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(54) METHOD AND APPARATUS FOR DISARMING AN EXPLOSIVE DEVICE

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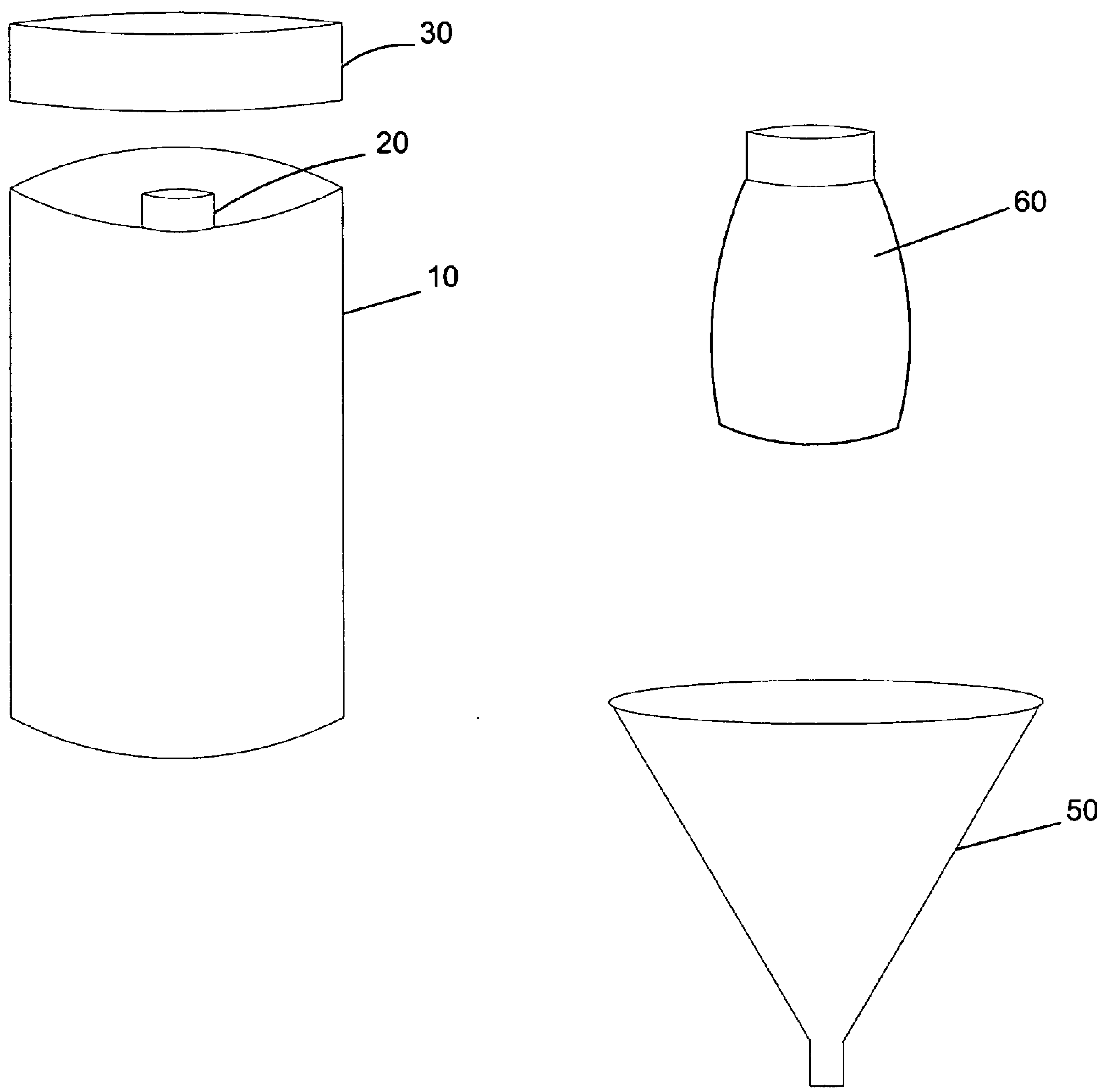
(57) **ABSTRACT**

Aspects of the present invention are directed to a method and system for disarming an explosive device. The apparatus may include a substantially cylindrically shaped container having a first hollow cavity therein. The apparatus may additionally include a column located within the hollow cavity, the column having a second smaller hollow cavity therein for receiving an explosive and an ablative agent within the first hollow cavity and surrounding at least a portion of the column. In embodiments of the invention, the ablative agent is industrial garnet and the explosive is a binary explosive. Interstitial spaces within the industrial garnet may be filled with water.



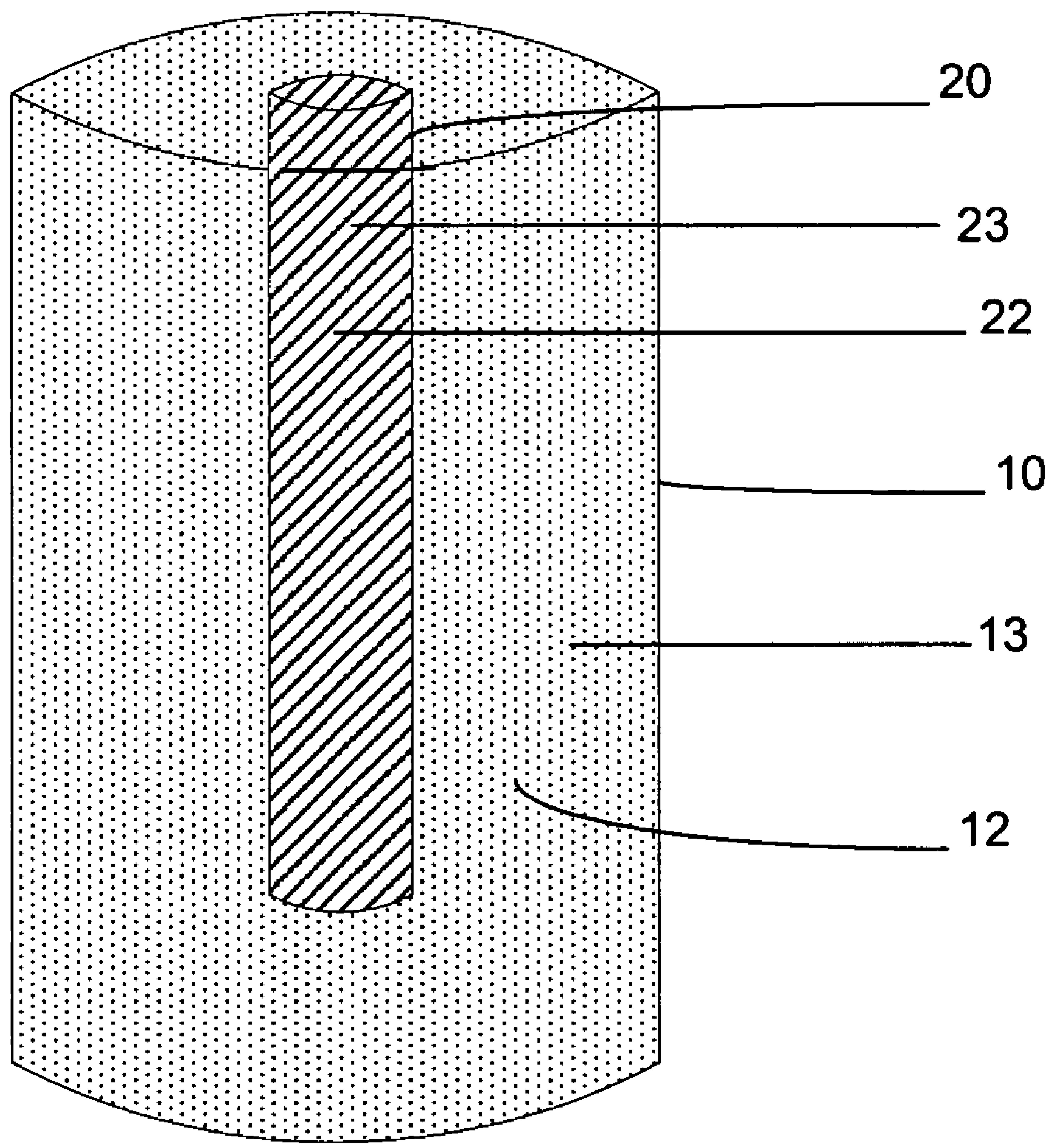


FIG 1

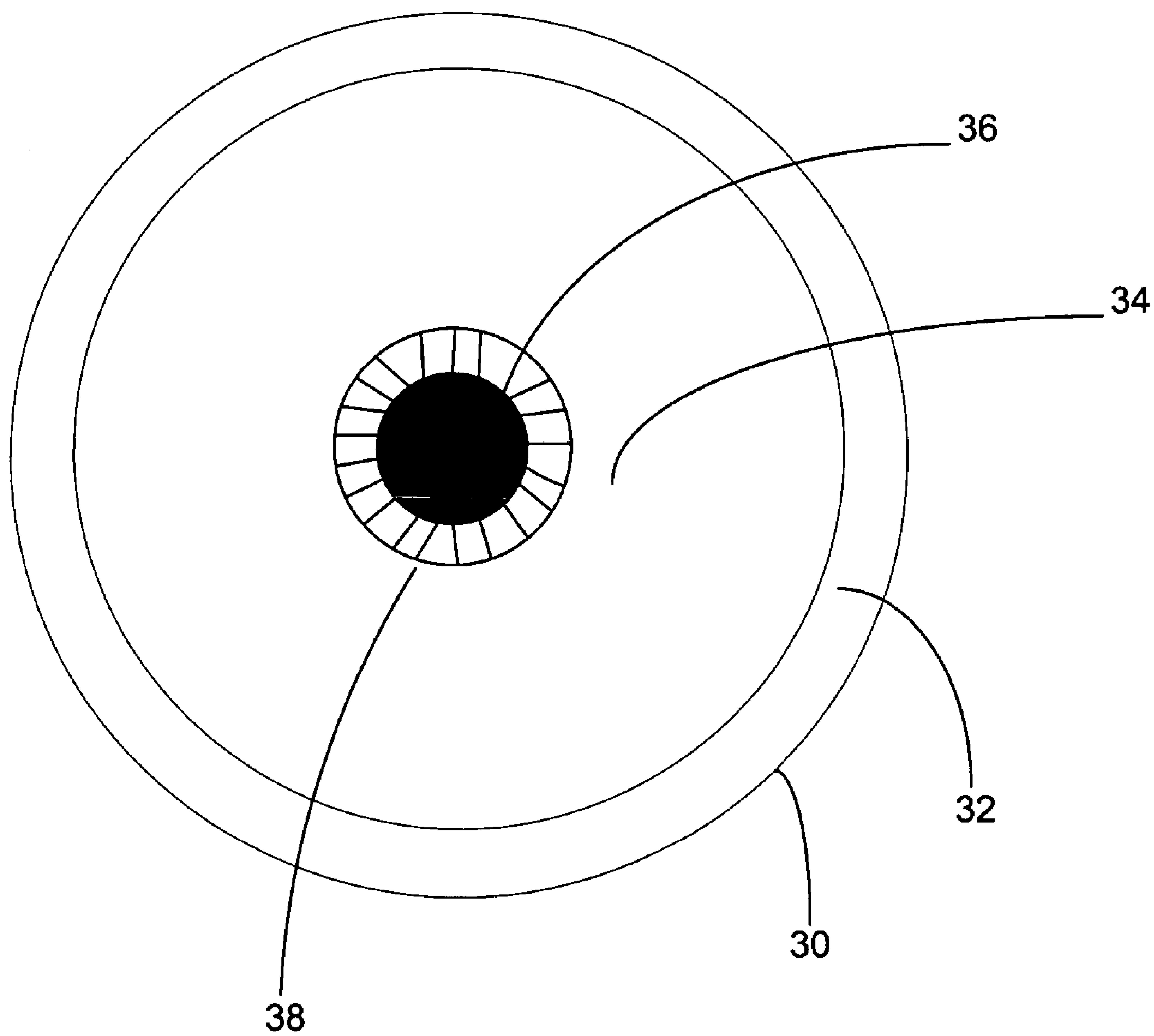


FIG 2

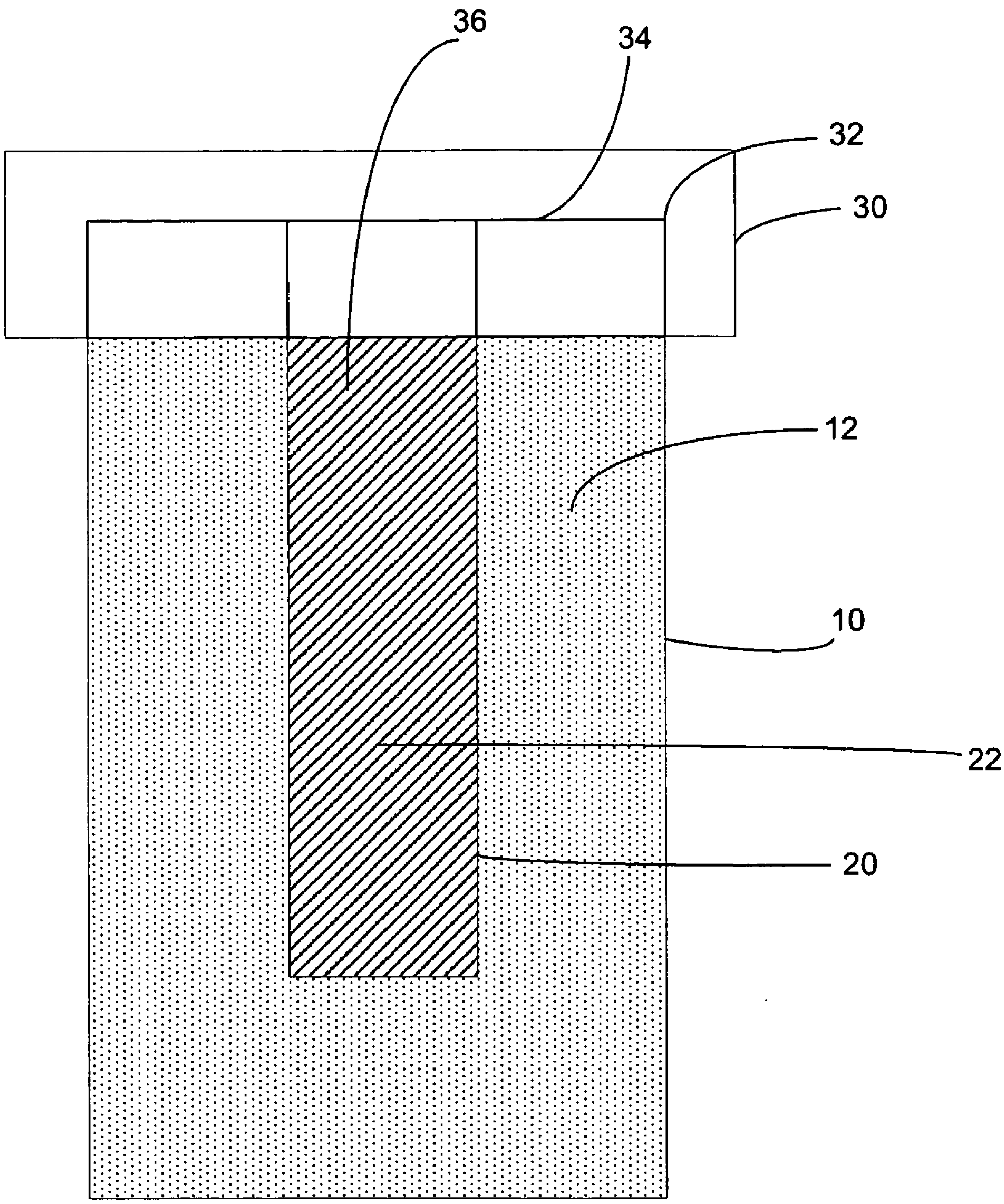


FIG 3

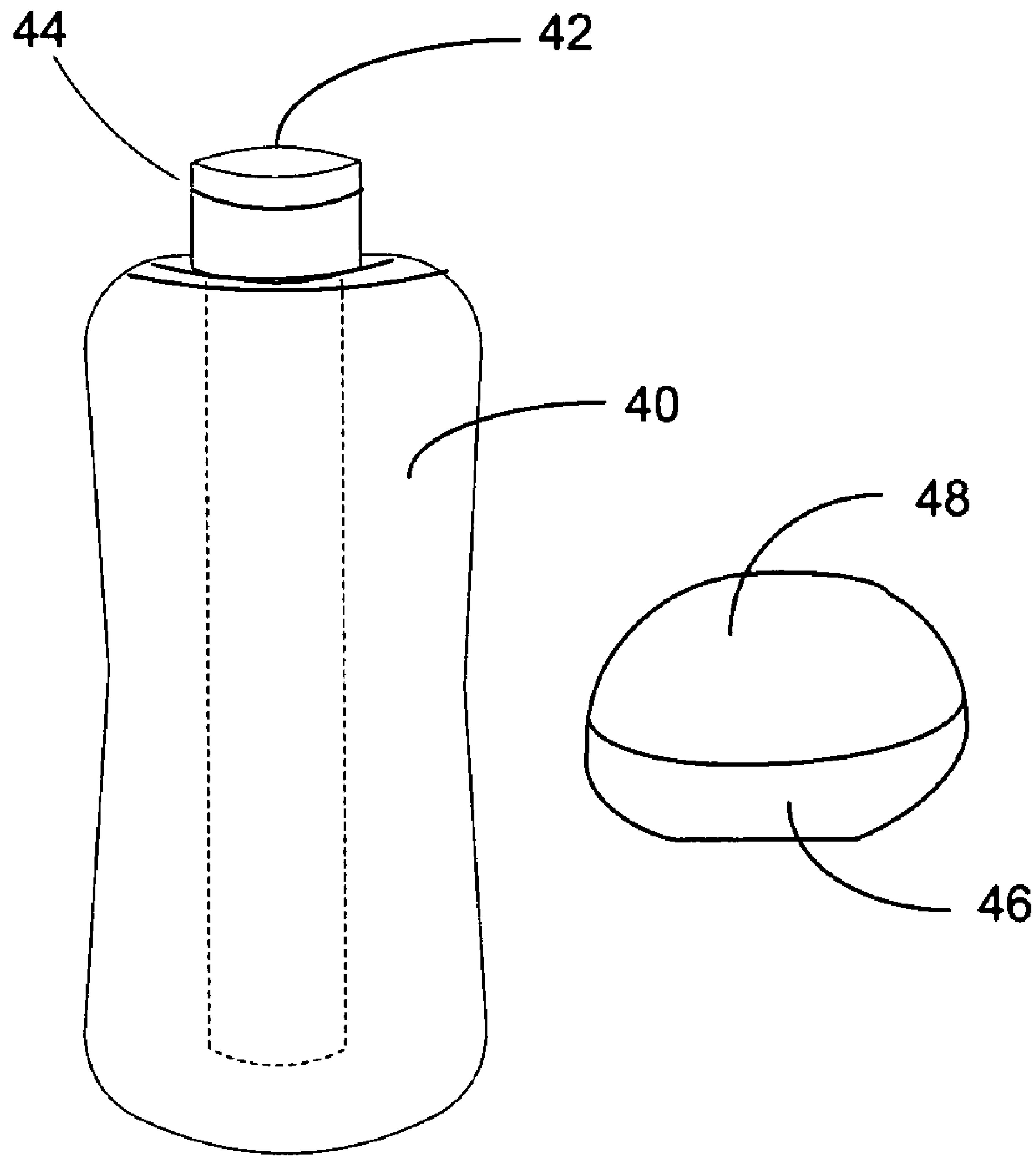


FIG. 4

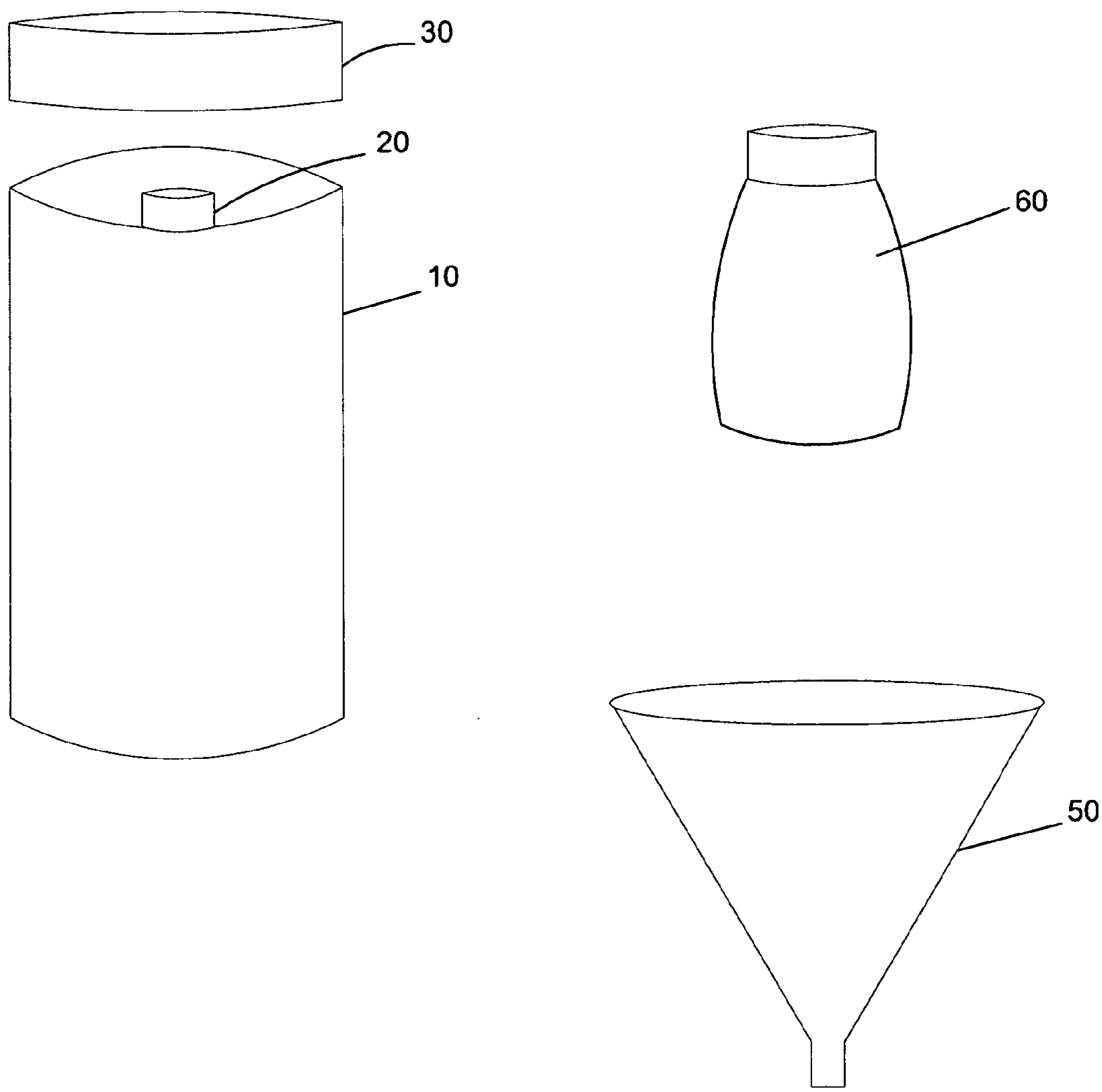


FIG 5

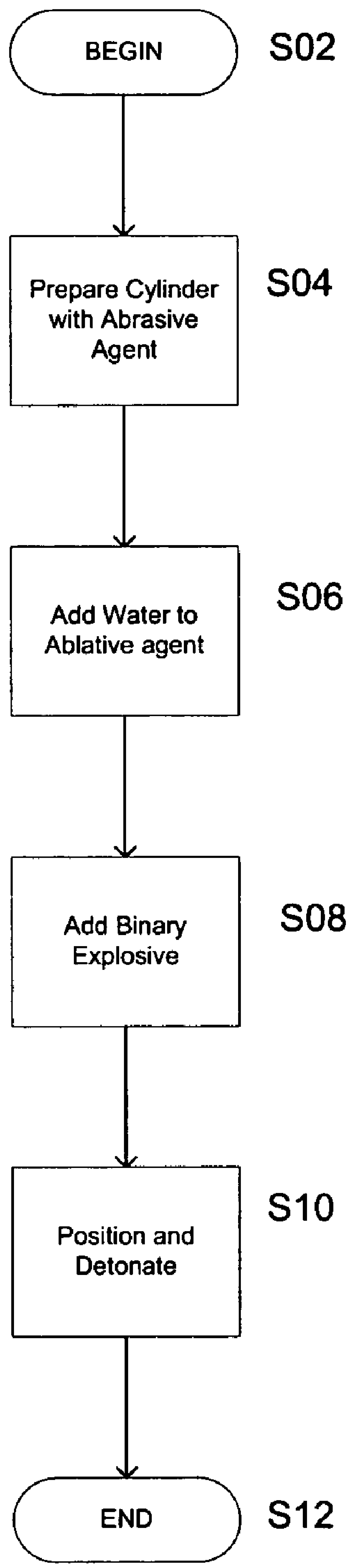

BEGIN
S02
Prepare Cylinder with Abrasive Agent
S04
Add Water to Ablative agent
S06
Add Binary Explosive
S08
Position and Detonate
S10
END
S12

FIG 6

METHOD AND APPARATUS FOR DISARMING AN EXPLOSIVE DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] None.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] None.

TECHNICAL FIELD

[0003] Embodiments of the present invention relate to disruption of explosives in order to prevent detonation and minimize damage. More particularly, embodiments of the invention are directed to an apparatus and method for disarming an improvised explosive device.

BACKGROUND OF THE INVENTION

[0004] An Improvised Explosive Device (IED) is a formal name for explosive devices used in unconventional warfare by terrorists. An IED is a device placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic, or incendiary chemicals and designed to destroy, incapacitate, harass, or distract. While IEDs may incorporate military stores, they normally include nonmilitary components.

[0005] IEDs typically include an explosive charge, possibly a booster charge, a detonator, and a mechanism known as an initiation system. IEDs may be extremely diverse in design and may include any type of firing device or initiator. They may further include commercial, military, or contrived chemical or explosive fillers. Sophisticated IEDs have been constructed from arming devices scavenged from conventional munitions and easily purchased electronics components as well as consumer devices. These IEDs are mostly conventional high explosive charges. However, the possibility of toxic chemical, biological or nuclear material can be included to add to the destructive power and psychological effect of the device.

[0006] Vehicle Borne Improvised Explosive Devices (VBEID) are IEDs that may be placed in any of various types of vehicles, such as cars, trucks, boats, or buses. Such explosive devices can be much larger and cause more destruction than devices implemented by single suicide bombers. VBIEDs typically include an explosive main charge that is placed out of view in a cargo compartment of a vehicle. The trigger for detonating the explosive main charge is typically located in a passenger area of the vehicle.

[0007] Current techniques developed in the United States for defeating VBIEDs often rely on theoretically sound but operationally impractical tools, tactics and procedures. These tools attack the main charge of the device and attempt to remove the explosives before the firing circuit can function. Available techniques may require up to twenty seven pounds of explosives and one hundred fifty gallons of water to be delivered by robot. The preparation time can require many tens of minutes. As the technique is time consuming and difficult to implement inside of a vehicle, it cannot practically be used in a real situation involving an actual threat.

[0008] Various additional methods have been suggested and/or utilized abroad for minimizing destruction caused by VBIEDs upon detection. One technique is to eject the explosive from the target area once the vehicle containing the explosive has been stopped. This technique involves significant risk and energy expenditure.

[0009] Another proposed technique is to disable the explosive train of the device at its initiation point. Tools implementing this technique may rely on water as the dynamic interface to affect disruption of an IED. These tools may cause disruption without risk of setting fire to the vehicle or detonating the IED. Some of these tools may use coarse salt and a specially prepared explosive that is not readily available to civilian law enforcement. C-4 explosives may be used to generate velocity in the water projected at the IED. The results are generally good for rapid mechanical disassembly of soft or light case containers. However, these tools are largely ineffective at removing heavy fabric or mechanically disassembling more complex IEDs like those used in VBIEDs.

[0010] Accordingly, a solution is needed that is simple and easy to use and obtain and will fully disable a trigger mechanism within a workable time period without detonating the main charge. Furthermore a solution is needed that will fully disarm the trigger mechanism without completely destroying the vehicle.

BRIEF SUMMARY OF THE INVENTION

[0011] In one aspect of the invention, an apparatus for disarming an explosive device is provided. The apparatus may include a substantially cylindrically shaped container having a first hollow cavity therein. A column may be located within the hollow cavity, the column having a second smaller hollow cavity therein for receiving an explosive. The apparatus may additionally include a garnet ablative agent within the first hollow cavity and surrounding at least a portion of the column.

[0012] In an additional aspect, a system may be provided for disarming an explosive device. The system may include a substantially cylindrically shaped container having an open end and a closed end, and a first hollow cavity therein. The cavity may be loaded with an ablative agent. A column may be located within the hollow cavity, the column having a second smaller hollow cavity therein for receiving an explosive. The system may additionally include a cap for closing the open end of the substantially cylindrically shaped container and a bottle for dispensing a pre-measured liquid for mixing with the ablative agent.

[0013] In yet a further aspect of the invention, a method may be provided for disarming an explosive device. The method may include loading an industrial garnet ablative agent in a substantially cylindrically shaped container and filling interstitial spaces in the industrial garnet ablative agent with water. The method may additionally include filling a cylindrical column of the substantially cylindrically shaped container with an explosive agent.

[0014] In an additional aspect, a method may be provided for disarming an explosive device. The method may include loading an ablating agent in a substantially cylindrically shaped container and filling interstitial spaces in the ablating agent with water. The method may additionally include filling a cylindrical column of the substantially cylindrically shaped container with a binary explosive agent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The present invention is described in detail below with reference to the attached drawings figures, wherein:

[0016] FIG. **1** is a perspective view illustrating a dynamic ablative cylinder apparatus in accordance with an embodiment of the invention;

[0017] FIG. **2** is a cross-sectional view of a cap of the dynamic ablative cylinder apparatus in accordance with an embodiment of the invention;

[0018] FIG. **3** is a plan view illustrating a dynamic ablative cylinder closed with the cap in accordance with an embodiment of the invention;

[0019] FIG. **4** is a perspective view illustrating a dynamic ablative cylinder in accordance with another embodiment of the invention;

[0020] FIG. **5** is a perspective view illustrating a dynamic ablative cylinder system in accordance with an embodiment of the invention; and

[0021] FIG. **6** is flow chart including a method for implementing the dynamic ablative cylinder system in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] Embodiments of the present invention are directed to an apparatus and method for disarming IEDs through implementation of a dynamic ablative cylinder. FIG. **1** is a perspective view of a dynamic ablative cylinder **10** in accordance with an embodiment of the invention. The dynamic ablative cylinder **10** may include a hollow cavity **12** that may be filled with an ablative material or agent **13**. A column **20**, which is preferably centrally located with the cylinder **10** may include a smaller hollow cavity **22** for receiving a binary explosive **23**.

[0023] The dynamic ablative cylinder **10** may in a preferred embodiment include a right cylinder having a volume of approximately one liter. The dynamic ablative cylinder **10** may be a substantially cylindrically shaped bottle preferably having a length of approximately eight inches, but may have other lengths, such as lengths between six and ten inches. The cylinder **10** may preferably be formed from a suitable plastic material.

[0024] The hollow cavity **12** contains an ablative material, which in a preferred embodiment is industrial garnet. Industrial garnet is a commercial abrasive that is significantly harder on the Mohs Hardness Scale than previously used materials such as salt and therefore ablates more materials effectively. This produces a greater potential for disruption of the IED and removal of the outer surface or covering from all other fixtures in the effected area (e.g. seat covers in vehicles). Although industrial garnet is considered a hard material, having a rating of 7.5 to 8.5 on the Mohs hardness scale, it has a low density. Because of its lighter mass, industrial garnet is less prone to detonate the explosive and more prone to ablate away. Accordingly, garnet has a powerful tearing or ablative force, but low detonation risk. In a preferred embodiment, industrial garnet has eighty grit particle diameter. Particle diameter of the ablative agent **13** may also impact detonation risk, with larger particle diameters increasing the risk. Additionally, a preferred quantity of industrial garnet for use in the dynamic ablative cylinder is approximately 4 pounds, although other quantities between 8 to 12 pounds may also be implemented and the exact quantity may depend on the selected size of the dynamic ablative cylinder **10**.

[0025] In embodiments of the invention, it may be possible to substitute aluminum oxide for industrial garnet. Aluminum oxide is a 9 on the Moh's hardness scale and has a powerful ablative force. However, aluminum oxide also is also used to enhance the power of some explosives. Use of aluminum oxide may make forensics difficult for investigators.

[0026] Interstitial spaces in the ablative agent **13** may be filled with water immediately prior to use. Filling the interstitial spaces with water serves three functions. First, it reduces "crush up" of the ablative agent **13**, which in turn maximizes the energy produced by the explosive that will be described below. Secondly, it quenches the flame production and significantly reduces or eliminates the possibility of a subsequent fire. The preferred quantity of water is 10 ounces for every 4 pounds of garnet used. Lastly, it reduces drag on the garnet while in-flight after detonation of the explosive.

[0027] The cavity **22** in the column **20** may be filled in a preferred embodiment with a commercial grade binary explosive **23** immediately prior to use. A preferred quantity of binary explosive is approximately one third pound but may vary based on bottle volume and an amount of ablative agent **13**. The column **20** is preferably also made from a plastic material. The dynamic ablative cylinder **10** preferably includes a binary explosive **23** that is readily available from commercial vendors in the United States. The use of a binary explosive **23** creates multiple advantages over the military explosives previously used. Because binary explosives include multiple components that only become explosive upon mixing, binary explosives can be stored and transported safely and without special security in a response vehicle. This saves valuable time for the responder by allowing the responder to proceed to the incident location without detouring to an explosives storage location. Unlike previous solutions implemented in other countries, the binary explosive **23** is easily prepared for use and produces repeatable results.

[0028] FIG. **2** is a cross sectional view of a cap **30** for placement on the dynamic ablative cylinder **10**. The cap **30** may have an outer wall **32**, an inner cavity **34** and a central recess **36** to accommodate the centrally located column **20** and a gasket **38** for sealing the cap **30** and the internal tube **20** for a liquid-tight connection. The gasket **38** may be made from rubber or other sealing material.

[0029] FIG. **3** is a plan view of the dynamic ablative cylinder **10** with the cap **30** attached. As explained above, the cylinder **10** contains an ablative agent **13** such as industrial garnet in the cavity **12**. The hollow portion **22** of the column **20** may be filled with the binary explosive **23**. The cap **30** includes a flange **32**, a main cavity **34**, and a central portion **36** and a gasket **38** (shown in FIG. **2**).

[0030] FIG. **4** is a perspective view illustrating an alternative preferred embodiment of a dynamic ablative cylinder.

As illustrated in FIG. **4**, a bottle **40** has a modified cylindrical shape. The bottle **40** has an inner hollow column **42** and a threaded upper portion **44** for connection with a cap **46**. The cap **46** may have an upper handle portion **48** that is easily manipulated in order to seal the upper portion **44** of the bottle **40**.

[**0031**] FIG. **5** is a perspective view of system for disarming an explosive device in accordance with an embodiment of the invention. The system may include the cylinder **10** having the central column **20**, the cap **30**, a funnel **50**, and a bottle **60**. The cylinder **10** may be prepared for the system by inclusion of the ablative agent **13** such as the industrial garnet in the cavity **12**. The bottle **40** may include a pre-measured quantity of liquid for introduction into the ablative material. A funnel **50** may also be included for ease of pouring. The system may also include a quantity of binary explosive to be poured in the column **20** immediately prior to use of the cylinder **10**. As set forth above, the binary explosive **23** may be stored in separate components, which are only explosive when mixed.

[**0032**] FIG. **6** is a flow chart illustrating a method for disarming an explosive device using the dynamic ablative cylinder **10**. The method may begin in step S**02**. In step S**04**, the cylinder **10** is prepared with the ablative agent **13**. As set forth above, the cylinder **10** is preferably a one liter plastic right cylinder loaded with industrial garnet. In step S**06**, the pre-measured quantity of water is added to the ablative agent **13** to fill the interstitial spaces in the ablative agent **13**. This step may be accomplished using the provided bottle **60** as shown in FIG. **5**. As set forth above, filling the interstitial spaces with water serves two functions. First, it reduces "crush up" of the ablative agent, which in turn maximizes the energy produced by the explosive. Secondly, it quenches the flame production and significantly reduces or eliminates the possibility of a subsequent fire initiated by the explosive in the dynamic ablative cylinder. Lastly, it reduces drag on the garnet while in-flight after detonation of the explosive. In step S**08**, the binary explosive **23** may be added. The binary explosive **23** is added to the central hollow cavity **22** and is preferably approximately one third pound of commercial binary explosive. The components of the binary explosive may be mixed immediately prior to the introduction of the binary explosive into the internal tube.

[**0033**] The introduction of the binary explosive may occur using any number of methods such as hand placement, rope, pole, or robot. One robot may include a boom with one to three cylinders. In some embodiments of the method, a blasting cap may be implemented to break vehicle windows. In operation, a robot may be operated remotely using remote cameras to select likely areas. Upon detonation of the dynamic ablative cylinder, the shockwave passes through efficiently as the cylinder explodes radially from the center.

[**0034**] The dynamic ablative cylinder is designed for use by trained bomb and explosive ordnance disposal technicians to render safe IEDs. Specifically, it meets the needs of the technicians to rapidly respond, render safe, and expose other potential threats beyond the capability of their current tool suite. It uses low cost resources readily available to perform a render safe procedure with minimal collateral damage due to its low explosive weight and method of use.

[**0035**] While particular embodiments of the invention have been illustrated and described in detail herein, it should be understood that various changes and modifications might be made to the invention without departing from the scope and intent of the invention.

[**0036**] From the foregoing it will be seen that this invention is one well adapted to attain all the ends and objects set forth above, together with other advantages, which are obvious and inherent to the system and method. It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated and within the scope of the appended claims.

What is claimed is:

1. An apparatus for disarming an explosive device, the apparatus comprising:

a substantially cylindrically shaped container having a first hollow cavity therein;

a column located within the hollow cavity, the column having a second smaller hollow cavity therein for receiving an explosive; and

a garnet ablative agent within the first hollow cavity and surrounding at least a portion of the column.

2. The apparatus of claim 1, wherein the garnet ablative agent is industrial garnet having a Mohs hardness scale rating of "7.5 to 8.5".

3. The apparatus of claim 2, wherein the garnet ablative agent is eighty grit.

4. The apparatus of claim 1, wherein the column is located centrally within the substantially cylindrically shaped container.

5. The apparatus of claim 1, wherein the explosive is a binary explosive including separately stored components.

6. The apparatus of claim 1, further comprising interstitial spaces within the garnet ablative agent filled with water.

7. The apparatus of claim 1, wherein the substantially cylindrically shaped container comprises a plastic container.

8. A system for disarming an explosive device, the system comprising:

a substantially cylindrically shaped container having an open end and a closed end, and a first hollow cavity therein, the first hollow cavity loaded with an ablative agent;

a column located within the first hollow cavity, the column having a second smaller hollow cavity therein for receiving an explosive;

a cap for closing the open end of the substantially cylindrically shaped container; and

a bottle including a pre-measured liquid for mixing with the ablative agent.

9. The system of claim 8, wherein the ablative agent is an industrial garnet ablative agent.

10. The system of claim 9, wherein the industrial garnet ablative agent has a Mohs hardness scale rating of "7.5 to 8.5".

11. The system of claim 9, wherein the garnet ablative agent is eighty grit.

12. The system of claim 8, wherein the column is centrally located within the substantially cylindrically shaped container.

13. The system of claim 8, wherein the explosive is a binary explosive including separately stored components.

14. The system of claim 8, further comprising interstitial spaces within the garnet ablative agent filled with water.

15. A method for disarming an explosive device, the method comprising:

loading an industrial garnet ablating agent in a substantially cylindrically shaped container;

filling interstitial spaces in the industrial garnet ablative agent with water; and

filling a cylindrical column within the substantially cylindrically shaped container with an explosive agent.

16. The method of claim 15, further comprising loading an eighty grit garnet ablative agent.

17. The method of claim 16, further comprising loading approximately ⅓ pound of the explosive agent.

18. The method of claim 15, wherein filling the central cylindrical column with an explosive agent comprises using a binary explosive including separately stored components.

19. The method of claim 15, further comprising filling interstitial spaces within the garnet ablative agent filled with water.

20. A method for disarming an explosive device, the method comprising:

loading an ablating agent in a substantially cylindrically shaped container;

filling interstitial spaces in the ablative agent with water;

filling a cylindrical column within the substantially cylindrically shaped container with a binary explosive agent.

21. The method of claim 15, further comprising loading a garnet ablative agent.

22. The method of claim 15, further comprising loading an eighty grit industrial garnet ablative agent.

23. The method of claim 15, further comprising loading approximately ⅓ pound of the binary explosive agent.

24. The method of claim 15, further comprising filling interstitial spaces within the garnet ablative agent filled with water.

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