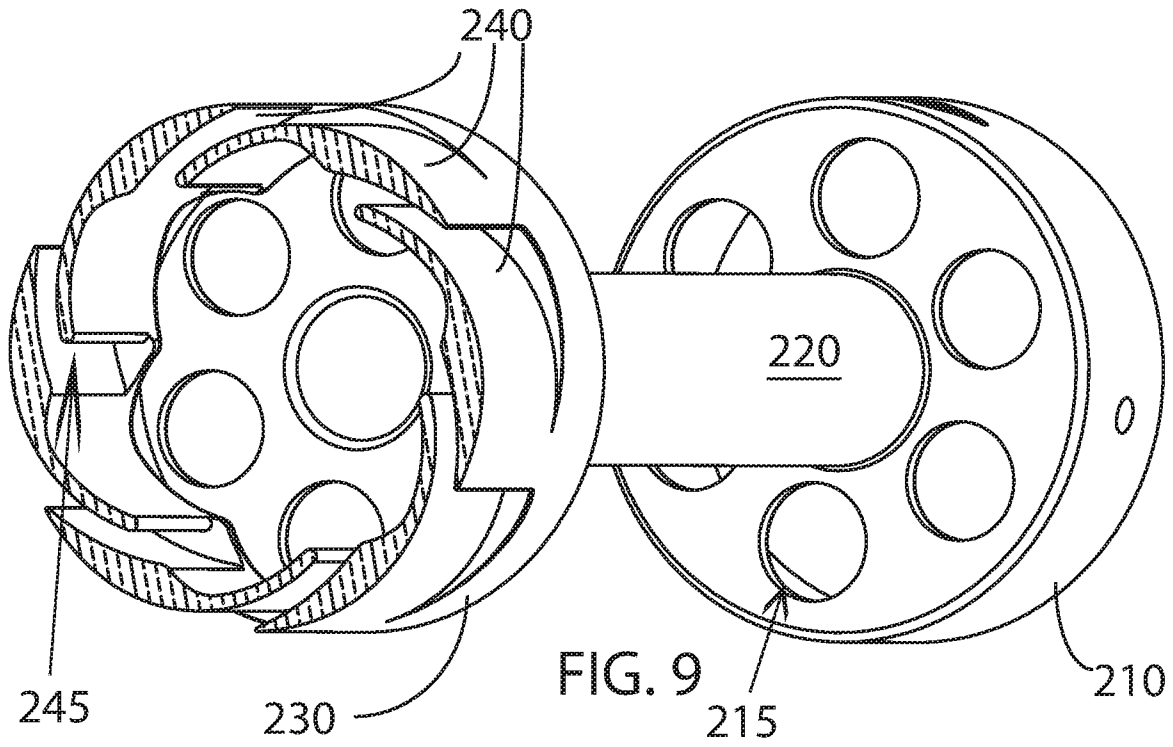


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/23013

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
 2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of any additional fees.
 3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

 4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
 - The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
 - No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/23013

Box IV TEXT OF THE ABSTRACT (Continuation of Item 5 of the first sheet)

NEW ABSTRACT

INTERNATIONAL SEARCH REPORT		International application No. PCT/US17/23013		
A. CLASSIFICATION OF SUBJECT MATTER IPC: F41A 21/08(2006.01),21/24(2006.01),21/34(2006.01),21/48(2006.01) USPC: F41F 1/10; F41A 7/10; F41A 9/36 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) U.S. : F41F 1/10; F41A 7/10; F41A 9/36				
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 practicable, 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	US 3,898,910 (Groff) 12 August 1975, see entire document.	1-8		
A	US 4,015,508 (Blodgee, Jr. et al.) 05 April 1977, see entire document.	1-8		
A	FR 846.077 (Wexler et al.) 05-1939., see entire document.	1-8		
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.				
* Special categories of cited documents: <table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; vertical-align: top;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p> </td> </tr> </table>			<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>
<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>			
Date of the actual completion of the international search 12 July 2017 (12.07.2017)		Date of mailing of the international search report 14 JUL 2017		
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-8300		Authorized officer John Nguyen Telephone No. 571-272-4300		

INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US17/23013**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.