# United States Patent [19]

White

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[54] **RADIOACTIVE WASTE FILTER REMOVAL SYSTEM**


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[73] Assignee: **Gilbert Associates, Inc.,** Reading, Pa.



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[52] **U.S. Cl.** ..... **250/506,** 250/507, 250/518, 176/30

[51] **Int. Cl.** ..... **G21f 1/00**

[58] **Field of Search** ..... 176/30, 14; 250/506, 507, 250/518



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*Primary Examiner*—Harold A. Dixon



[57] **ABSTRACT**

A radioactive waste filter cartridge removal apparatus comprising a shielding cask having removable top and bottom lids and a support collar integrally secured to the outer wall of the cask for support on a shouldered and shimmed support. Two lowering assemblies comprising rods extending vertically through said support collar at diametrically opposite sides of the cask are provided for effecting lowering movements of the bottom lid. One of said rods has its lower end welded to the peripheral portion of the bottom lid whereby such lid may be rotated about the axis of the rod and thus clear the bottom opening of the cask to permit vertical downward movement of the filter cartridge through such opening. A grappling tool and viewer are mounted on the top lid.


**8 Claims, 8 Drawing Figures**

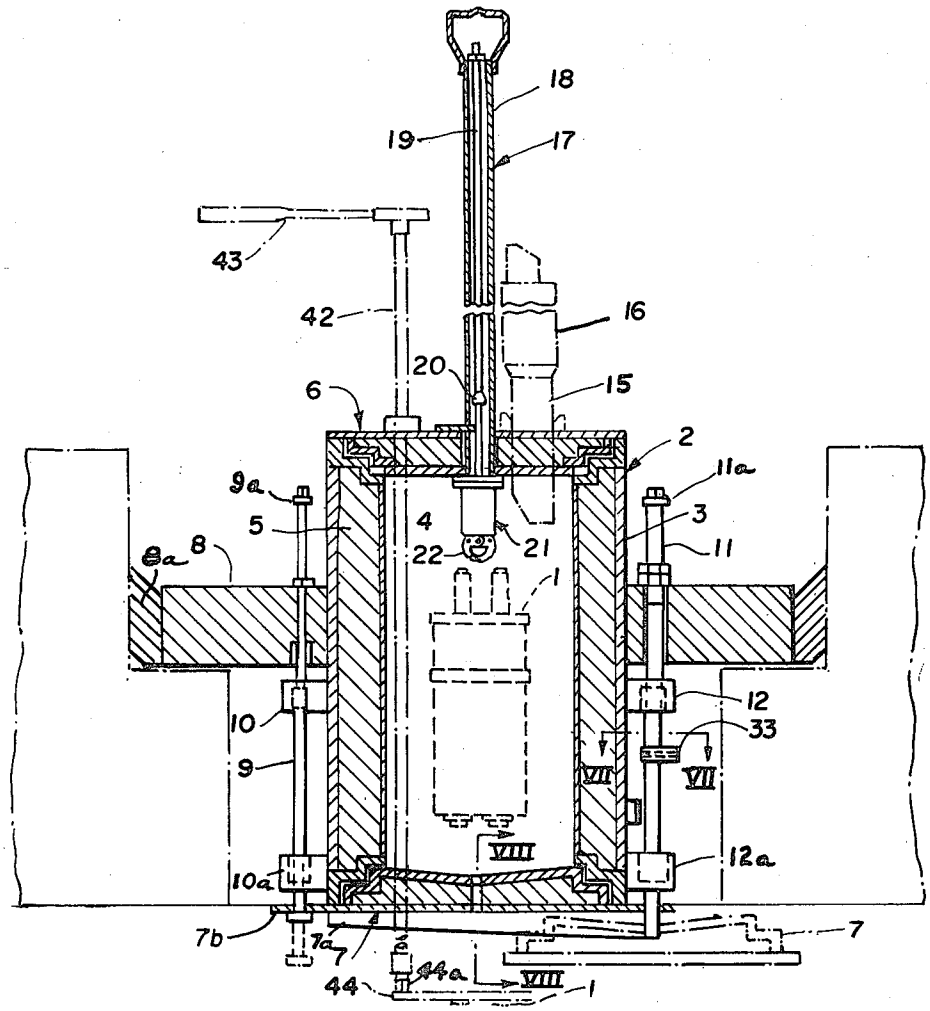


Fig.1

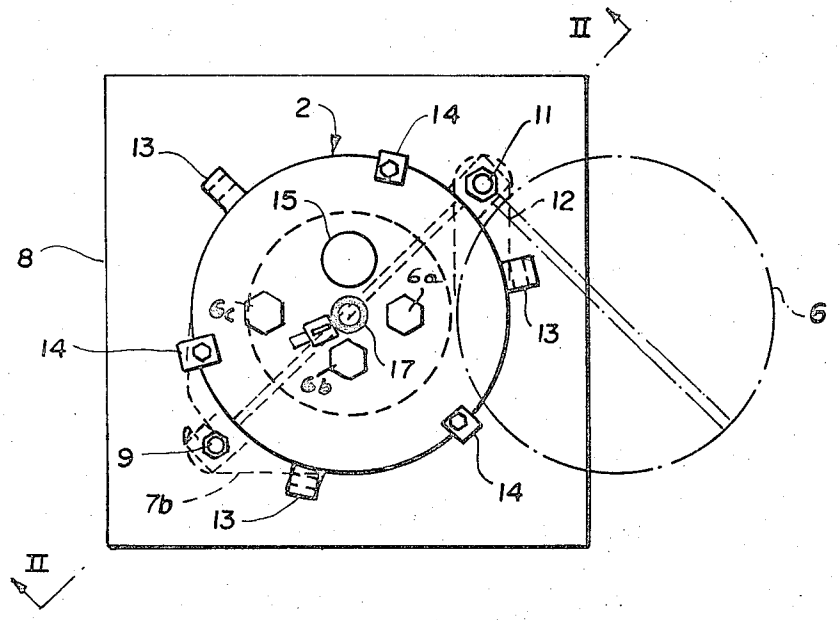
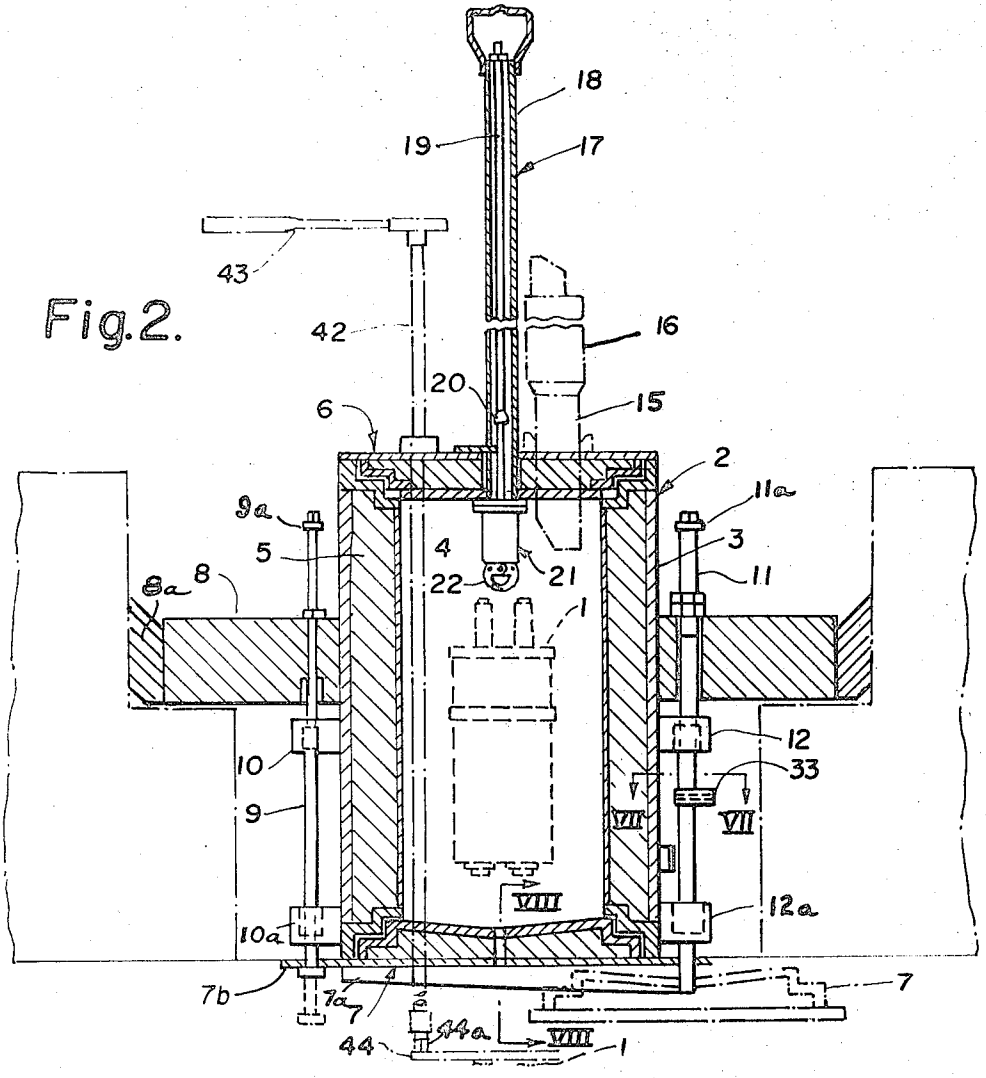

II
2
14
11
13
15
12
8
6a
6
6c
13
14
17
6b
9
14
7b
13
II

Fig.2.


18
19
17
43
42
16
20
15
6
2
11a
9a
3
5
4
21
11
8a
8
22
1
12
10
33
9
VII
VII
VIII
12a
10a
7b
7a
7
44a
VIII
44
1

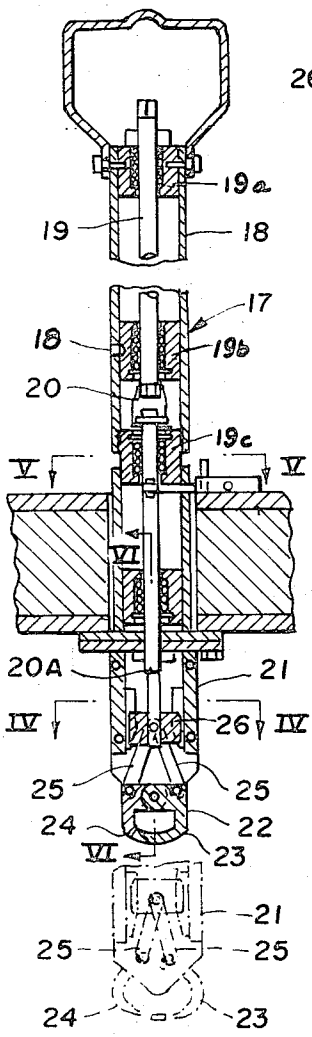



Fig.3.

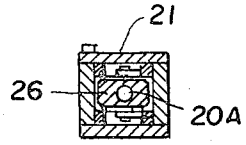



Fig.4.

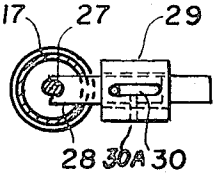



Fig.5.

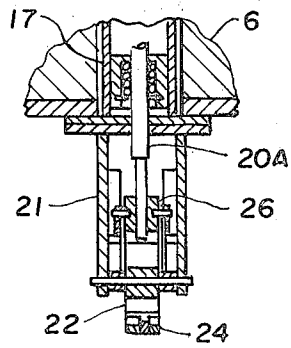



Fig.6.

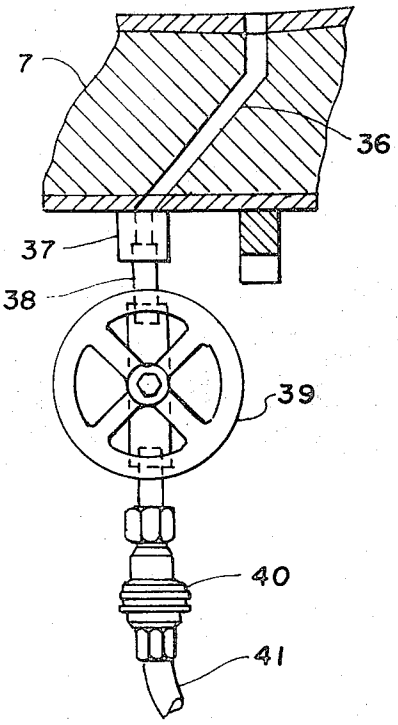



Fig.8.

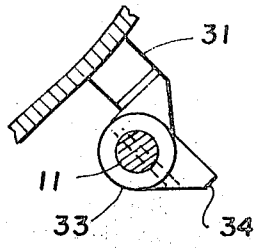



Fig.7.

# RADIOACTIVE WASTE FILTER REMOVAL SYSTEM

This invention relates to a radioactive waste removal system and, more particularly, to a radioactive shielding assembly for enabling safe removal of radioactive waste filter cartridges.

An outstanding disadvantage of presently used shielding systems for removing radioactive waste filter cartridges has been that they are not totally reliable in operation in assuring complete shielding at all stages of the removal process, also they involve complicated time consuming expensive procedures for performing the removal operation.

An object of the present invention is to provide a novel radioactive waste filter cartridge removal system that will overcome the above named disadvantages and which will be capable of removing and transporting, from the filter vessel to a drumming station, a plurality of radioactive (spent) filter cartridges, handling one filter cage assembly at a time, which cartridges will then be deposited in a suitable container for shipping.

Other objects and advantages will become more apparent from a study of the following description taken with the accompanying drawings wherein:

FIG. **1** is a top view and

FIG. **2** is a vertical, cross-sectional view taken along line II—II of FIG. **1** of a cask assembly used for removal of a radioactive waste filter cartridge **1** shown in dotted outline;

FIG. **3** is an enlarged, vertical, top cross-sectional view of the grappling tool assembly shown in FIG. **1**, — the dot and dash outline showing the grappling tool in open or expanded position;

FIG. **4** is a cross-sectional view taken along line IV—IV of FIG. **3**;

FIG. **5** is a top view of the locking mechanism and taken along line V—V of FIG. **3**;

FIG. **6** is an enlarged, cross-sectional view taken along line VI—VI of FIG. **3**;

FIG. **7** is an enlarged, fragmentary, cross-sectional view of a stop for the cask lid; and,

FIG. **8** is an enlarged, cross-sectional view of a drainage connection attachable to the bottom of the cask.

Referring more particularly to FIGS. **1** and **2** of the drawing, numeral **1** denotes a radioactive waste filter cartridge which has been spent from use in a nuclear power station. Numeral **2** denotes, generally, a radioactive shielding cask of such construction as to enable removal and shielding of the cartridge **1**.

In operation, a 5 ton monorail crane will remove the concrete hatch plug. The filter removal apparatus will be lowered into the open hatch by the crane where it will rest firmly on the access hatch ledge (see FIG. **2**). Shims **8***a* will have been previously installed (preferably welded in place) during plant construction, after the filters **1** have been installed, to guide the apparatus and assure proper alignment.

The top and bottom cask lids **6** and **7**, respectively, are stepped to prevent radiation streaming. They are preferably made of lead having a thickness exceeding 3 inches. All parts of the cask **2** which may come in contact with the filter cartridge **1** or its drippings are preferably made of stainless steel. Other parts of the cask and lids may be clad in carbon steel as mechanical strength requires. The support collar **8** is preferably



fabricated of carbon steel not less than about 6 inches thick.

The total access plugs **6***a*, **6***b*, **6***c*, are sized for the necessary socket sizes. A bushing for shielding is provided. A ratchet wrench **43** with extension **42** is preferably capable of operating at the following torques:

For ¾ inch bolt — 35 ft - lb

For ⅝ inch bolt — 120 ft-lb

For ⅞ inch bolt — 250 ft-lb

The lowering rod **11** and support gusset **7***a* are welded to the bottom cask lid **7**. All stresses do not exceed 18,000 psi.

The top cask lid **6** has mounted thereon three tool access plugs **6***a*, **6***b*, **6***c*, one grappling tool hole in the center, and a viewing apparatus **15**. In addition, rotatability is incorporated. Hold-down bolts are provided to serve the top lid **6** during movement of the cask.

The bottom cask lid **7** has remote lowering and raising capability as well as rotatability provided by two rod and nut assemblies **9** and **11** (one affixed). The bottom cask lid **7** is gasketed for leak-tight integrity. The viewing apparatus **15** provides the equivalent of 3.3 in. lead minimum. The viewer scan will cover the three different bolt locations and the filter centerline which will require approximately a 15° cone of view. A removable section **17** comprising extension rod **19** surrounded by shield **18** is provided.

The bottom cask lid **7** will be lowered by the two rod and nut assemblies **9** and **11** extending through support collar **8** and through ball bushings and retaining rings **10, 12, 10***a*, and **12***a*, all of which are welded to cask cover **3**. This will be accomplished with the use of a ratchet wrench and socket or equivalent.

When the bottom cask lid **7** has been lowered to a depth at which the top of the lid clears the filter cubicle ceiling (about 5 inches), it may be rotated up to about 90° about the axis of the affixed rod and nut lowering assembly **11** to the position shown in dot and dash lines in FIG. **2** such that the cylindrical cask **2** is completely open at the bottom. Hook portion **76** unhooks from rod **9** to permit such swing. A limit is imposed on the depth to which the bottom lid **7** may be lowered by the stop collars **9***a* and **11**a of the lowering rods.

The filter cover bolts **44***a* are loosened by a ratchet wrench **43** with a socket extension **42**. The top cask lid **6** provides the tool access to the filter cover bolts **44***a*. Tool access plugs **6***a*, **6***b*, and **6***c*, located in the top lid, preferably at 3 inch, 3 3/4 inch, and 5 3/4 inch radius about the centerline, allow access to the three different filter cover bolt patterns. Three evenly spaced lifting lugs **13** are welded onto the top lid **6**. The appropriate access plug is removed and the ratchet wrench extension **42** is inserted. Proper tool alignment is achieved by rotating the top cask lid **6** over each vessel head bolt and observing alignment with the viewing apparatus **15**.

After loosening of the filter cover bolts **44***a* has been completed, the ratchet wrench extension **42** will be withdrawn and the tool access plug **6***c* re-inserted in the cask lid. The filter cover bolts **44***a* will then be pushed away with the use of a rod inserted through the viewing port. The filter cover **44** may then be lifted aside remotely by a pulley line arrangement.

A grappling tool **21** with parts **23, 24, 25, 26** (see FIG. **3**) located in the center of the cask lid **6**, is provided for the lifting of the filter cartridge **1** into the main cask body **3, 5**. The upper section **17** is removable

and serves as an extension. It is attached (and removed) from the permanently installed lower section with a spanner wrench. The grappling tool **23, 24, 26, 26,** may be lowered manually to securely hook onto the filter cage assembly with its "ice tong" design. Use of a ratchet wrench on the hexagonal (top) end of shaft **19** will open or close the jaws **23, 24,** of grappling tool **21.** Three ball bushings and retaining ring assemblies **19***a*, **19***b* and **19***c* are provided, — also drill hole **18***a* for a spanner wrench, as well as a hexagonal shaped socket **20** to receive the hexagonal lower end of rod **19** enclosed by shield **18.**

When the filter **1** is securely hooked, it may be lifted into the main cask body as shown in dotted lines in FIG. **2.** The bottom cask lid **7** will then be closed securely by reversing the above described lowering procedure. The upper sections **16** and **17** of the viewing apparatus and grappling tool, respectively, may be removed. A locking mechanism (see FIG. **5**) is provided for the lower section of the grappling tool. It comprises a slide bolt or plate **28** with flat sections **27** fitting flat sections of the rod and being slidable by a pin and slot connection **30** and locked in place by a ball plunger **30**A. The top cask lid **6** is secured by tightening the hold-down bolts provided. The cask assembly will then be removed from the access hatch by the monorail crane.

A forklift or equivalent will be necessary for the transportation of the cask assembly to the drumming station. A portable stand will be provided in the drumming station for the transfer of the spent filter from the cask to a 55 gallon concrete-lined shipping drum. The drumming station crane will place the cask on the stand. Before filter transfer, the valve **39** extending below the bottom cask lid **7** will be opened to drain any drippings accumulated through the quick connect line **37, 38, 40, 41,** to the shipping drum or other suitable container. The filter is lowered into the drum with the grappling tool. The drum may be capped and secured manually, then transferred to the drum storage area by the drumming station crane.

The appropriate filter cubicle and the filter removal apparatus should be washed down after each use to eliminate any residual radioactive drippings. After washdown, a new filter cartridge may be installed directly.

Thus it will be seen that I have provided a highly reliable and efficient radioactive waste filter removal system for safely shielding spent filter cartridges while removing and transporting from the filter vessel to the drumming station; moreover, I have provided a novel and efficient cask assembly for handling a cartridge in a safe and reliable manner.

I claim:

**1.** A cask for shielding radioactive waste filter cartridges comprising a cylindrical container with open ends and having removable circular top and bottom lids for detachably covering said open ends, a support collar integrally secured to the outer wall of said cylindrical container, a lowering rod mounted on said support collar for effecting lowering of said bottom lid and pivotal movement of said bottom lid about the axis of said lowering rod, whereby the bottom lid may be moved aside from the lower opening of said cask to permit vertical lowering therethrough of the radioactive waste filter cartridge.

**2.** A cask as recited in claim **1** together with a grappling tool mounted on and extending through said top lid and including a vertical rod, the turning of which in one direction or in an opposite direction will effect opening and closing movements of the grappling tool.

**3.** A cask as recited in claim **1** together with a second lowering rod mounted on said support collar diametrically opposite said first mentioned lowering rod for detachably supporting a hook shaped extension from said bottom lid which is adapted to hook about said second lowering rod to permit detachment and lateral swinging movement of said bottom lid about the axis of said first mentioned lowering rod.

**4.** A cask as recited in claim **1** together with a plurality of plugs at different radii on said top lid through which an extension for a wrench may be inserted and projected throughout the entire height and beyond the lower end of said cask to permit unscrewing of bolts on the cartridge when located below the cask.

**5.** A cask as recited in claim **1** together with a viewing apparatus mounted in said top lid to permit viewing of the interior of said cask.

**6.** A cask as recited in claim **2** wherein said grappling tool is provided with an elongated removable extension projecting upwardly from said top cask lid, and a shield enclosing said removable extension.

**7.** A cask as recited in claim **1** together with a second support rod diametrically opposite said first-mentioned support rod and extending vertically through said support collar, a plurality of vertically disposed ball bushings and retaining rings for mounting said rods and which are attached to diametrical opposite outer surface portions of said cask, the said first-mentioned support rod having its lower end welded to said bottom lid so that rotation thereof about its axis will swing said bottom lid away from the lower opening of said cask.

**8.** A cask as recited in claim **1** together with a base having a circular shoulder for supporting said support collar, and shim means surrounding said support collar and supported by said shoulder.

* * * * *