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W. D. McFERRIN ET AL

3,477,372

DIRECTIONAL CHARGE EXPLOSIVE DEVICE

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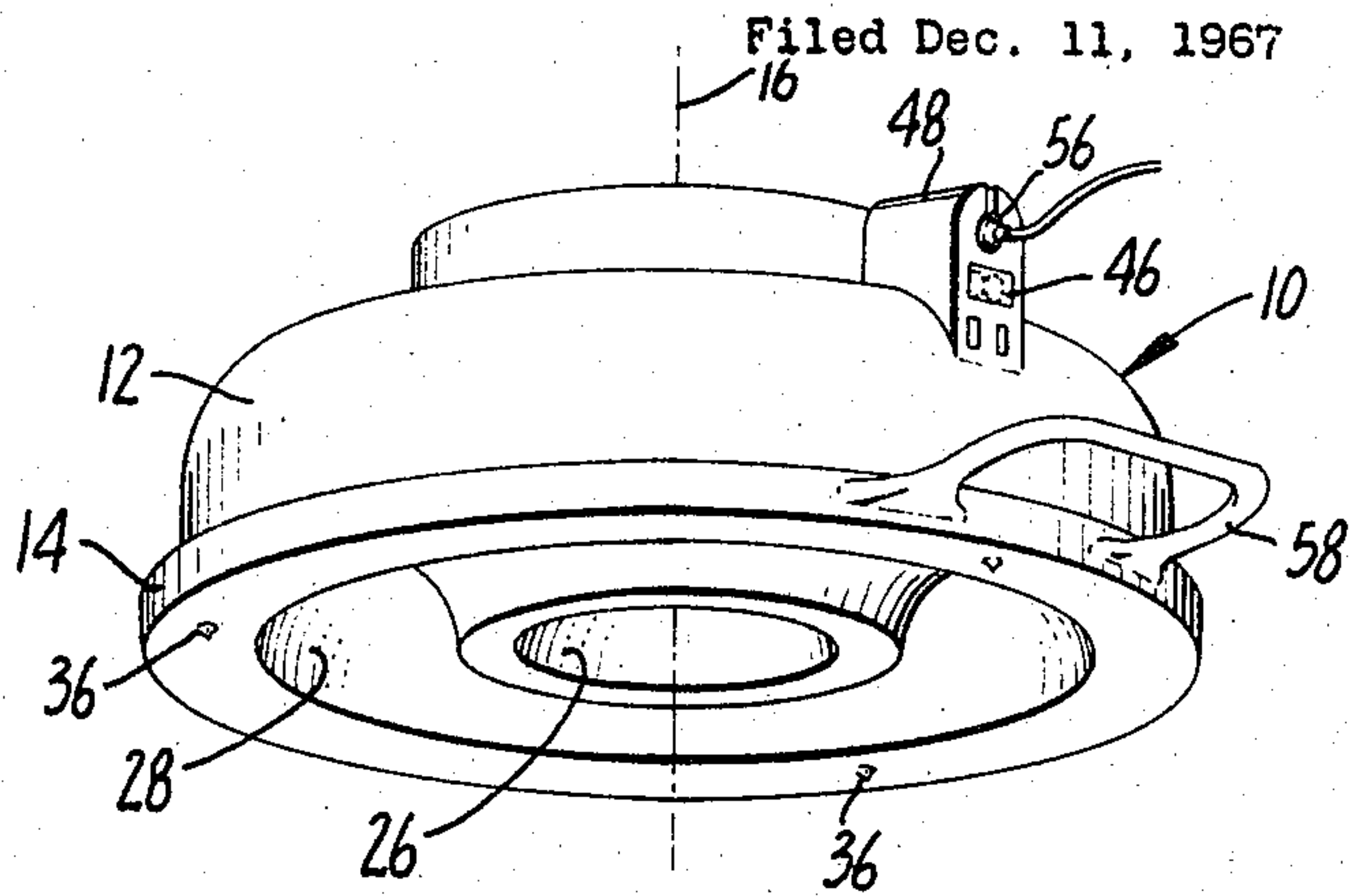


FIG. 1.

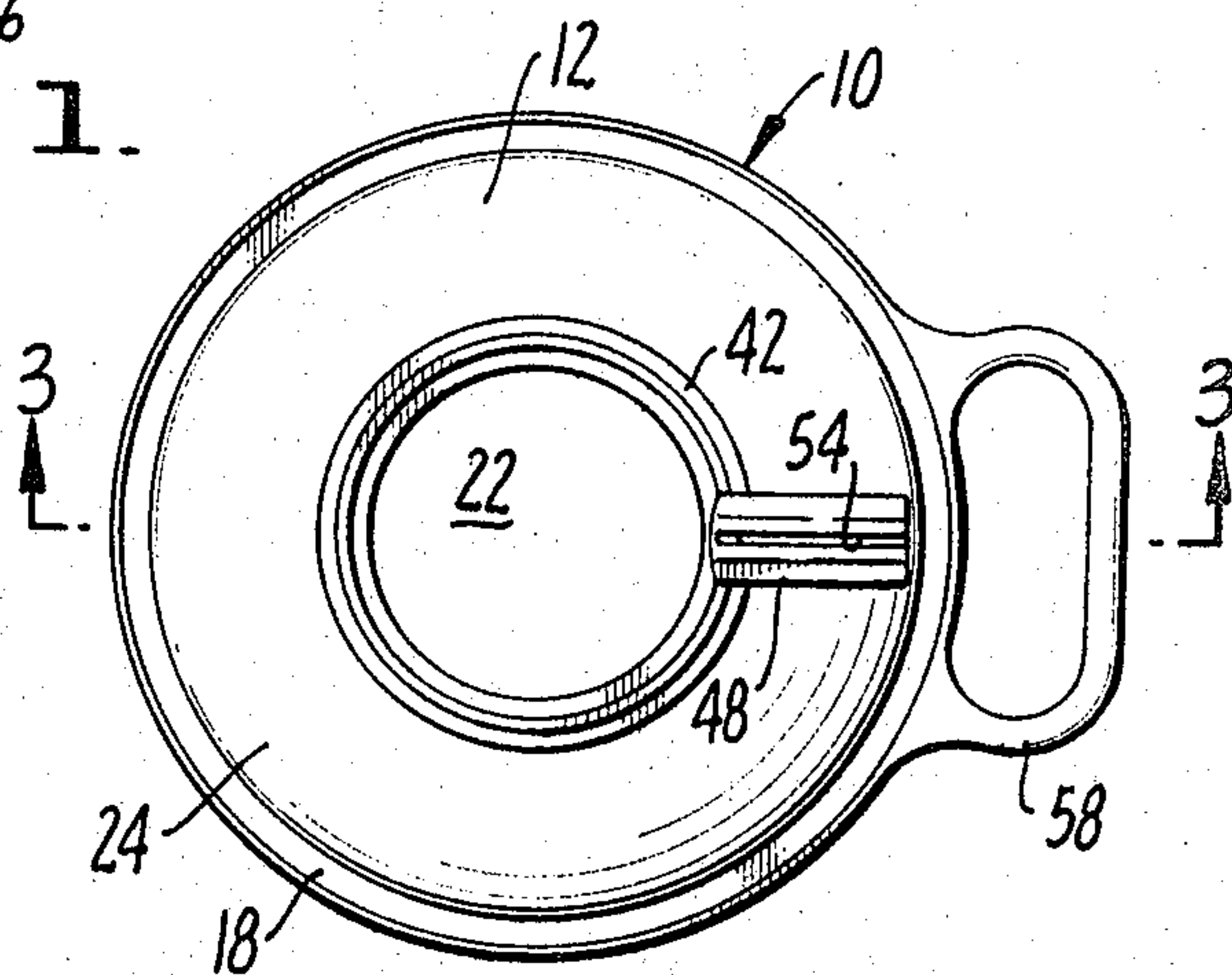


FIG. 2.

FIG. 4.

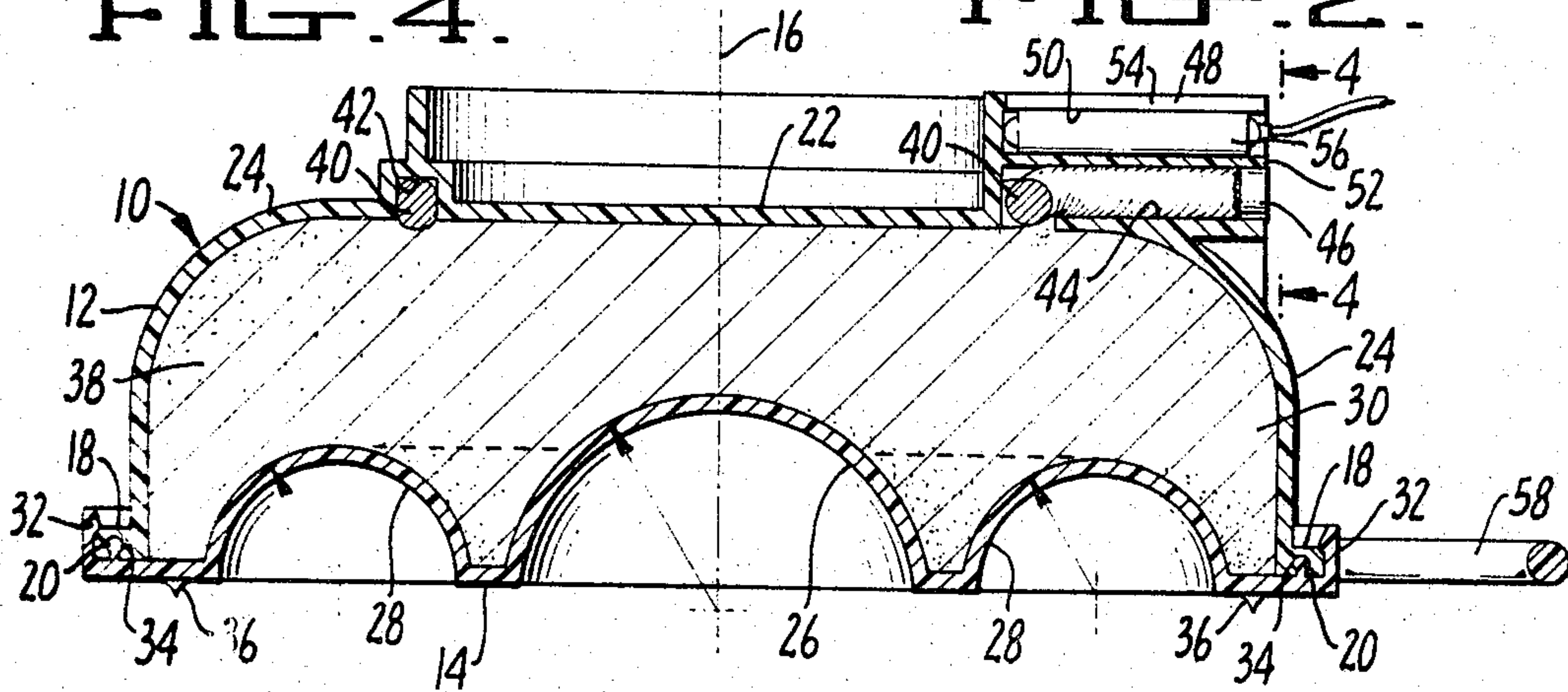
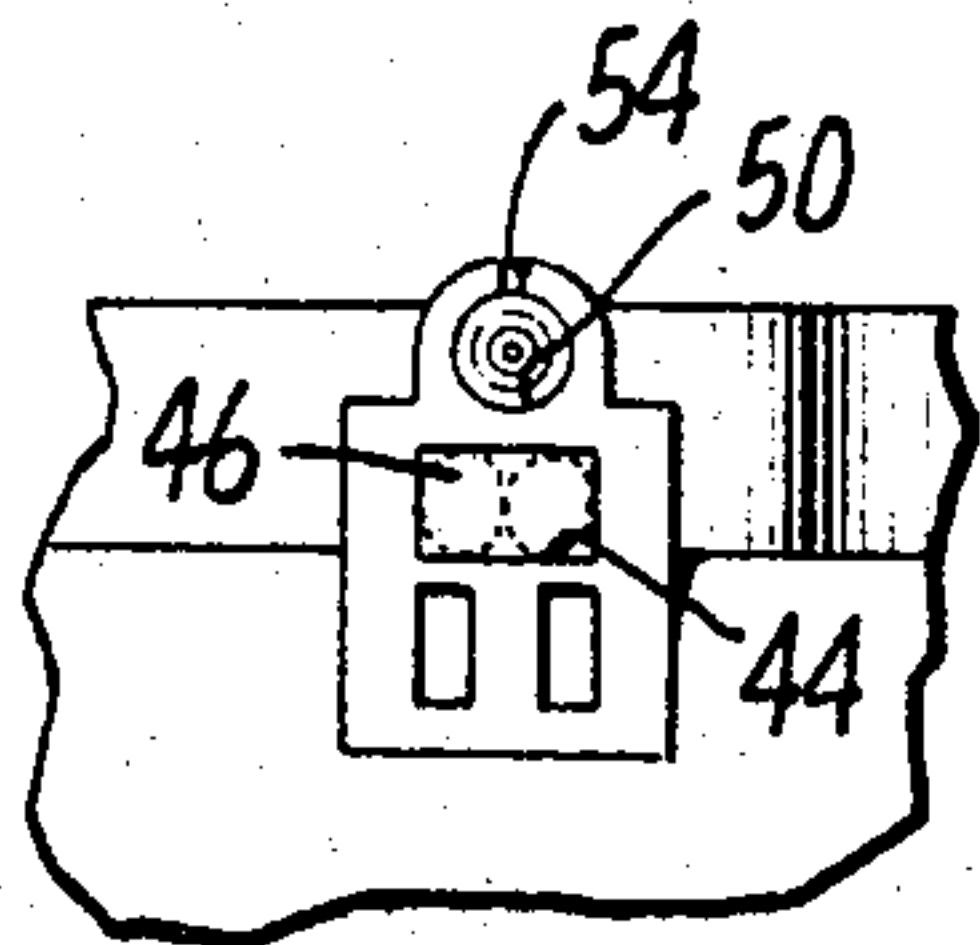


FIG. 3.

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DIRECTIONAL CHARGE EXPLOSIVE DEVICE
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2 Claims

ABSTRACT OF THE DISCLOSURE

A directional charge explosive device is provided with a dome-shaped casing and a bottom cover which entirely encloses the bottom of the casing and has therein a central downwardly opening circular concavity and an outer downwardly opening semi-toroidal concavity. The concavities in the bottom cover, when used in conjunction with a 360° "over-drive" detonation arrangement, direct the force of the detonated explosive charge in the desired direction.

BACKGROUND OF THE INVENTION

Field of the invention

A directional charge explosive device unit is provided with a central concavity and an outer concavity, and a 360° "over-drive" detonation arrangement, all three being substantially concentric with the central vertical axis of the device.

Description of the prior art

The closest prior art known to applicants is Wofford et al. 3,244,102. This patent is discussed and distinguished hereinafter.

SUMMARY OF THE INVENTION

A directional charge explosive device is used to reduce large rocks, boulders, pieces of concrete and the like into fragments which can be more easily handled, positioned and removed. Many times a secondary blasting unit, such as the directional charge explosive device of this invention, only comes into usage after an initial larger detonation has blasted material from a hillside or the like.

Typical of the heretofore used secondary blasting units is a patent issued to Wofford et al., 3,244,102. The device in 3,244,102 is satisfactory for most blasting operations but the device of the present invention has improved the directional accuracy and is of improved mechanical construction. Applicants have improved the above described device by providing an improved secondary blasting unit having formed therein a central downwardly opening circular concavity as well as an outer downwardly opening semi-toroidal concavity used in conjunction with a 360° "over-drive" detonation arrangement.

It is the primary object of the present invention to provide a new and improved directional charge explosive device.

Another object of the invention is to provide a directional charge explosive device with a double seal between the casing and the bottom cover.

A further object of the present invention is to provide a plurality of downwardly opening concavities in the bottom cover to insure increased directional effect of the detonation.

A further object of the present invention is to provide a 360° "over-drive" detonation arrangement which is substantially concentric with the central vertical axis of the device.

A further object is to provide a directional charge explosive device which produces a great breaking power with the use of a small amount of explosive.

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A still further object of the present invention is to provide a directional charge explosive device in which the explosive strength of the explosive filler may be altered as desired.

Still another object is to provide an improved, split-top cap holder, permitting use with various designs of detonating caps.

A final object is to provide a directional charge explosive device which produces a disruptive imploding force that disintegrates boulders and the like rather than blasting them apart.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an isometric or perspective view illustrating the secondary blasting unit of the present invention.

FIGURE 2 is a top plan view.

FIGURE 3 is an enlarged sectional view taken substantially as indicated along line 3—3 of FIGURE 2.

FIGURE 4 is a fragmentary view taken substantially as indicated along line 4—4 of FIGURE 3 and illustrating the detonating cap cavity and the interior opening recesses.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, the directional charge explosive device of the present invention, generally indicated 10, which is intended for use in any type of secondary blasting application, is provided with a domed-shaped casing 12 and a bottom cover 14. The domed-shaped casing 12 is substantially concentric with a central vertical axis indicated by line 16 and terminates in a substantially circular lower rim 18 having a groove 20 on the lower side thereof. The casing 12 has a planar upper central portion 22 surrounded by curved walls 24.

The bottom cover 14 has formed therein a central downwardly opening circular concavity 26 and an outer downwardly opening semi-toroidal concavity 28 in order to focus the heat and energy of the explosives into a very small area. Both of the concavities 26 and 28 are substantially concentric with the central vertical axis 16. The focal point of convergence of concavity 26 is below the bottom cover 14 and the focal point of convergence of concavity 28 can be on the bottom cover 14 or below it as desired, thus making concavity 26 less than one half a sphere and concavity 28 at most one half a sphere. Casing 12 and cover 14 enclose a central chamber 30 and by means of lip portion 32 of the bottom cover 14, which overlaps the circular lower rim 18 of the casing 12, and rib 34, which matingly fits into the groove 20, provide a double seal between the casing 12 and the cover 14 so that the directional charge explosive device of the present invention can be used under all weather, temperature, surface and marine conditions. A plurality of pointed members 36 may be provided on the bottom cover if desired to insure positional stability of the directional charge explosive device. A material such as plastic which can be readily molded into the desired shape has been found suitable for making the casing 12 and cover 14.

Located within the central chamber 30 is a charge of explosive filler 38 which is of the alkali nitrate category and detonates at a self-propagating rate of approximately 14,000 to 15,000 feet per second. The explosive filler 38 is of a regular commercial type and it is well known to the art. The relative weight strength or explosive equivalent of this explosive filler 38 is normally 90%. However in certain applications of this directional charge explosive device it has been found that the explosive filler 38 should have a lower relative weight strength or explosive equivalent. A detonating fuse 40 is positioned in an annular channel 42 in the casing 12 with the ends

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of the fuse 40 being coterminous in a lower recess 44. Plug 46 is provided to protect the fuse 40. The detonating fuse 40 is commercially made and detonates at the rate of approximately 20,000 to 22,000 feet per second. As can be seen in FIGURE 3, the diameter of the annular channel 42 as measured from the vertical axis 16 is approximately equal to the mean diameter of the semi-toroidal concavity 28.

The various strengths of the explosive filler 38 that may be used in the directional charge explosive device are cap-sensitive explosives and do not require dynamite as a booster. The explosive fillers when properly initiated, have considerably more power than the standard dynamites. To get the maximum efficiency, it is essential that the peak velocity of the explosive fillers be reached as quickly as possible. This is accomplished by using the proper initiation device for the particular explosive.

As can be seen in FIGURE 2, the annular channel 42 allows the fuse 40 to have a 360° shape. This generates a force wave which travels at several times the speed of sound within the 360° loop when the fuse 40 is detonated. This creates a tremendous shock to the localized area thereby creating an efficient "over-drive" detonation mechanism for the explosive filler.

The term "over-drive," as used in the industry, describes that property of explosives which enables them to detonate at a rate greater than their self-propagating detonation rate. For example, an explosive which detonates at the rate of 22,000 feet per second (detonating fuse) is set off in contact with another explosive which detonates at the rate of 15,000 feet per second (explosive filler) then this 15,000 feet per second explosive will detonate at a rate higher than 15,000 feet per second but somewhat lower than 22,000 feet per second.

Therefore, by using this principle the detonation velocity of the explosive filler can be increased from approximately 15,000 feet per second to over 18,000 feet per second as desired. In addition, this method of detonation of the explosive filler greatly improves the results of the new directional charge explosive device of the present invention.

Radial boss 48 on the upper portion of the casing 12 houses the lower recess 44 and the upper exterior opening cavity so with frangible walls 52 separating the recess 46 and the cavity 50. The cavity 50 is provided with slit 54 in order to allow spreading or flaring when detonating caps 56 of various sizes are inserted into it. Handle 58 is provided for ease in handling.

In actual operation and after the directional charge explosive device is properly positioned on or near the target object, the detonating cap 56 is ignited. The force of the detonating cap 56 ruptures the frangible walls 52 and in turn detonates the ends of the detonating fuse 40. The detonating fuse 40 then causes detonation of the explosive filler 38 to take place along the path of the annular channel 42, thus providing an instantaneous accelerated detonation of the filler 38 which results in a vortiginous propagation front which in turn accentuates the toroidal blast of the device 10.

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Due to the focal point of the convergence of the plural concavities, the energy of the explosion is transmitted within the target object causing the target object to fail from implosion resulting from the explosion of the directional charge explosive device positioned on the periphery of the target object. Since an implosion is created, there is no danger that men and/or machinery will be damaged by flying rocks and debris. In addition, there is a tremendous saving in the cost of labor, time and equipment in that no drilling operation precedes the utilization of the directional charge explosive device of this invention.

In numerous actual field tests, the device of this invention has been able to average over one cubic yard of breakage per pound of explosive filler.

We claim:

1. A directional charge explosive device comprising:

(a) a dome-shaped casing substantially concentric with a central vertical axis, said casing terminating in a substantially circular lower rim,

(b) a planar bottom cover mounted on said lower rim and entirely enclosing the bottom of said casing, said casing having formed therein a central downwardly opening circular concavity having its focal point of convergence below the plane of the bottom cover and an outer downwardly opening semi-toroidal concavity having its focal point substantially in the plane of the bottom cover, both of said concavities being substantially concentric with said central vertical axis and the peripheral edges of both concavities being in substantially the plane of the bottom cover;

(c) a radial boss on the upper portion of said casing, said boss being formed with an exterior opening cavity to receive a detonating cap, and an interior opening recess alongside said cavity and separate therefrom by frangible walls;

(d) an explosive charge in said casing; and a circular detonating fuse in said casing and extending substantially 360° in contact with said charge, said circular fuse being substantially concentric with said central vertical axis, the ends of said detonating fuse terminating in said recess.

2. The directional charge explosive device of claim 1 wherein the exterior opening cavity has a slit whereby the cavity can be spread so that detonating caps of various sizes may be inserted therein.

References Cited

UNITED STATES PATENTS

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