

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT3172627

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT
CONVEYING PARTY DATA	
Name	Execution Date
O.S.S. HOLDINGS, LLC	12/10/2014
RECEIVING PARTY DATA	
Name:	OSS SUPPRESSORS LLC
Street Address:	5430 LBJ FREEWAY, SUITE 1480
City:	DALLAS
State/Country:	TEXAS
Postal Code:	75240
PROPERTY NUMBERS Total: 21	
Property Type	Number
Patent Number:	D639375
Patent Number:	8196701
Patent Number:	8790434
Patent Number:	8516941
Patent Number:	8826793
Patent Number:	8286750
Patent Number:	D642648
Patent Number:	D643087
Patent Number:	D642649
Patent Number:	D642650
Patent Number:	D674034
Patent Number:	D646345
Patent Number:	8671818
Application Number:	14326152
Application Number:	61303553
Application Number:	13309392
Application Number:	13275191
Application Number:	61393821
Application Number:	61418285
Application Number:	61418294

Property Type	Number
Application Number:	61418311

CORRESPONDENCE DATA

Fax Number: (214)661-6662
Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 214-953-5880
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NAME OF SUBMITTER:	PETE HYNDMAN
SIGNATURE:	/Pete Hyndman/
DATE SIGNED:	01/07/2015
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 3
source=OSSHoldingsIntellectual Property Assignment#page1.tif
source=OSSHoldingsIntellectual Property Assignment#page2.tif
source=OSSHoldingsIntellectual Property Assignment#page3.tif

INTELLECTUAL PROPERTY ASSIGNMENT

For good and valuable consideration, the receipt of which is hereby acknowledged, O.S.S. Holdings, LLC, a Utah limited liability company having a place of business at 14051 Sage Hollow Drive, Draper, Utah 84020 (“Assignor”), hereby assigns, conveys and transfers to OSS Suppressors LLC, a Texas limited liability company, having a place of business at 5430 LBJ Freeway, Suite 1480, Dallas, Texas 75240 (“Assignee”), all of Assignor’s right, title and interest in and to the intellectual property set forth in the following clauses (A), (B) and (C) (the “Assigned Intellectual Property”) pursuant to that certain Asset Purchase Agreement, dated as of December 10, 2014 by and among Assignor, Assignee, Praeda, Inc., and Holliday Holding LLC (the “Asset Purchase Agreement”),

- (A) the patents, patent registrations and patent applications owned or purported to be owned by Assignor at the time immediately prior to the Closing, including, but not limited to, those patents, patent registrations and patent applications identified on Schedule A hereto as well as all inventions disclosed therein and all continuations, divisions, continuations-in-part, reissues, and extensions thereof, and all Letters Patent of the United States and any foreign country which may be granted thereon, and all rights to claim priority on the basis of any of the foregoing;
- (B) inventions, trademarks (and goodwill associated therewith), Internet domain names, copyrights, trade secrets and know-how, in each case which are owned or purported to be owned by Assignor at any time prior to the Closing; and
- (C) all agreements relating to intellectual property between Assignor and OSS (Operators Suppressor Systems Inc.), a Wyoming corporation (“**OSS**”), including but not limited to, that certain License Agreement dated August 4, 2012 by and between Assignor and OSS.

together with the goodwill of the business symbolized by the Assigned Intellectual Property, any future registrations of the Assigned Intellectual Property, and all common law rights associated with the Assigned Intellectual Property, and, any and all causes of action and other rights assertable under the Assigned Intellectual Property, including, without limitation, the right to sue for infringement, misappropriation of, or improper activities regarding the Assigned Intellectual Property, subject, in all cases, to the Asset Purchase Agreement referred to above, and the right to enjoy all of the monetary benefits obtained as a result of any such litigation, the same to be held and enjoyed by Assignee, its successors and assigns, as fully and entirely as the same would have been held and enjoyed by Assignor had this Intellectual Property Assignment not been made.

This Intellectual Property Assignment shall be governed by and construed in accordance with the laws (but not the rules governing conflicts of laws) of the State of Texas.

All capitalized terms used in this Intellectual Property Assignment, but not otherwise defined herein, are given the meanings set forth in the Asset Purchase Agreement.

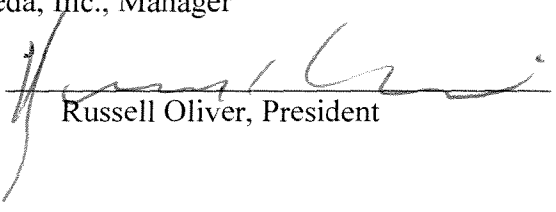
This Intellectual Property Assignment may be executed in any number of counterparts, all of which together shall constitute one and the same document. A photocopied or facsimile signature shall be deemed to be the functional equivalent of a manually executed original for all purposes.

This Intellectual Property Assignment shall be binding upon, and inure to the benefit of, and be enforceable by, Assignor, Assignee and their respective successors and assigns.

Executed as of the 10th day of December, 2014.

O.S.S. HOLDINGS, LLC

By: Praeda, Inc., Manager

By: 

Russell Oliver, President

OSS SUPPRESSORS LLC

By: 

Richard Emery,
CEO

SCHEDULE A**Issued Patents**

<u>Patent Title</u>	<u>Country</u>	<u>Patent No.</u>
Octagonal Firearm Suppressor	U.S.	D639,375
Firearm Suppressor	Canada	136645
Octagonal Firearm Suppressor	European Community	001742693-0001
Acoustic and Heat Control Device	U.S.	8,196,701
Particulate Capture from a High Energy Discharge Device	U.S.	8,790,434
Interchangeable, Modular Firearm Mountable Device	U.S.	8,516,941
Interchangeable, Modular Firearm Mountable Device	U.S.	8,826,793
Energy Capture and Control Device	U.S.	8,286,750
Hexagonal Firearm Suppressor	U.S.	D642,648
Nonagonal Firearm Suppressor	U.S.	D643,087
Heptagonal Firearm Suppressor	U.S.	D642,649
Decagonal Firearm Suppressor	U.S.	D642,650
Six-Sided Handrail for Firearms	U.S.	D674,034
Visual Signal Reducer	U.S.	D646,345
Firearm Discharge Gas Flow	U.S.	8,671,818

Pending Patents

<u>Patent Title</u>	<u>Country</u>	<u>Serial No.</u>
Particulate Capture from a High Energy Discharge Device	U.S.	14/326,152
Energy and Particulate Capture and Control Devices	U.S.	61/303,553
Augmented Handrail System for Firearm Accessory Mounting	U.S.	13/309,392
Augmented Handrail System for Firearm Accessory Mounting	U.S.	13/275,191
Augmented Handrail System for Firearm Accessory Mounting	U.S.	61/393,821
Sound Reduction Module	U.S.	61/418,285
Firearm Discharge Gas Flow Control	U.S.	61/418,294
Coupling Device, System, and Methods to Maintain Relative Position Between Two Components	U.S.	61/418,311

Closed or Expired PatentsTitle

Back Pressure Regulator for Firearms
Muzzle Integrated Laser Sight
Target Stand with Multiple Replaceable Targets

Trademark

Hexagonal Suppressor Configuration



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
61/303,553	02/11/2010		110	3212.002.PROV		

CONFIRMATION NO. 5986

20551
THORPE NORTH & WESTERN, LLP.
P.O. Box 1219
SANDY, UT 84091-1219

FILING RECEIPT



Date Mailed: 03/05/2010

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Russell Oliver, Sandy, UT;

Power of Attorney:

Erik Ericksen--48954

If Required, Foreign Filing License Granted: 03/03/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 61/303,553**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

ENERGY AND PARTICULATE CAPTURE AND CONTROL DEVICES

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international

patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and

Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 1 of 2

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. e-filed

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Russell	Oliver	Sandy, Utah
<i>Additional inventors are being named on the _____ separately numbered sheets attached hereto.</i>		
TITLE OF THE INVENTION (500 characters max):		
ENERGY AND PARTICULATE CAPTURE AND CONTROL DEVICES		
<i>Direct all correspondence to:</i> CORRESPONDENCE ADDRESS		
☒ The address corresponding to Customer Number: 20,551		
OR ☐ Firm or Individual Name		
Address		
City	State	Zip
Country	Telephone	Email
ENCLOSED APPLICATION PARTS (check all that apply)		
☐ Application Data Sheet. See 37 CFR 1.76 ☐ CD(s), Number of CDs _____		
☒ Drawing(s) <i>Number of Sheets</i> <u>10</u> ☐ Other (specify) _____		
☒ Specification (e.g. description of the invention) <i>Number of Pages</i> <u>16</u>		
Fees Due: Filing Fee of \$220 (\$110 for small entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is \$270 (\$135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).		
METHOD OF PAYMENT OF THE FILING FEE AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT		
☒ Applicant claims small entity status. See 37 CFR 1.27. 110.00		
☐ A check or money order made payable to the <i>Director of the United States Patent and Trademark Office</i> is enclosed to cover the filing fee and application size fee (if applicable). TOTAL FEE AMOUNT (\$)		
☐ Payment by credit card. Form PTO-2038 is attached.		
☒ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: <u>20-0100</u> .		

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PROVISIONAL APPLICATION COVER SHEET
Page 2 of 2

PTO/SB/16 (12-08)

Approved for use through 06/30/2010. OMB 0651-0032

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

SIGNATURE /eriksericksen/ Date 02/11/2010

TYPED or PRINTED NAME Erik S. Ericksen REGISTRATION NO. 48,954
(if appropriate)

TELEPHONE (801) 566-6633 Docket Number: 3212.002.PROV

UNITED STATES PROVISIONAL PATENT APPLICATION

of

Russell Oliver

for

ENERGY AND PARTICULATE CAPTURE AND CONTROL DEVICES

THORPE, NORTH & WESTERN, LLP

ATTORNEYS AT LAW

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ENERGY AND PARTICULATE CAPTURE AND CONTROL DEVICES

BACKGROUND

High energy sources can produce undesirable levels of acoustic noise and/or particulate pollution. Frequent exposure to high levels of acoustic noise can cause permanent or temporary hearing loss. Furthermore, in the case of firearms discharge, such acoustic noise can also provide information as to location of a shooter. In the field of firearm sound suppression, basic sound suppression technology has varied only modestly over the past hundred years. Generally, these designs are based on internal baffles which direct gases into vortices or other flow patterns with optional expansion chambers. Although these designs provide suppression of sound from firearm discharge, there is still a substantial decibel level produced when using these devices. Those designs which reduce sounds to a higher degree also tend to have a lower useful lifespan. Many of the current high-end designs utilize a sound absorbing fluid such as oil or water in the device. Such fluids must be periodically replaced (e.g. every few shots) and can be vaporized and distributed into the air upon discharge of the firearm. Therefore, despite some advantageous performance of these devices, many challenges still remain in achieving a long service life suppressor with low maintenance requirements and high acoustic suppression performance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side cross-sectional view of a device showing multiple concentric tubes, a helical wall, and series of deflectors.

FIG. 2 shows several views of an innermost tube having apertures to allow fluids from the central chamber into the off axis chamber.

FIG. 3 shows a perspective and side cross-sectional view of a locking block having a tapered throat portion.

FIG. 4 shows a perspective and side cross-sectional view of a locking block having a tapered throat portion with an intermediate throat portion.

FIG. 5 shows a perspective and side cross-sectional view of a primary deflector.

FIG. 6 shows a perspective and side cross-sectional view of a secondary deflector.

FIG. 7 shows a perspective and side cross-sectional view of a tertiary deflector.

FIG. 8 shows a perspective and side cross-sectional view of a tube cap.

FIG. 9 shows a perspective and side cross-sectional view of an end cap.

FIG. 10 is a side view of a single revolution helical wall.

FIG. 11 is a side view of a 2 revolution helical wall.

5 FIG. 12 is a side view of a 3 revolution helical wall.

FIG. 13 is a side view of a 4 revolution helical wall.

FIG. 14 is a side and end view of an octagonal outer shell.

FIG. 15 is a side cross-sectional shaded contour view of an optional device having rectangular cross-section helical walls in the annular spaces.

10 FIG. 16 is several views of a particulate capture module having a particulate absorbent material contained therein.

FIG. 17 is a perspective partial see-through view of a device having longitudinal chambers which are each off set from the central axis.

These figures are provided for convenience in describing the following aspects. In particular, variation may be had in dimensions, materials, configurations and proportions from those illustrated and not depart from the scope of the invention.

DETAILED DESCRIPTION

While these exemplary embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, it should be understood that other embodiments may be realized and that various changes to the invention may be made without departing from the spirit and scope of the present invention. Thus, the following more detailed description of the embodiments of the present invention is not intended to limit the scope of the invention, as claimed, but is presented for purposes of illustration only and not limitation to describe the features and characteristics of the present invention, to set forth the best mode of operation of the invention, and to sufficiently enable one skilled in the art to practice the invention. Accordingly, the scope of the present invention is to be defined solely by the appended claims.

Definitions

30 In describing and claiming the present invention, the following terminology will be used.

The singular forms “a,” “an,” and “the” include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to “a tube” includes reference to one or more of such members, and reference to “directing” refers to one or more such steps.

5 As used herein with respect to an identified property or circumstance, “substantially” refers to a degree of deviation that is sufficiently small so as to not measurably detract from the identified property or circumstance. The exact degree of deviation allowable may in some cases depend on the specific context.

As used herein, “adjacent” refers to the proximity of two structures or elements.
10 Particularly, elements that are identified as being “adjacent” may be either abutting or connected. Such elements may also be near or close to each other without necessarily contacting each other. The exact degree of proximity may in some cases depend on the specific context.

As used herein, a plurality of items, structural elements, compositional elements,
15 and/or materials may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member. Thus, no individual member of such list should be construed as a *de facto* equivalent of any other member of the same list solely based on their presentation in a common group without indications to the contrary.

20 Concentrations, amounts, and other numerical data may be presented herein in a range format. It is to be understood that such range format is used merely for convenience and brevity and should be interpreted flexibly to include not only the numerical values explicitly recited as the limits of the range, but also to include all the individual numerical values or sub-ranges encompassed within that range as if each numerical value and sub-
25 range is explicitly recited. For example, a numerical range of about 1 to about 4.5 should be interpreted to include not only the explicitly recited limits of about 1 to about 4.5, but also to include individual numerals such as 2, 3, 4, and sub-ranges such as 1 to 3, 2 to 4, etc. The same principle applies to ranges reciting only one numerical value, such as “less than about 4.5,” which should be interpreted to include all of the above-recited values and
30 ranges. Further, such an interpretation should apply regardless of the breadth of the range or the characteristic being described.

Any steps recited in any method or process claims may be executed in any order and are not limited to the order presented in the claims. Means-plus-function or step-plus-function limitations will only be employed where for a specific claim limitation all of the following conditions are present in that limitation: a) “means for” or “step for” is expressly
5 recited; and b) a corresponding function is expressly recited. The structure, material or acts that support the means-plus function are expressly recited in the description herein. Accordingly, the scope of the invention should be determined solely by the appended claims and their legal equivalents, rather than by the descriptions and examples given herein.

10 **Energy and Particulate Capture and Control**

An energy capture and control device can comprise a central chamber oriented along a central axis within an outer shell. The central chamber can have an inlet configured to receive a high energy material from a high energy outlet. An off axis chamber can be oriented within the outer shell in fluid communication with the central chamber. The off
15 axis chamber can have a fluid outlet and multiple internal walls configured to produce an axially serpentine fluid pathway which dissipates energy transferred from the high energy material.

As illustrated in FIG. 1, the central chamber can further comprise a locking block oriented at the inlet. The locking block can have an engagement surface configured to
20 attach to the high energy outlet and a hollow interior along the central axis, said hollow interior having a reducing throat portion and a flared outlet. FIG. 3 and FIG. 4 illustrate two optional configurations for a locking block.

In another aspect, the central chamber can further comprise a plurality of deflectors oriented in series along the central axis. A variety of specific contours and deflector shapes
25 can be used. In one aspect, the plurality of deflectors can be frustoconical having a hollow interior along the central axis and each having a flared exit portion as illustrated in FIG. 1 and FIGs. 5-7. The embodiment shown in FIG. 1 and FIG. 15 illustrate a plurality of deflectors which include a primary deflector, a secondary deflector, and at least one tertiary deflector, e.g. the at least one tertiary deflector can often include four deflectors. The
30 tertiary deflectors are not required but can be at least partially engaged within the flared

exit portion of an adjacent deflector. In another optional aspect, the plurality of deflectors can span substantially the entire central axis along the central chamber.

The multiple internal walls can provide an increased volume for fluid expansion and increased acoustic absorbent path length. In one aspect, the multiple internal walls are formed by multiple concentric tubes having progressively larger diameters so as to form annular spaces between each adjacent tube, as illustrated in FIG. 1 and FIG. 15. The axially serpentine fluid pathway can be formed using a variety of wall configurations. In one aspect, the concentric tubes can have ends offset from an adjacent tube so as to produce a serpentine fluid annular pathway. The multiple concentric tubes can include an innermost tube which includes orifices oriented to allow fluid to pass from the central chamber into a first annular space adjacent the innermost tube and through the annular spaces of progressively larger diameter. One configuration of an innermost tube is shown in FIG. 2. Orifices can be varied in location, size and number for individual designs. In one aspect, the holes can oriented adjacent a contact point between a deflector and an inner wall of the innermost tube.

Another optional aspect of the device is to include a helical wall oriented within at least one of the annular spaces to direct fluids along a helical path within the at least one annular space. Although not all of the annular spaces need a helical wall, in one aspect all of the annular spaces which define the fluid pathway include a helical wall. FIGs 1 and 10-13 illustrate a helical rod having a spring-like shape. FIG. 15 illustrates a helical wall having a square cross-section. However, any suitable cross-section can be used (e.g. quadrilateral cross-section or a circular cross-section). As illustrated in FIGs. 10-13 the helical walls can have varying winding ratios (i.e. windings:diameter). This winding ratio can be varied to optimize performance of the device for particular applications based on a number of variables (e.g. caliber, back pressure, etc.). The helical walls can be optionally replaceable so as to provide an adjustable tuning or may be fixed. This ratio can also be changed in order to control and/or adjust the energy transfer velocity and subsequent back pressure returned to the high energy outlet. This innovation is a completely new approach and resolves or mitigates adverse effects that traditional sound suppressors have on their host weapon. For example, 75% loss of expected life span of the weapon due to excessive PSI, rate of fire increases, excessive fouling and carbon buildup, debris returning to the

operators face via the chamber of the barrel, unreliability due to combinations of these issues. These drawbacks can be largely eliminated or substantially reduced using the configurations described herein.

Generally, a higher rate of twist provides a greater path length for fluids along the fluid pathway to the chamber outlet. Although other ratios can be suitable, in one aspect, the helical wall has a winding ratio of about 3:1 to about 8:1. In one aspect, the device can include five multiple concentric tubes forming the annular spaces although other numbers of concentric tubes can be suitable. For example, pistol suppressors can sometimes utilize fewer chambers while high caliber rifles can utilize more chambers to achieve desirable sound suppression.

In another aspect, the off axis chamber can further include an annular dampening chamber oriented about the central chamber and being filled with an energy absorbent material. The dampening chamber can be oriented adjacent the outer shell as illustrated in FIG. 1 and FIG. 15. The energy absorbent material can be any suitable acoustic impedance filter. Generally, the material can absorb and/or deflect acoustic waves back toward the bullet path. In one aspect, the energy absorbent material is a dry material. Non-limiting examples of suitable material can include powder tungsten filament, metal powder, graphite, polymer, and the like. In one aspect the material can be a powder tungsten filament or other heavy metal or metal powders (e.g. aluminum, stainless steel, carbon steels, iron, copper, tantalum, titanium, vanadium, chromium, zirconium, carbides of these, alloys of these, and the like). Although fluids could be used (e.g. oil, water etc.) these are generally not needed and can be conveniently omitted without loss of performance. This dampening chamber can be used in connection with or without the axially serpentine fluid pathway or the plurality of deflectors. The energy absorbent material can also be optionally introduced into other chambers within the device. For example, the energy absorbent material can be particularly beneficial when placed in one or more annular spaces intermediate between the central axis and the outer shell. In one aspect such as those shown in FIG. 1 and FIG. 15 a tapered annular space exists between the locking block throat and the adjacent tube (i.e. tube 3).

The outer shell can be generally tubular and have any suitable cross-section shape. in one aspect, the outer shell has an octagonal cross-section as shown in FIG. 1 A-A and

FIG. 14. The outer shell can optionally have a circular cross-section or any other desired shape (e.g. 5, 6, 7, 9 or 10 sides). Optionally, the outer shell can include an end cap assembly at an outlet end of the central chamber and which allows fluid to escape from the off axis chamber. The end cap assembly shown in FIG. 1 (and FIG. 8 and 9) shows an assembly where the outlet slits along the tube cap (FIG. 8) and the exit apertures of the end cap (FIG. 9) are offset to prevent an unobstructed exit of fluids from the chamber.

In some applications a modular system can be desirable to allow for adjustable acoustic suppression in the field. For example, the device can be modularized along the central axis to form at least two detachable portions. In one aspect, the chamber can be divided between the secondary and tertiary deflectors of FIG. 1 and capped at the junction on each corresponding end. The ends can include an engagement mechanism to secure the modules together when desired. Non-limiting examples of suitable engagement mechanisms can include threaded engagement, recessed locking, interference fit, detent locking, and the like. The modular design can be sub-divided into additional sub-modules as desired and reassembled to provide function individually or assembled.

In another optional aspect, a particulate modular attachment can be used to capture particulates from the high energy material as it exits the chamber. This can be particularly useful in firearm applications where the high energy material is a bullet. Regardless, the particulate modular attachment can have a particulate inlet and a module outlet defining a particulate control chamber (as shown in FIG. 16). The attachment can be configured to attach to the fluid outlet and remove particulates. In one aspect, the particulate modular attachment includes a self-healing polymeric material oriented in the particulate control chamber. The self-healing polymeric material can be any suitable material such as, but not limited to, expanded polyurethane, expanded polyethylene, expanded polystyrene, ionomeric metal salt of an ethylene-vinyl copolymer, copolymers thereof, and composites thereof. In one aspect, the self-healing polymeric material is expanded polyurethane or an ionomeric metal salt. The chamber can optionally include a removable cap to allow the polymeric material to be periodically replaced. Over time, this material can lose its resiliency and/or accumulate excessive particulates sufficient to make replacement desirable.

In another aspect, the device has substantially no moving parts during operation. This can greatly improve the useful life of the device by avoiding or reducing mechanical friction and potential for part wear and/or fatigue. In one aspect, the central chamber includes a central chamber outlet along the central axis and the high energy material is a bullet. The high energy outlet in this case can be a firearm muzzle (e.g. rifle, pistol, etc).

Although the parts of the device can be formed of any suitable material, the central chamber and off axis chamber can be formed substantially of titanium. Non-limiting examples of other suitable materials can include high impact polymers, stainless steels, aluminum, molybdenum, refractory metals, super alloys, aircraft alloys, carbon steels, composites thereof, and the like. One or more of the individual components can further include optional coatings such as, but not limited to, diamond coatings, diamond-like carbon coatings, molybdenum, tungsten, tantalum, and the like can also be used. These components can be molded, machined, deposited or formed in any suitable manner. Currently, machining can be particularly desirable but is not required.

FIG. 17 illustrates another optional configuration for the multiple internal walls which form a plurality of longitudinal chambers and are each off set from the central axis and fluidly connected to from the axially serpentine fluid pathway. In this case, the longitudinal chambers include a first primary chamber which splits the fluid flow into two paths at the end. The two paths serpentine along opposing sides and then recombine at a lower common chamber which can then direct fluids to a chamber exit.

The devices can generally perform well for a large number of cycles, periodic optional cleaning can remove film, debris or other material which collects within the device. Non-limiting examples of suitable cleaning protocols can include sonication, solvent immersion, disassembly, and high pressure air. Although specific acoustic suppression performance can vary depending on the specific configuration and options included, these designs have shown up to 15% sound reduction. The resulting devices can dramatically suppress acoustic impact of high energy materials with minimal maintenance and high cycle life.

Although the devices described are exemplified in terms of firearms, other applications can also benefit from these configurations. For example, high velocity/high temperature gases, projectiles, heat or sound energy can be suppressed using these devices.

By adjusting the chamber configurations (e.g. number or shapes of tubes, deflectors, windings, etc) the back pressure can be tuned for a particular application. Most often, the device also does not adversely affect performance of the host mechanism to which it is attached.

5 The foregoing detailed description describes the invention with reference to specific exemplary embodiments. However, it will be appreciated that various modifications and changes can be made without departing from the scope of the present invention as set forth in the appended claims. The detailed description and accompanying drawings are to be regarded as merely illustrative, rather than as restrictive, and all such modifications or
10 changes, if any, are intended to fall within the scope of the present invention as described and set forth herein.

CLAIMS

What is claimed is:

1. An energy capture and control device, comprising:
 - a) a central chamber oriented along a central axis within an outer shell, said central
5 chamber having an inlet configured to receive a high energy material from a high energy outlet;
 - b) an off axis chamber oriented within the outer shell in fluid communication with the central chamber and having a fluid outlet and multiple internal walls configured to produce an axially serpentine fluid pathway which dissipates energy transferred
10 from the high energy material.
2. The device of claim 1, wherein the central chamber further comprises a locking block oriented at the inlet, said locking block having an engagement surface configured to attach to the high energy outlet and a hollow interior along the central axis, said
15 hollow interior having a reducing throat portion and a flared outlet.
3. The device of claim 1 or 2, wherein the central chamber further comprises a plurality of deflectors oriented in series along the central axis.
- 20 4. The device of claim 2, wherein the plurality of deflectors are frustoconical having a hollow interior along the central axis and each having a flared exit portion.
5. The device of claim 3, wherein the plurality of deflectors include a primary deflector, a secondary deflector, and at least one tertiary deflector.
25
6. The device of claim 4, wherein the at least one tertiary deflector includes four deflectors.
7. The device of claim 5, wherein the tertiary deflectors are at least partially engaged
30 within the flared exit portion of an adjacent deflector.

8. The device of claim 3, wherein the plurality of deflectors span substantially the entire central axis along the central chamber.
9. The device of claim 1, wherein the multiple internal walls are formed by multiple concentric tubes having progressively larger diameters so as to form annular spaces between each adjacent tube, and having alternating ends offset so as to produce a serpentine fluid annular pathway.
10. The device of claim 9, wherein the multiple concentric tubes include an innermost tube which includes orifices oriented to allow fluid to pass from the central chamber into a first annular space adjacent the innermost tube and through the annular spaces of progressively larger diameter.
11. The device of claim 9, wherein the annular spaces further include a helical wall oriented within at least one of the annular spaces to direct fluids along a helical path within the at least one annular space.
12. The device of claim 11, wherein the helical wall has a quadrilateral cross-section or a circular cross-section.
13. The device of claim 11, wherein the helical wall has a winding ratio (windings : diameter) of about 3:1 to about 8:1.
14. The device of claim 11, wherein all of the annular spaces include a corresponding helical wall.
15. The device of claim 9, wherein there are five multiple concentric tubes forming the annular spaces.

16. The device of claim 1 or 9, wherein the off axis chamber further includes an annular dampening chamber oriented about the central chamber and being filled with an energy absorbent material.
- 5 17. The device of claim 16, wherein the dampening chamber is oriented adjacent the outer shell.
18. The device of claim 16, wherein the energy absorbent material is a powder tungsten filament.
- 10 19. The device of claim 16, wherein the outer shell has an octagonal cross-section.
20. The device of claim 1, wherein the outer shell includes an end cap assembly at an outlet end of the central chamber and which allows fluid to escape from the off axis chamber.
- 15 21. The device of claim 1, 3 or 9, wherein the device is modularized along the central axis to form at least two detachable portions.
- 20 22. The device of claim 1, further comprising a particulate modular attachment having a particulate inlet and a module outlet defining a particulate control chamber, said attachment configured to attach to the fluid outlet and remove particulates.
23. The device of claim 22, wherein the particulate modular attachment includes a self-healing polymeric material oriented in the particulate control chamber.
- 25 24. The device of claim 23, wherein the self-healing polymeric material is selected from the group consisting of expanded polyurethane, expanded polyethylene, expanded polystyrene, ionomeric metal salt of an ethylene-vinyl copolymer, copolymers thereof, and composites thereof.
- 30

25. The device of claim 1, wherein the device has substantially no moving parts during operation.

26. The device of claim 1, wherein the central chamber includes a central chamber outlet along the central axis and the high energy material is a bullet.

27. The device of claim 1, wherein the central chamber and off axis chamber are formed substantially of titanium.

28. The device of claim 1, wherein the multiple internal walls form a plurality of longitudinal chambers which are each off set from the central axis and fluidly connected to from the axially serpentine fluid pathway.

29. An energy capture and control device, comprising:

- a) a central chamber oriented along a central axis within an outer shell, said central chamber having an inlet configured to receive a high energy material from a high energy outlet;
- b) an off axis chamber oriented within the outer shell in fluid communication with the central chamber.

30. The device of claim 29, wherein the off axis chamber further comprises a fluid outlet and multiple internal walls configured to produce an axially serpentine fluid pathway which dissipates energy transferred from the high energy material.

31. The device of claim 30, wherein the multiple internal walls are formed by multiple concentric tubes having progressively larger diameters so as to form annular spaces between each adjacent tube, and having alternating ends offset so as to produce a serpentine fluid annular pathway.

32. The device of claim 29, wherein the central chamber further comprises a plurality of deflectors oriented in series along the central axis.

33. The device of claim 29, wherein the off axis chamber further includes an annular dampening chamber oriented about the central chamber and being filled with an energy absorbent material.

5

34. The device of claim 33, wherein the dampening chamber is oriented adjacent the outer shell.

10

35. The device of claim 33, wherein the energy absorbent material is a powder tungsten filament.

15

36. An energy capture and control device, comprising:

a) a central chamber oriented along a central axis within an outer shell, said central chamber having an inlet configured to receive a high energy material from a high energy outlet;

b) an off axis chamber oriented within the outer shell in fluid communication with the central chamber and having a fluid outlet, wherein the off axis chamber further includes an annular dampening chamber oriented about the central chamber and being filled with an energy absorbent material.

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37. The device of claim 36, wherein the energy absorbent material is selected from the group consisting of powder tungsten filament, heavy metal powder, graphite, polymer, and combinations thereof.

25

38. The device of claim 36, wherein the energy absorbent material is a particulate selected from the group consisting of aluminum, stainless steel, carbon steels, iron, copper, tantalum, titanium, vanadium, chromium, zirconium, carbides of these, alloys of these, and combinations thereof.

ENERGY AND PARTICULATE CAPTURE AND CONTROL DEVICES

ABSTRACT OF THE DISCLOSURE

An energy capture and control device is disclosed and described. The device can include a central chamber oriented along a central axis within an outer shell, said central chamber having an inlet configured to receive a high energy material from a high energy outlet. An off axis chamber can be oriented within the outer shell in fluid communication with the central chamber and having a fluid outlet and multiple internal walls configured to produce an axially serpentine fluid pathway which dissipates energy transferred from the high energy material. The energy capture and control device can be particularly useful in effective suppression of acoustic impact of firearm discharge with high cycle life and low maintenance.

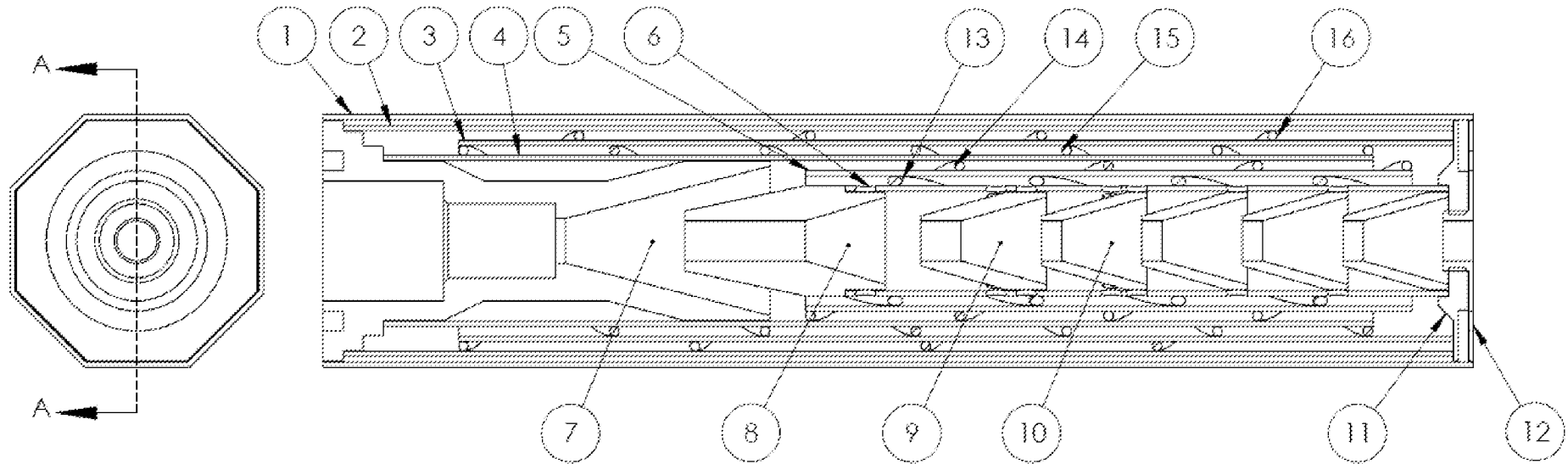


FIG. 1

ITEM NO.	DESCRIPTION	PART NO.	QTY.
1	Outer Shell	1001	1
2	Tube 5	1002	1
3	Tube 4	1003	1
4	Tube 3	1004	1
5	Tube 2	1005	1
6	Tube 1	1006	1
7	Locking Block 10-16-20	1008	1
8	Primary Deflector	1009	1
9	Secondary Deflector	1010	1
10	Quad Deflector	1011	4
11	Tube Cap	1012	1
12	End Cap	1013	1
13	Tube Rod 1	1014	4
14	Tube Rod 2	1015	2
15	Tube Rod 3	1016	2
16	Tube Rod 4	1017	1

1/10

2/10

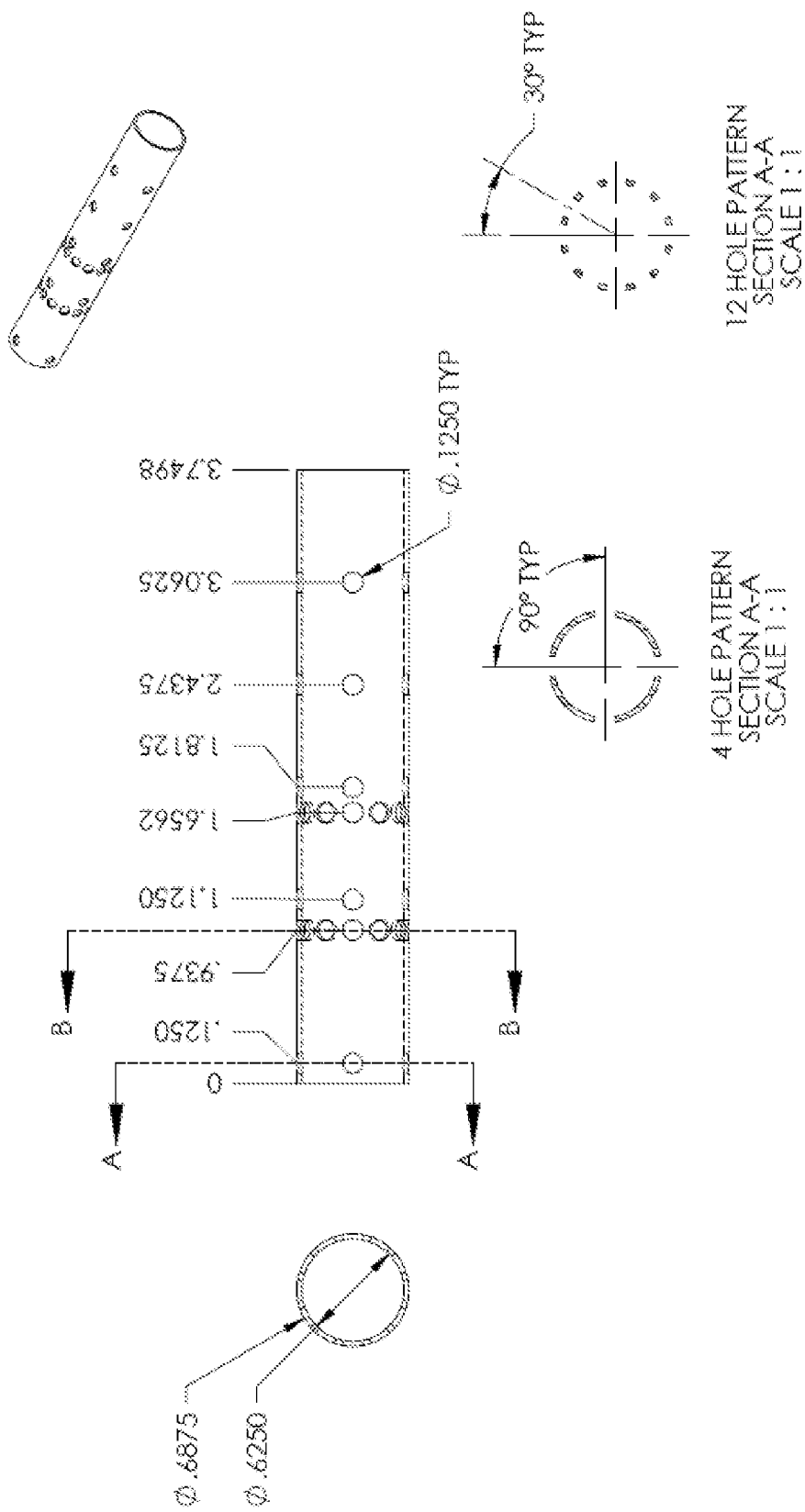


FIG. 2

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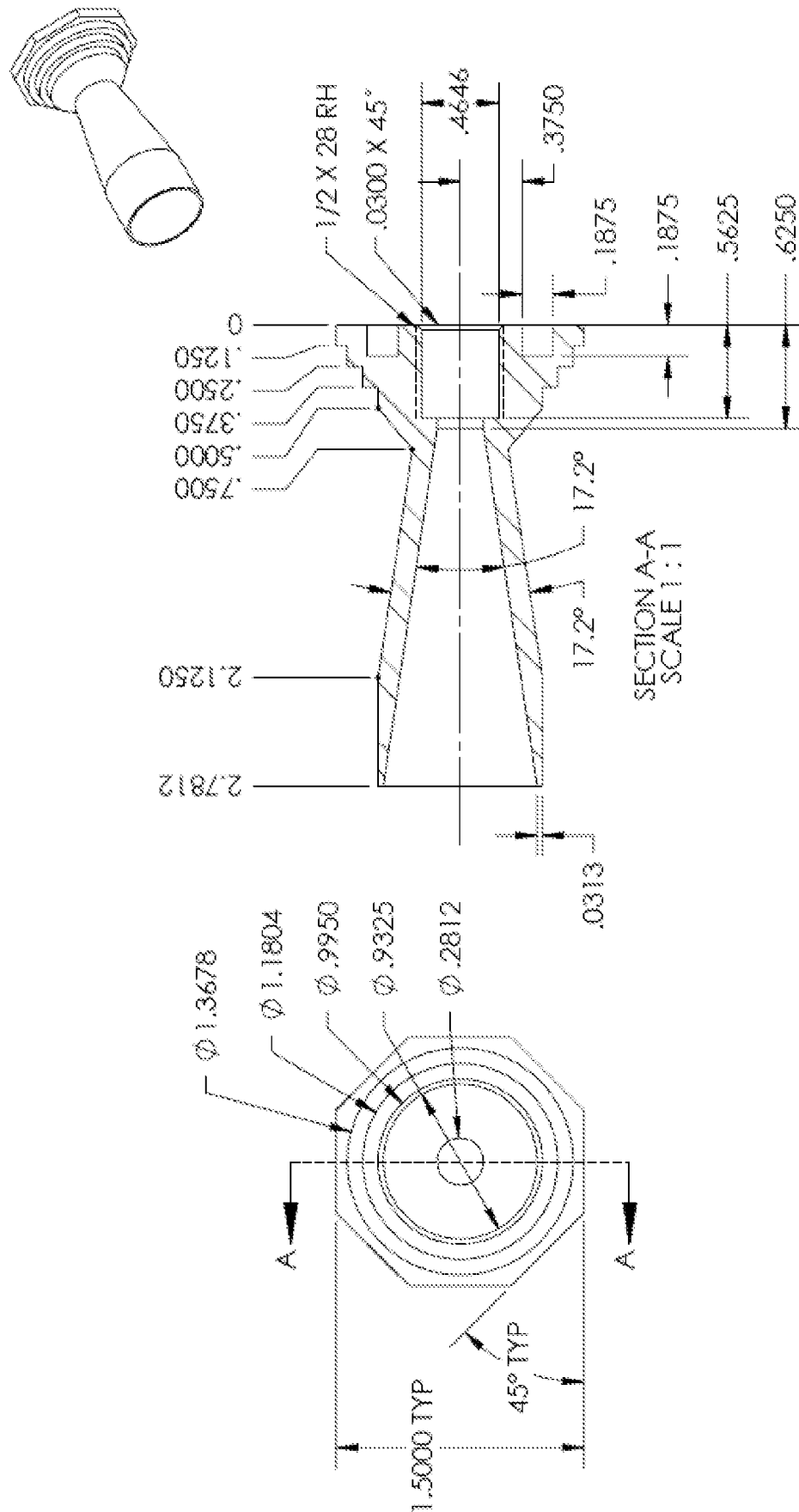


FIG. 3

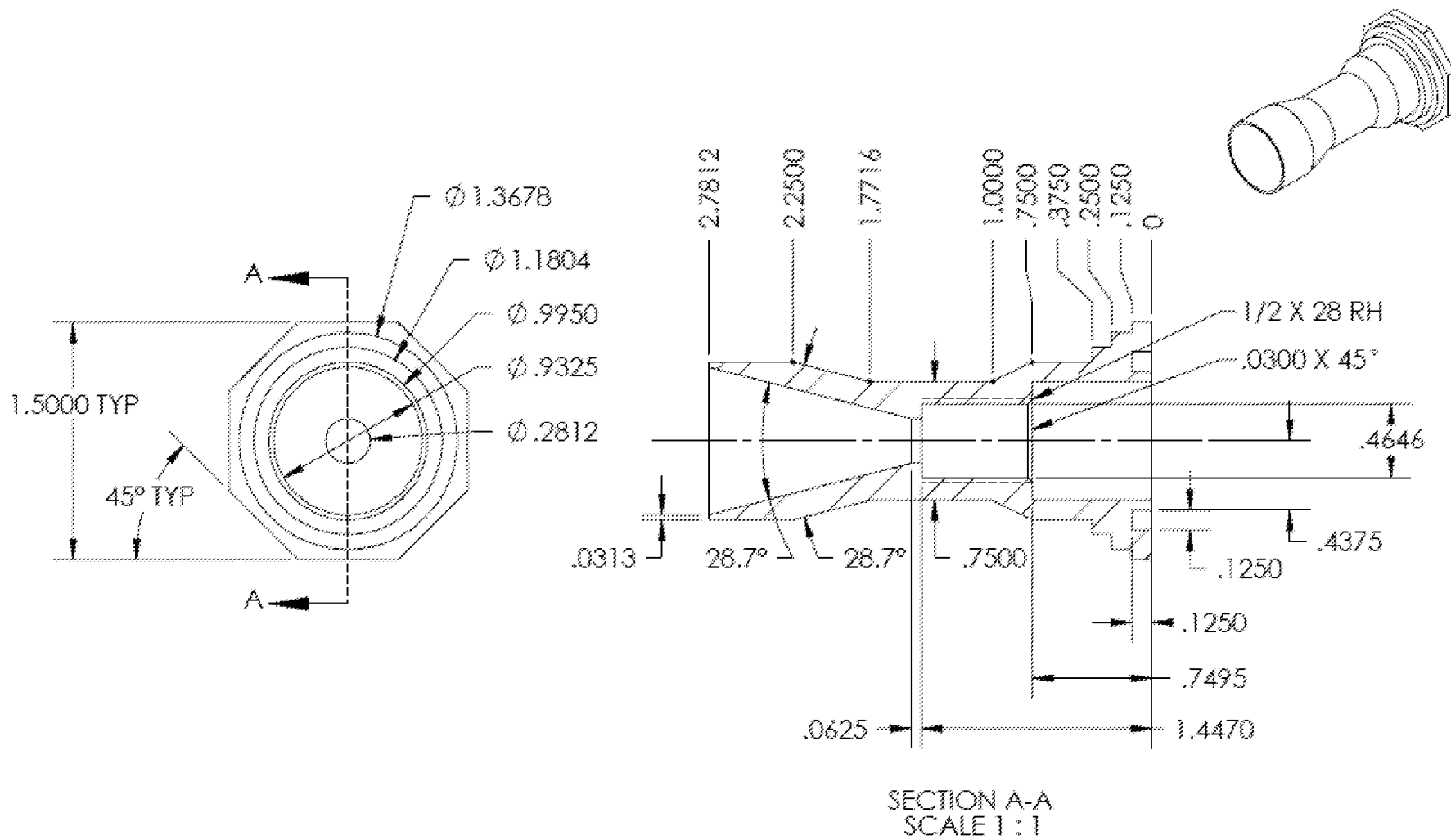


FIG. 4

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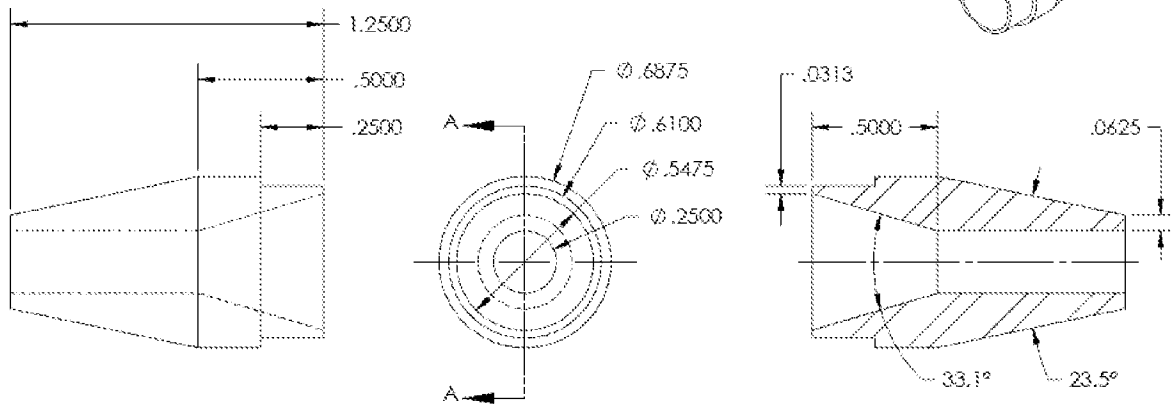


FIG. 5

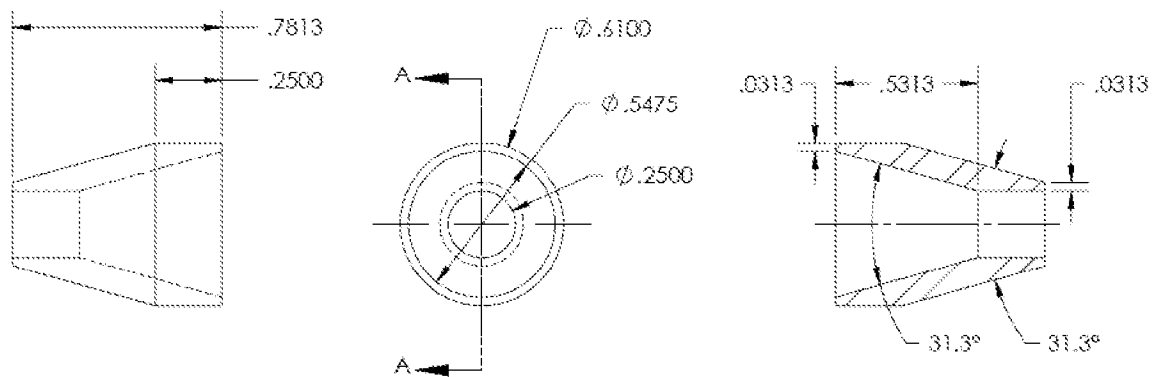


FIG. 6

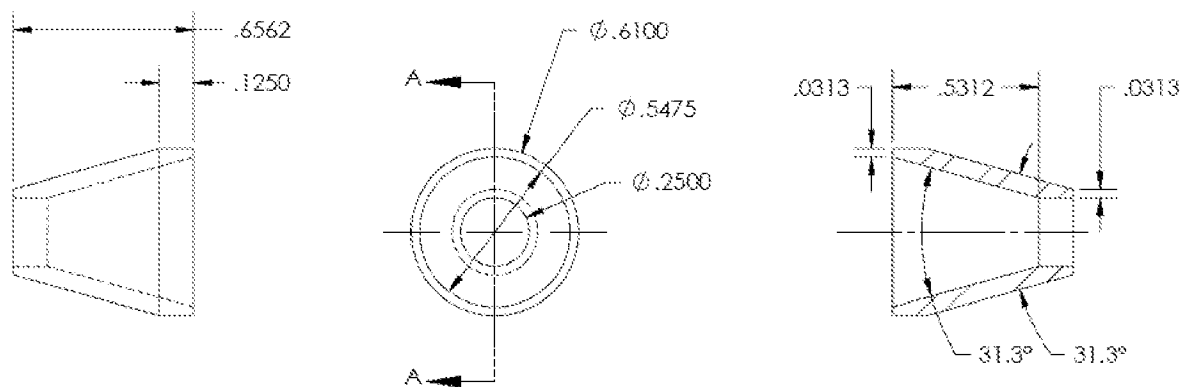


FIG. 7

6/10

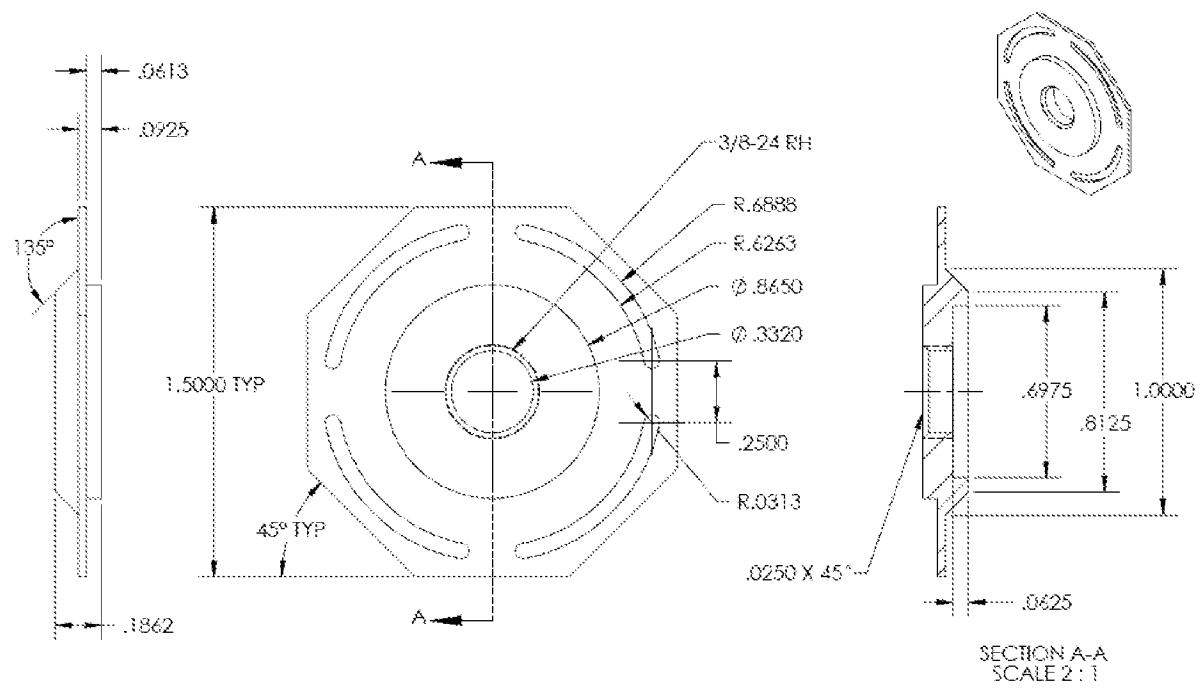


FIG. 8

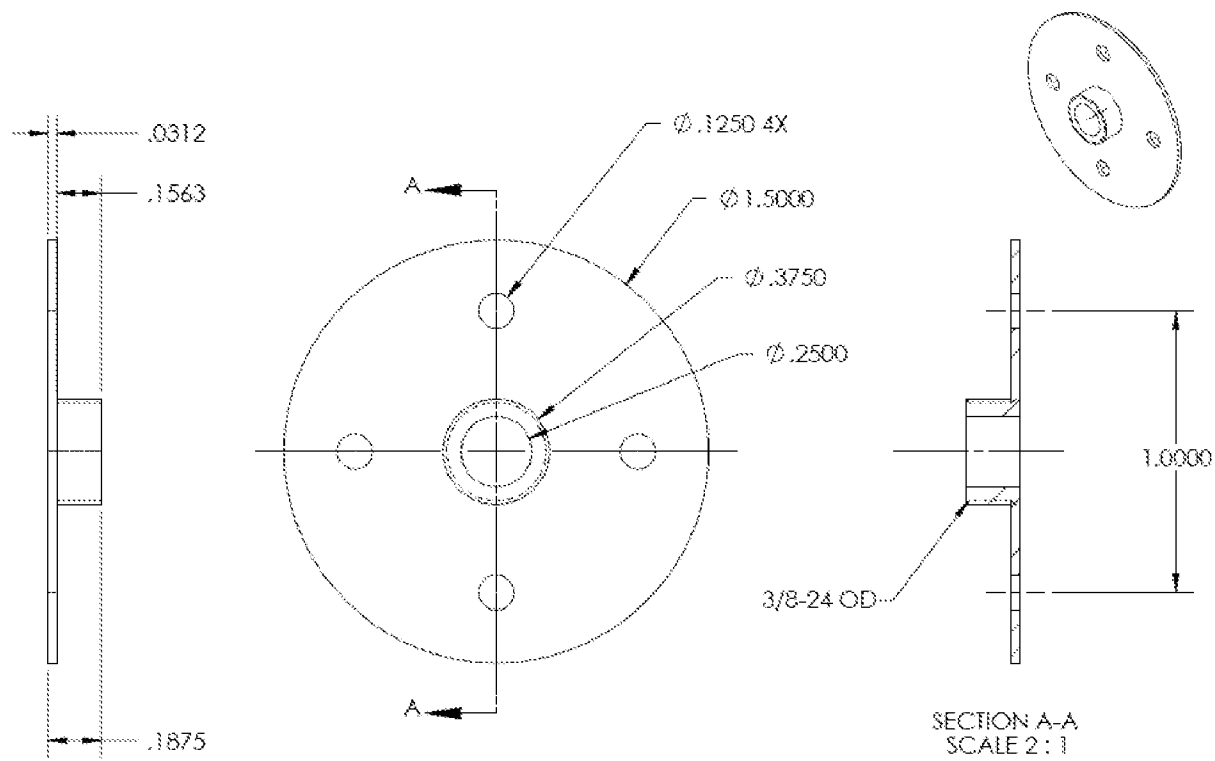


FIG. 9

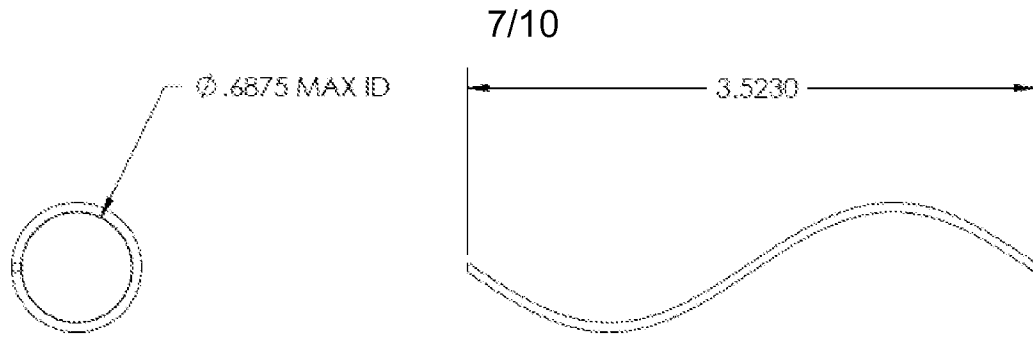


FIG. 10 1 REVOLUTION

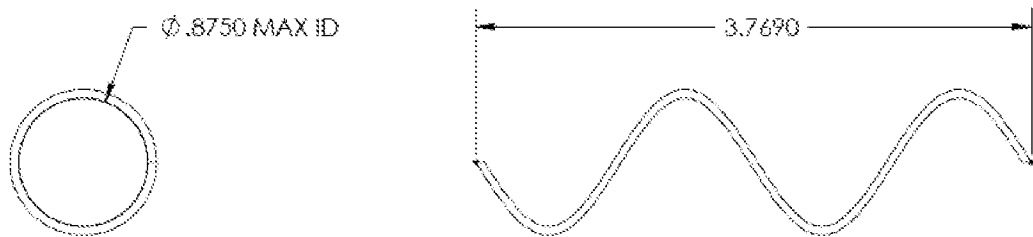


FIG. 11 2 REVOLUTIONS

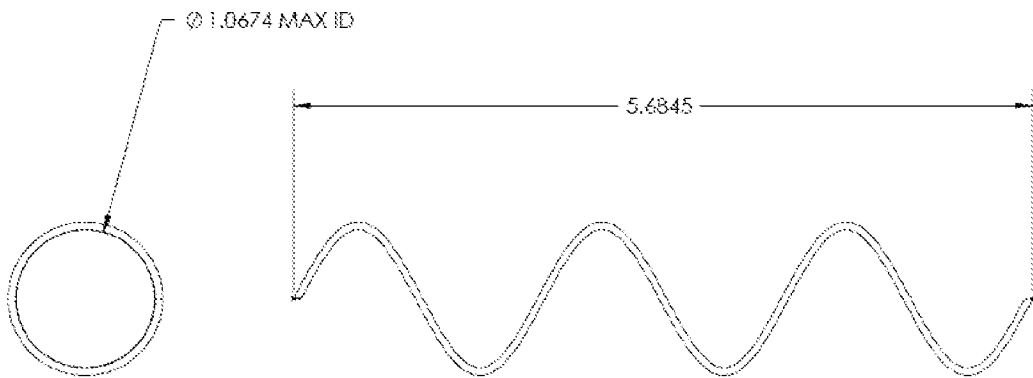


FIG. 12 3 REVOLUTIONS

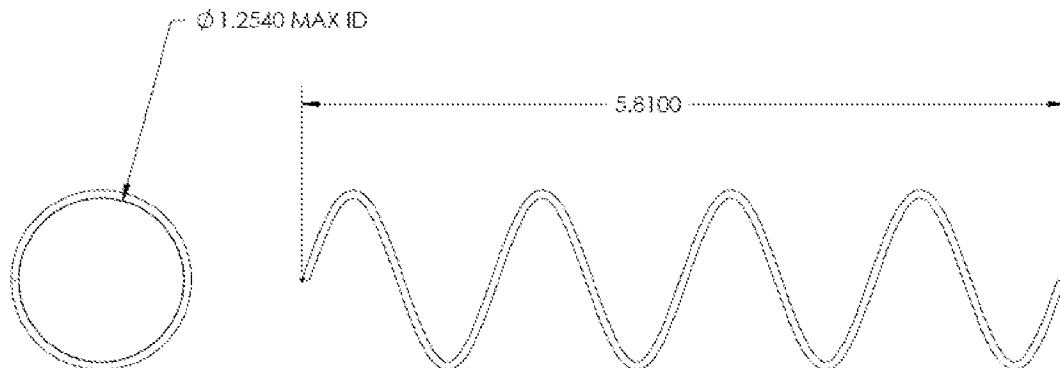


FIG. 13 4 REVOLUTIONS

8/10

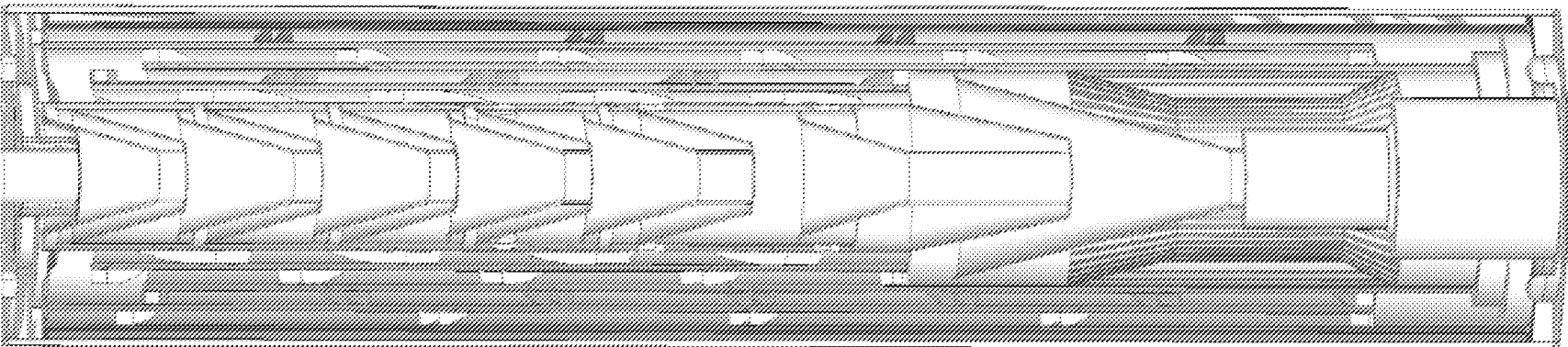


FIG. 15

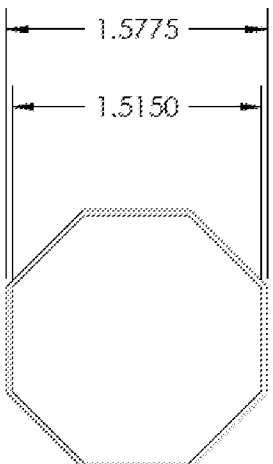
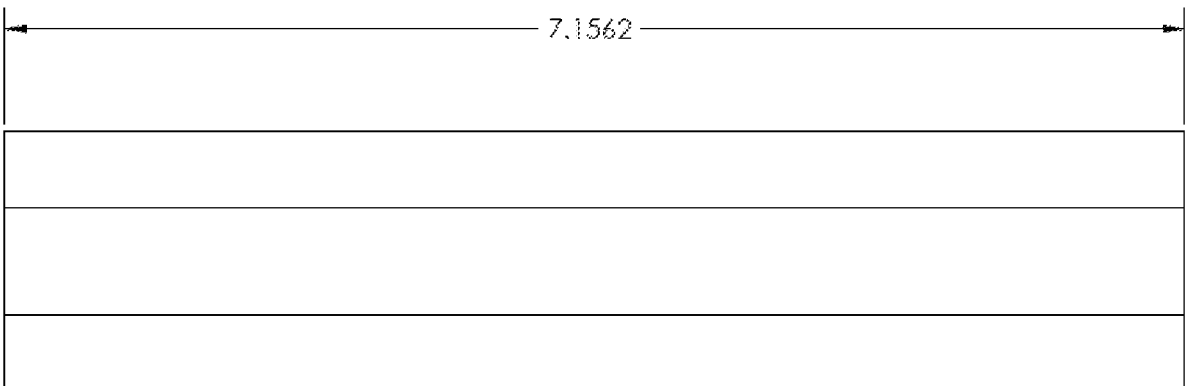
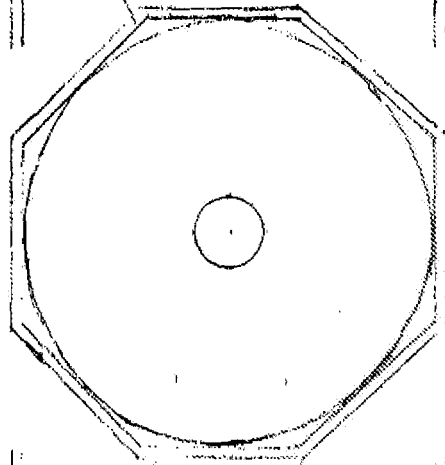
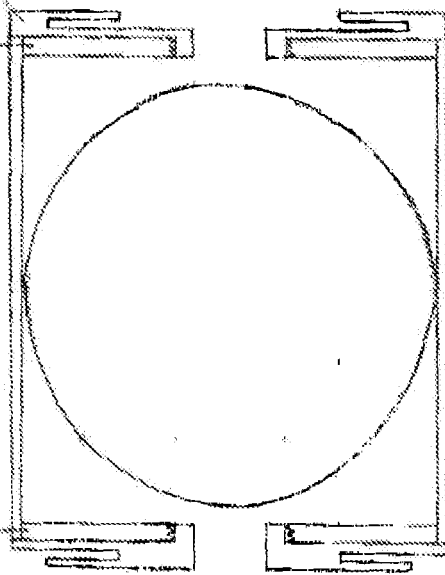


FIG. 14

Modular Particulate Capture Device

removable end caps

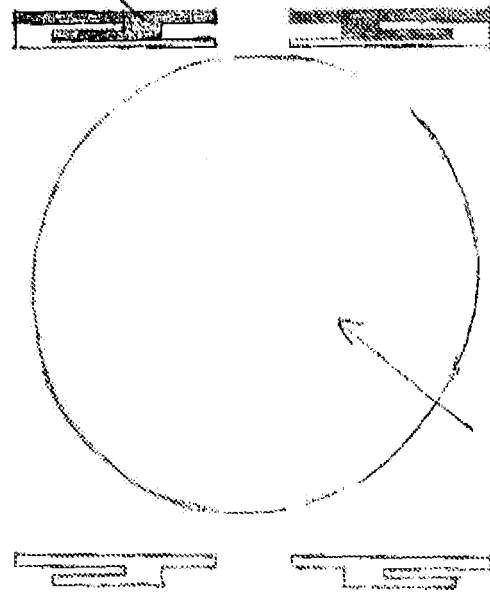
Female "slide on connector"



1500"

Octagon tube, same as
 energy capture devices

9/10



Male slide on connector
 attached to female connector.
 Allows multiple units to be
 assembled together, work
 in conjunction with energy
 capture devices.

1.50" Ballistic Self healing Ball

High density Foam / replaceable with removable end cap

Energy capture device also
 operates as "modular components"
 able to be used with 1 or
 more devices attached to
 each other extending the length
 and level of efficiency.
 Energy capture device is also
 available in one (1) variations
 7" tube

Scale 1.00" = .50"

FIG. 16

10/10

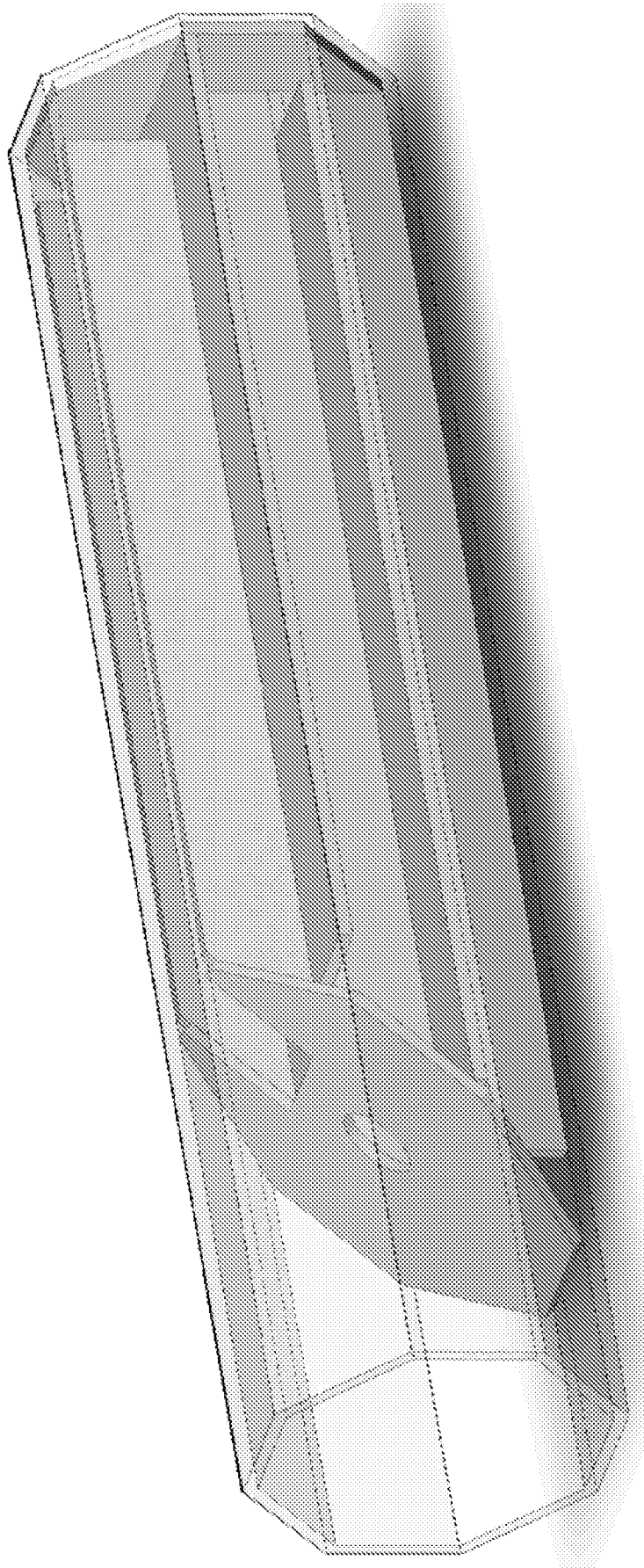


FIG. 17

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	ENERGY AND PARTICULATE CAPTURE AND CONTROL DEVICES			
First Named Inventor/Applicant Name:	Russell Oliver			
Filer:	Erik Sun Ericksen			
Attorney Docket Number:	3212-002.PROV			
Filed as Small Entity				
Provisional Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional Application filing fee	2005	1	110	110
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				110

Electronic Acknowledgement Receipt

EFS ID:	6995043
Application Number:	61303553
International Application Number:	
Confirmation Number:	5986
Title of Invention:	ENERGY AND PARTICULATE CAPTURE AND CONTROL DEVICES
First Named Inventor/Applicant Name:	Russell Oliver
Customer Number:	20551
Filer:	Erik Sun Ericksen
Filer Authorized By:	
Attorney Docket Number:	3212-002.PROV
Receipt Date:	11-FEB-2010
Filing Date:	
Time Stamp:	18:15:07
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Electronic Funds Transfer
Payment was successfully received in RAM	\$ 110
RAM confirmation Number	3620
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Provisional Cover Sheet (SB16)	ProvCoverSheet.pdf	955811 f58bf36e52a2bf15aeba3dc0fd9eb16a79bb5651	no	2
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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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