United States Patent

Wapner et al.

[15] **3,664,003**

[45] **May 23, 1972**

[54] APPARATUS FOR INSERTING FILTER ELEMENTS INTO A TANK

[72] Inventors: **Stanley H. Wapner,** New York, N.Y.; **Alfonse J. Soriente,** Gillette, N.J.

[73] Assignee: **Ecodyne Corporation,** Chicago, Ill.

[22] Filed: **Nov. 12, 1970**

[21] Appl. No.: **88,602**

[52] **U.S. Cl.** .....**29/200 R,** 29/227

[51] **Int. Cl.** **B23p 19/00,** B23p 19/04

[58] **Field of Search** .....29/200 R, 227, 280, 215

[56] **References Cited**

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917,802	4/1909	Schneider	30/124
1,858,372	5/1932	McNaught et al.	29/215
3,242,560	3/1966	Mitchell	29/203 H
3,495,320	2/1970	Wapner et al.	29/427

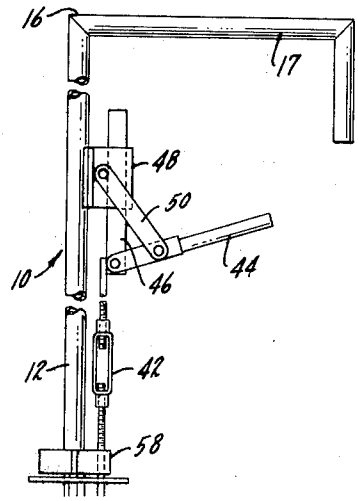
Primary Examiner—Thomas H. Eager

Attorney—Charles M. Kaplan

[57] **ABSTRACT**

An improved apparatus for inserting filter elements into a tank designed for use with a particular type of filter element. The apparatus has an elongated rod portion having first and second ends and element support means outwardly disposed from the first end. Element spring compressing means are positioned above the support means and mounted for movement in a direction generally parallel to the rod portion. Control means are provided adjacent to the second end of the rod portion for controlling the movement of the spring compressing means.

8 Claims, 10 Drawing Figures



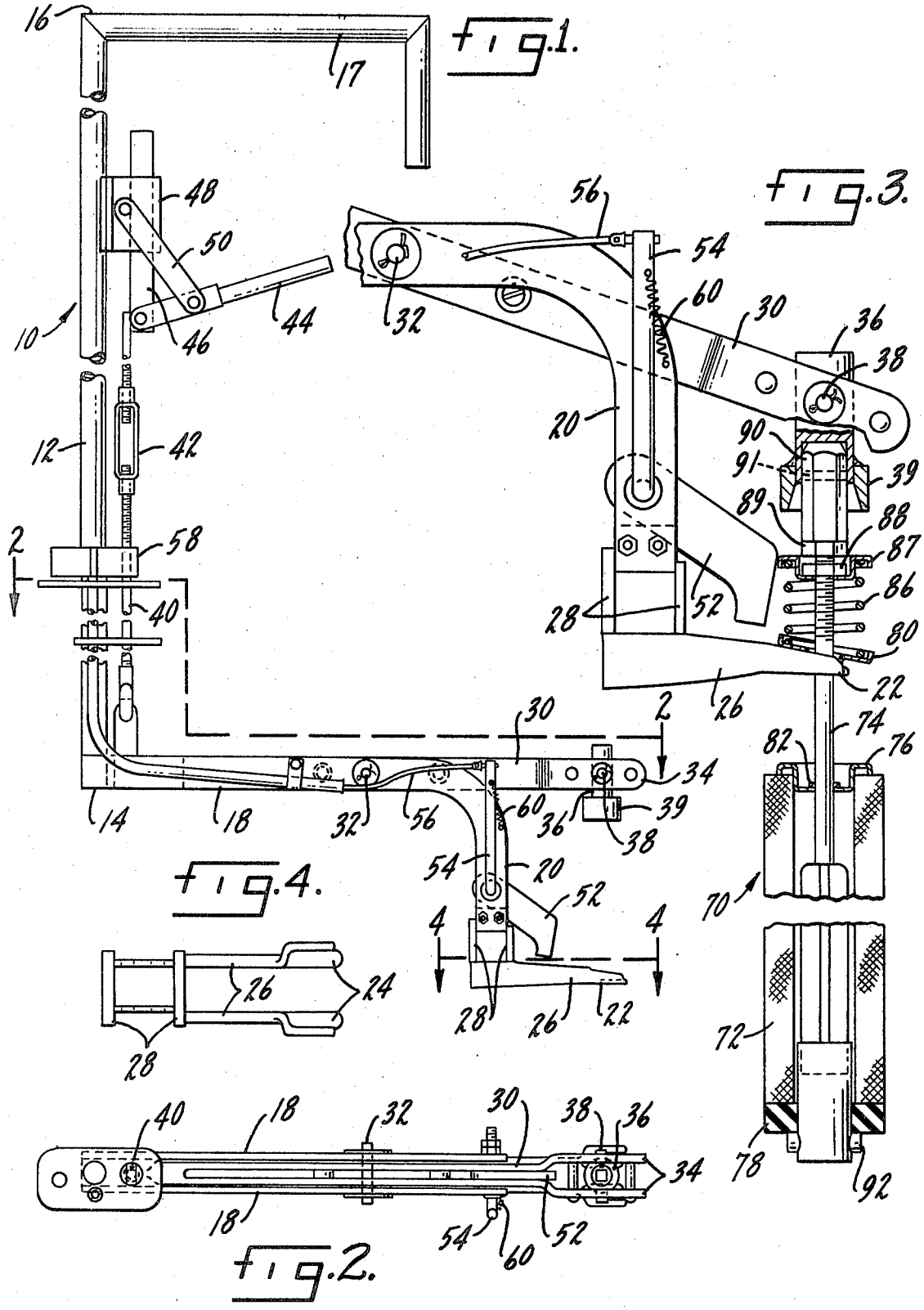


Fig. 1.

Fig. 3.

Fig. 4.

Fig. 2.

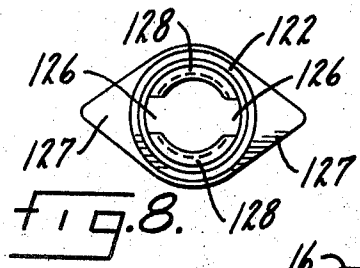


Fig. 8.

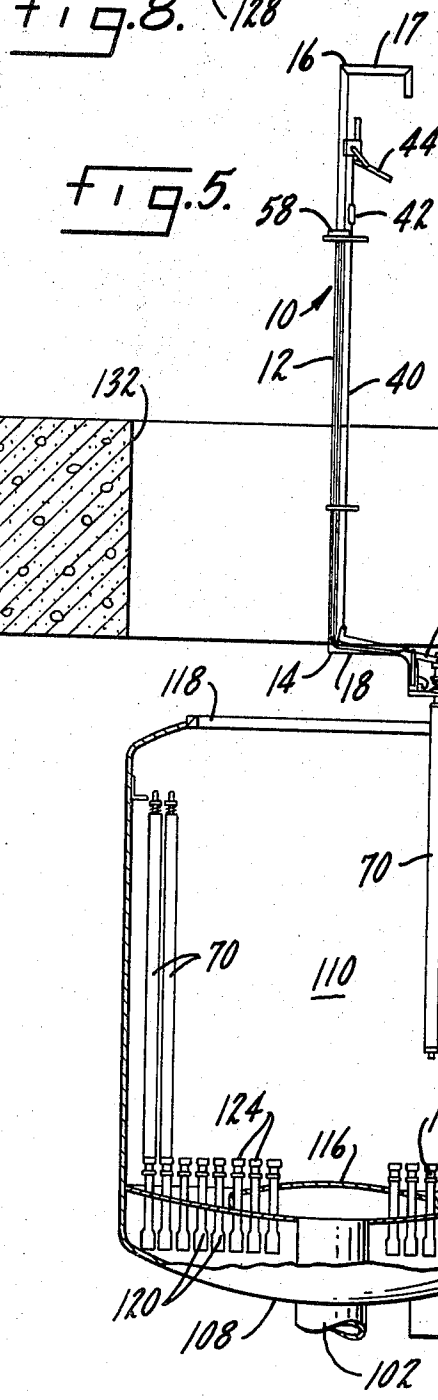


Fig. 5.

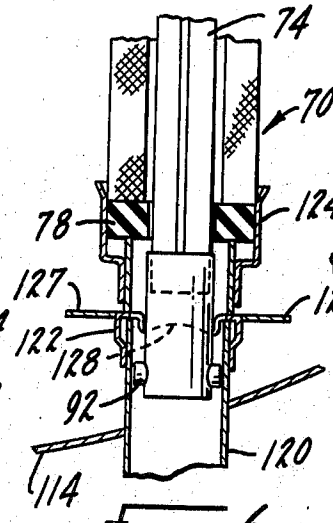


Fig. 6.

Fig. 7.

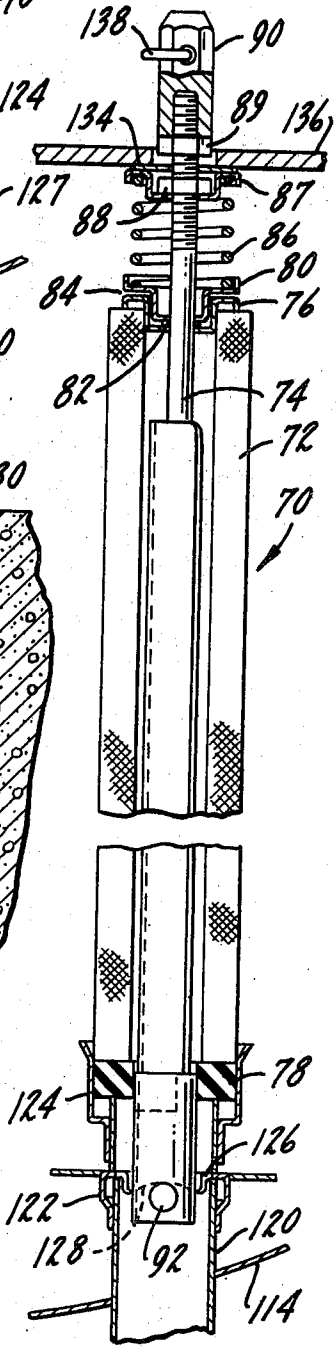


FIG. 10.

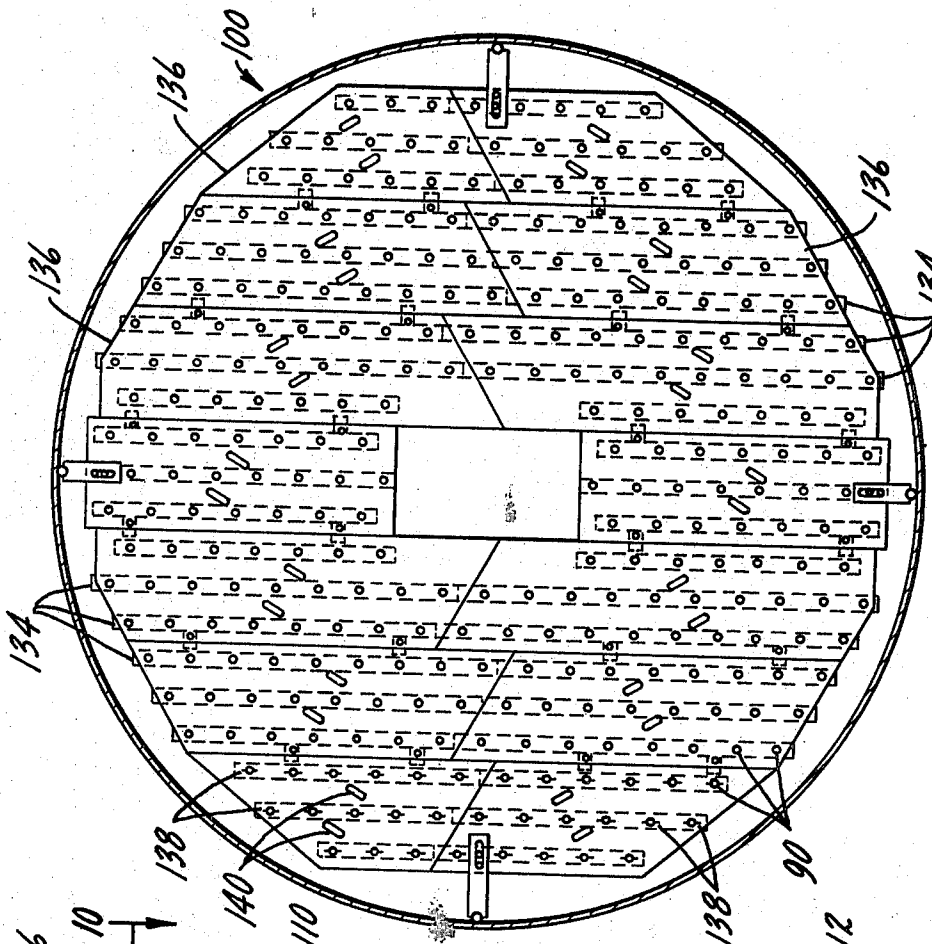
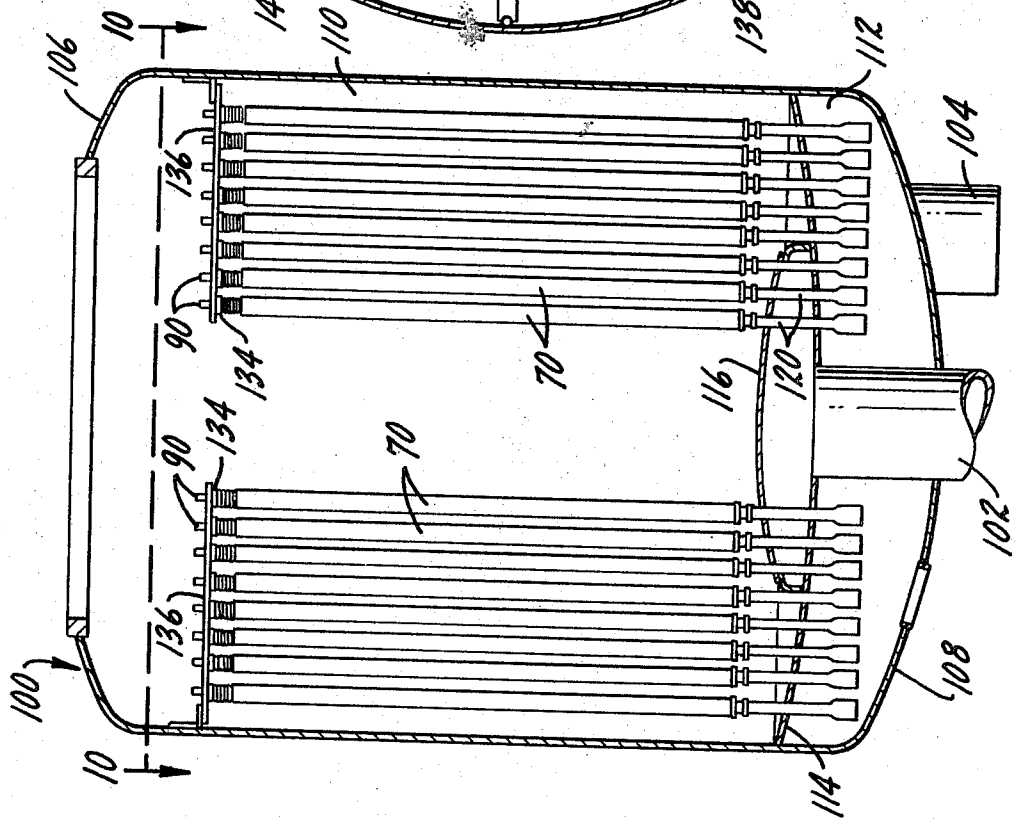

100
136
136
136
134
134
138
140
138
90

FIG. 9.


10
106
110
112
104
136
90
134
70
116
120
134
90
70
136
102
100
108
10
114

APPARATUS FOR INSERTING FILTER ELEMENTS INTO A TANK

The present invention relates to an improved apparatus for inserting a filter element into a tank.

Filter tanks having replaceable filter cartridges are well known in the art. An exemplary filter tank with filter cartridges is described in Soriente et al., U.S. Pat. No. 3,279,608, issued Oct. 18, 1966, and assigned to the assignee of the present application. When filter cartridges have heretofore been installed it was usually necessary for personnel to reach into or enter the filter tank in order to handle them. Ordinarily this is not hazardous, but when the apparatus is used to filter substances containing toxic and/or radioactive substances, it is dangerous for personnel to enter the tank or to be in close proximity to the interior of the tank for extended periods of time. In such instances, the operating personnel must have means for installation of filter cartridges from a point outside the tank. Even in instances when toxic or radioactive materials are not involved, it would be a great convenience to have a tool that enabled filter cartridges to be installed without any requirement for entering the tank.

A typical tool that has heretofore been developed in an effort to solve this problem is described in Wapner et al., U.S. Pat. No. 3,495,320, issued Feb. 17, 1970, and assigned to the assignee of this application. However such apparatus had numerous disadvantages, and it was awkward to handle filter cartridges with them. Furthermore, this apparatus was not well adapted to handle cartridges of the current design, as described herein.

Generally, the present invention provides an improved apparatus for inserting filter elements into a tank. Generally, the apparatus comprises an elongated rod portion having first and second ends. Support means are outwardly disposed from the rod portion adjacent to the first end, and element spring compressing means are positioned above the support means and mounted for movement in a direction generally parallel to the rod portion. Control means are provided adjacent to the second end of the rod portion for controlling the movement of the spring compressing means.

The invention, its construction and method of operation, together with the objects of advantages thereof, will be best understood by reference to the following detailed description, taken in conjunction with the drawings, in which:

FIG. 1 is a side elevation view of an apparatus constructed in accordance with the present invention;

FIG. 2 is a partial plan view taken along line 2—2 of FIG. 1;

FIG. 3 is a plan view, partially in section, showing a portion of the apparatus shown in FIG. 1 in engagement with a filter cartridge;

FIG. 4 is a partial plan view taken along line 4—4 of FIG. 1;

FIG. 5 is an elevation view, cut away to show the use of the apparatus of the present invention to insert a filter element into a filter tank;

FIG. 6 is a partial cross-sectional view showing the insertion of a filter element into element seat means within a filter tank;

FIG. 7 is a cross-sectional view showing a filter element in engagement with the seat means;

FIG. 8 is a plan view of a cartridge receiving adapter, which forms a part of the element seat means;

FIG. 9 is a diagrammatic view showing filter elements mounted within a filter tank; and

FIG. 10 is a cross-sectional view taken along line 10—10 of FIG. 9.

Referring to FIG. 1, a filter element insertion apparatus constructed according to the present invention is generally indicated by reference numeral 10. The insertion apparatus 10 has an elongated rod portion 12 having a lower or first end 14 and a second end 16. A handle 17 is affixed to the second end 16.

A pair of parallel, generally L-shaped element support bars 18 extend outwardly from the first end 14 of the elongated rod portion 12. The element support bars 18 each have a downwardly extending portion 20. The downwardly extending portions 20 have an outwardly extending support bracket 22 mounted thereon. Referring to FIGS. 1 and 4, the support bracket 22 has a pair of outwardly extending fingers 24, each of which has a wedge-shaped side portions 26. The support bracket 22 carries a pair of mounting bars 28 which mount the support bracket 22 to the downwardly extending portions 20 of the filter element support bars 18.

A spring compressing bar 30 is mounted between the element support bars 18 by means of a shaft 32, as best shown in FIG. 2. This shaft 32 permits rotation of the spring compression bar 30 in a plane parallel to the elongated rod 12. The spring compression bar 30 has a fork-shaped end portion 34 which is above the support bracket 22.

The end portion 34 carries a socket 36 mounted on a shaft 38 for rotation in the same plane as the spring compression bar 30. As hereinafter described, the socket 36 is adapted to fit over the top of the central guide rod of a filter element. As shown in the drawings, the socket 36 is positioned over the support bracket 22. The socket 36 has a lower guide portion 39, which has a tapered inner surface as shown in FIG. 3. This tapered inner surface aids in guiding the end of an element guide rod into the socket 36 as hereinafter described.

The spring compressing bar 30 has control means, which in this instance include a control rod 40 connected to the end of the spring compression bar 30 adjacent to the elongated rod portion 12. The control rod 40 has a turn buckle 42 for adjusting the length thereof. The upper end of the control rod 40 is connected to a lever 44, which is capable of moving the control rod 40 parallel to the elongated rod portion 12. In this instance, the same end portion of the lever 44 that is connected to the control rod 40 is also connected to a slidable shaft 46 which slides in a sleeve member 48 parallel to the elongated rod portion 12. A central portion of the lever 44 is journalled to a movable arm 50, the opposite end of which is journalled to the sleeve member 48. By this design, the lever 44 will be locked in position when pushed to its downwardmost limit of travel, so that an operator need not retain pressure on the lever 44 to maintain the spring compressing bar 30 in the compressing position while inserting an element into a tank as hereinafter described.

As shown in FIG. 1, the apparatus of the present invention also includes element release means, in this instance, an element release bar 52 which is mounted adjacent to the support bracket 22 for rotation so that an end portion of the release bar 52 can contact an element to push it away from the support bracket 22. This rotation is accomplished by means of a rotation lever 54 connected to the element release bar 52. The end of the rotation lever 54 opposite the element release bar 52 is connected to a cable 56. The opposite end of the cable 56 is connected to a release handle 58 on the elongated rod portion 12. As can be seen from FIG. 1, when the release handle 58 is pulled upwardly the element release bar 52 will be caused to rotate, and will push a filter element out of engagement with the support bracket 22. When the release handle 58 is released, the element release bar will return to its original position under the influence of a spring 60.

In order to fully understand the operation of the apparatus of the present invention, it is important to have some understanding of the filter cartridges of the type for which its use is primarily contemplated. Such a filter cartridge is shown installed in its seat means within a filter tank in FIG. 7. The filter cartridge, which is indicated generally by reference numeral 70, has an annular filter portion 72 with a central guide rod 74 mounted therein for sliding movement parallel to the axis of the filter portion 72. The filter portion 72 may be made of stainless steel wrapped with a filtering material, such as nylon or the like, and has an upper seat plate 76 with a central opening therein for the guide rod 74. The lower end of the filter portion 72 has a gasket 78, also having a central opening for the guide rod 74.

At the upper end of the filter cartridge 70, an annular spring seat 80 having a central opening therein for the guide rod 74 is positioned above the seat plate 76. The seat plate 76 and

spring seat **80** are separated by an elastomeric O-ring **82** so that an annular gap **84** is formed between the seat plate **76** and spring seat **80**. A spring **86** is positioned around the guide rod **74**, and is seated in the spring seat **80**. The top of the spring **86** is seated in an annular top cap **87**. The top cap **87** has a nut **88** welded thereto at the central opening, so that the top cap **88** may simply be screwed onto the upper, threaded end of the guide rod **74**. In the embodiment shown, a lock nut **89** and an extension nut **90**, having transverse aperture **91**, are screwed onto the top of the guide rod **74**. The lock nut **89** is employed to lock the extension nut **90** in position.

As best shown in FIG. **6**, the bottom of the guide rod **74** has a transverse pin **92**, which aids in seating the element **70** in the element seat means as hereinafter described. The pin **92** also prevents the guide rod **74** from sliding upwardly through the gasket **78** at the bottom of the element **70**. The extension nut **90** is preferably locked in position with the transverse aperture **91** parallel to the pin **92**.

The apparatus shown in FIG. **1** is illustrated in an intermediate position. That is, in its released position, the spring compression bar will be tilted so that the end portion **34** is farther away from the support bracket **22** than is shown in FIG. **1**. Similarly, when the spring compression bar **30** is in its compression position, the end portion **34** will be displaced downwardly from the position shown in FIG. **1**.

As can be seen from the foregoing description and from the drawings, the end portion **34** of the spring compressing bar **30** moves in an arcuate fashion between its released and compression positions. This arc has been described herein as "-generally parallel" to the elongated rod portion **12**. Of course, modifications of the apparatus **10** will occur to those skilled in the art in which the spring compressing means move in a linear fashion parallel to the rod portion **10**.

To operate the apparatus of the present invention, the lever **44** is first moved upwardly as far as possible. This operation moves the control rod **40** downwardly so that the end portion **34** of the spring compression bar **30** is in its fully raised or released position. The support bracket **22** is then wedged into the gap **84** between the seat plate **76** and the spring seat **80**. The wedge-shaped side portions **26** wedge the spring seat **80** and seat plate **76** apart, slightly compressing the spring **86**. The guide rod **74** passes between the fingers **24**. The apparatus **10** is properly positioned on the filter cartridge **70** when the socket **36** is above the end of the guide rod **74**, which in this instance is capped with an extension nut **90**. At this time, the lever **44** is moved downwardly raising the control rod **40**, thereby lowering the end portion **34** of the spring compressing bar **30** so that the socket **36** engages the extension nut **90** on the end of the guide rod **74**. As the lever **44** is moved further, the spring **86** is compressed, and the spring seat plate **80** is moved toward the top cap **87**, enlarging the gap **84**. This fully compressed position is shown in FIG. **3**. As can be seen from FIG. **3**, the annular filter portion **72** of the cartridge **70** is prevented from sliding off the guide rod **74** by the transverse pin **92** at the bottom of the guide rod **74**. In the position shown in FIG. **3**, the element is ready to be placed into a filter tank.

Referring to FIG. **5**, a typical tank for use in the present invention is generally indicated by reference numeral **100**. This tank **100** is adapted to receive an influent stream, filter the stream, and discharge the filtrate of effluent stream. To these ends, the filter tank **100** has an inlet or influent line **102** and an outlet or filtrate line **104**. The filter tank **100** is a generally cylindrical vessel made of steel or the like having an outwardly convex top **106** and an outwardly convex bottom **108**. The tank **100** is divided into an influent zone **110** and a filtrate zone **112** by a downwardly convex tube sheet plate **114** suitably secured to the interior of the tank **100** by welding or the like. The influent line **102** extends through the bottom **108** of the tank **100** and communicates with the influent zone **110** so that all of the influent stream is passed directly to the influent zone **110**. The influent pipe **102** is attached to the tube sheet plate **114** by welding or the like. In this manner, direct communication between the influent zone **110** and the filtrate zone **112** is precluded. The stream from the influent line **102** is dispersed as it enters the influent zone **110** by a distributor plate **116**.

Mounted within the influent zone **110** are a plurality of filter cartridges **70** as shown in FIG. **9**. The influent stream must pass through these cartridges before entering the filtrate zone **112** and being discharged from the tank **100** through the effluent line **104**. A filter cartridge **70** is placed into and removed from the filter tank **100** through a manhole opening **118** in the filter tank **100**. The manhole opening **118** has a cover means (not shown) which may be removed to provide access to the interior of the filter tank **100**.

Referring to FIGS. **7** and **9**, the tube sheet plate **114** has attached thereto a cartridge seat means **120** for each filter cartridge **70** in the filter tank **100**. Each cartridge seat means **120** comprises a small pipe made of steel or the like which extends through a hole in the tube sheet plate **114** and is attached to the tube sheet plate **114** by welding or other suitable means. The cartridge seat means **120** is substantially parallel to the longitudinal axis of the filter tank **100**, and connects the influent zone **110** with the filtrate zone **112**.

Each cartridge seat means **120** includes a slotted cartridge receiving adapter **122** having a positioning shield **124** mounted thereon. As shown in FIG. **8**, the slotted adapter **122** has a pair of opposed slots **126** which receive the pin **92** on the bottom of the guide rod **74**. The slotted adapter **122** also has a pointer **127** projecting outwardly from each side thereof. The pointers **127** are aligned with the slots **126**, and aid in mounting a cartridge **70** therein, as hereinafter described. As shown in FIGS. **6** and **7**, the slotted adapter **122** has upwardly arcuate portions **128**. As shown in FIG. **6**, when the cartridge **70** is positioned in the seat means **120**, it is lowered so that the pin **92** at the bottom of the guide rod **74** passes through the slot **126**. The guide rod **74** is then turned 90° to the position shown in FIG. **7**. The spring **86** is then released, as hereinafter described, so that the pin **92** contacts the underside of the arcuate portions **128** to retain the cartridge **70** in position.

In operation, the filter element insertion apparatus **10** of the present invention is first placed into engagement with a filter cartridge **70** in the manner previously described. That is, referring to FIGS. **1** and **7**, the support bracket **22** is wedged between the element spring seat **80** and seat plate **76**. The lever **44** is then moved downwardly so that the socket **36** engages the extension nut **90**, and the spring **86** is compressed, as shown in FIG. **3**.

FIG. **5** shows a typical nuclear installation wherein the filter tank **100** is surrounded by a concrete radiation shield **130** having an opening **132** above the tank **100**. An operator stands on the shield **130** and lowers the filter element **70** into the tank **100** through the manhole opening **118** as shown in FIG. **5**. Before lowering the filter element **70** into the positioning shield **122**, the cartridge is rotated so that the pin **92** is aligned with the pointers **127**, and will be in position to drop through the slots **126**. The filter element **70** is then lowered into position until its lower end is fitted within a positioning shield **122**, as shown in FIG. **6**. The passage of the pin **92** through the slots **126** is easily detected because the guide rod **74** is felt to move downwardly. The insertion apparatus **10** is then rotated 90° to position the pin **92** under the arcuate portions **128** of the receiving adapter **124**, as shown in FIG. **7**. The lever **44** is then moved upwardly, so that the socket **36** is raised out of contact with the extension nut **90**, releasing the spring **86**. The spring now retains the pin **92** in contact with the arcuate lower surfaces **128**. In order to be sure that the cartridge **70** is properly seated, it is advantageous to pull upwardly on the insertion apparatus **10** at this point. If there is resistance to this pulling, the cartridge is properly seated.

After seating the cartridge, the operator pulls the release handle **58**, rotating the element release bar **52** so that the cartridge **70** is moved away from the support bracket **22**. Upon release of the handle **58**, the element release bar **52** returns to its original position, under the influence of the spring **60**.

The foregoing operation is repeated until a number of elements in a row have been installed. As shown in FIG. **10**, at this point an element spacing bar **134**, having a plurality of spaced apertures, is positioned over the extension nuts **90** of a row of elements, so that they are properly positioned with respect to one another. After a group of filter elements **70** has been so installed, an apertured cover plate **136** is placed over the ends of the elements **70** in the group above the element spacing bars **134**. This procedure is repeated until all of the elements **70** have been installed in the tank **100**.

Referring to FIG. **7**, after the apertured cover plates **136** have been installed, a removable pin **138** is located in the nut **90** through the transverse aperture **91**. These removable pins **138** prevent the apertured cover plates from being lifted off the elements **70**. Furthermore, these apertured cover plates, which have lifting eyes **140**, permit the remote removal of groups of elements from a position outside the tank. Such remote removal is accomplished by simply rotating each of the extension nuts **90** ninety degrees with a wrench, thus unseating the elements from the seat means **120**. Groups of elements are then lifted out of the tank by means of the lifting eyes **140**.

As will be appreciated by those skilled in the art, the apparatus of the present invention may be used in conjunction with filter elements and/or seating means having a design that differs from the design shown in the drawings. Exemplary filter elements and seating means having a different design are shown and described in U.S. Pat. Nos. 3,279,608 and 3,405,807, which are assigned to the assignee of this application. Some of the filter elements and seating means shown in these patents require tilting of the elements, rather than rotation, to accomplish the seating and unseating operations.

Obviously, many modifications and variations of the invention as hereinbefore set forth will occur to those skilled in the art, and it is intended to cover in the appended claims all such modifications and variations as fall within the true spirit and scope of the invention.

I claim:

1. Improved apparatus for inserting filter elements into a tank comprising: an elongated rod portion having first and second ends; support means outwardly disposed from said rod portion adjacent said first end; element spring compressing means positioned above said support means mounted for movement generally parallel to said rod portion; and control means adjacent to said second end for controlling the movement of said spring compressing means.

2. The apparatus as defined in claim 1 further comprising element release means adjacent to said support means for pushing said filter elements away from said support means.

3. The apparatus as defined in claim 1 further comprising a handle on said second end of said rod portion.

4. The apparatus as defined in claim 1 wherein said element spring compressing means include a socket adapted to fit over the top of a central guide rod of said filter element.

5. The apparatus as defined in claim 1 wherein said control means include locking means for retaining said spring compressing means in a spring compressing position.

6. Improved apparatus for inserting filter elements into a tank comprising: an elongated rod having first and second ends; a support bar extending outwardly from said first end; an outwardly extending support bracket mounted on the end of said support bar; a spring compressing bar mounted on said support bar for rotation about a central portion of said spring compressing bar in a plane parallel to said elongated rod, said spring compressing bar having an end portion above said support bracket; a socket in said end portion adapted to fit over the top of the central guide rod of said filter element, said socket being mounted for rotation in the same plane as said spring compressing bar; and control means for rotating said spring compressing bar so that said end portion describes an arc above said support bracket generally parallel to said elongated rod.

7. The apparatus as defined in claim 6 further comprising an element release bar mounted adjacent to said support bracket for rotation so that an end of said release bar contacts said filter element to push said element away from said support bracket.

8. The apparatus as defined in claim 7 wherein said support bracket has a generally wedge-shaped portion.

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