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[54] EASILY-CLEANABLE FILTERS

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U.S. Applications:

[63] Continuation of Ser. No. 148,211, Jan. 25, 1988, abandoned.

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[5] **B01D 29/46**

[52] **U.S. Cl.** **210/108**; 210/411; 210/414; 210/488

[58] **Field of Search** 210/108, 333.01, 333.1, 210/355, 393, 408, 411, 412, 413, 414, 415, 425, 426, 427, 488

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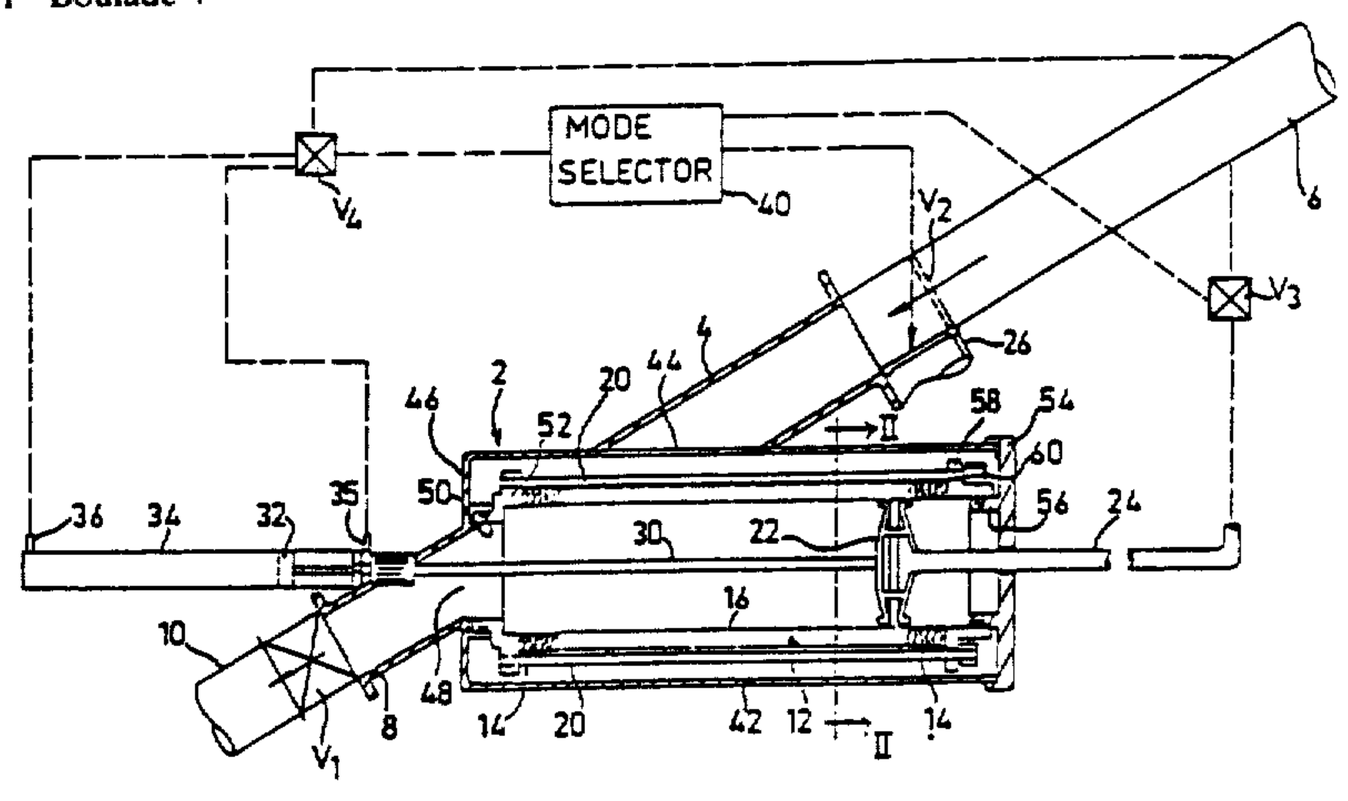
[57] **ABSTRACT**

A filter including a plurality of filter discs each formed with a central opening and disposed in a stack within a filter housing with the side faces of adjacent discs contacting each other for filtering the fluid flowing through the housing from its inlet to its outlet, the filter discs being maintained in a stack by a plurality of axially-extending rods arranged in a circular array around the outer faces of the discs and circumferentially spaced from each other to permit the filter disc stack to be cleaned by passing a cleaning nozzle through the central openings of the filter discs in the stack.

17 Claims, 2 Drawing Sheets



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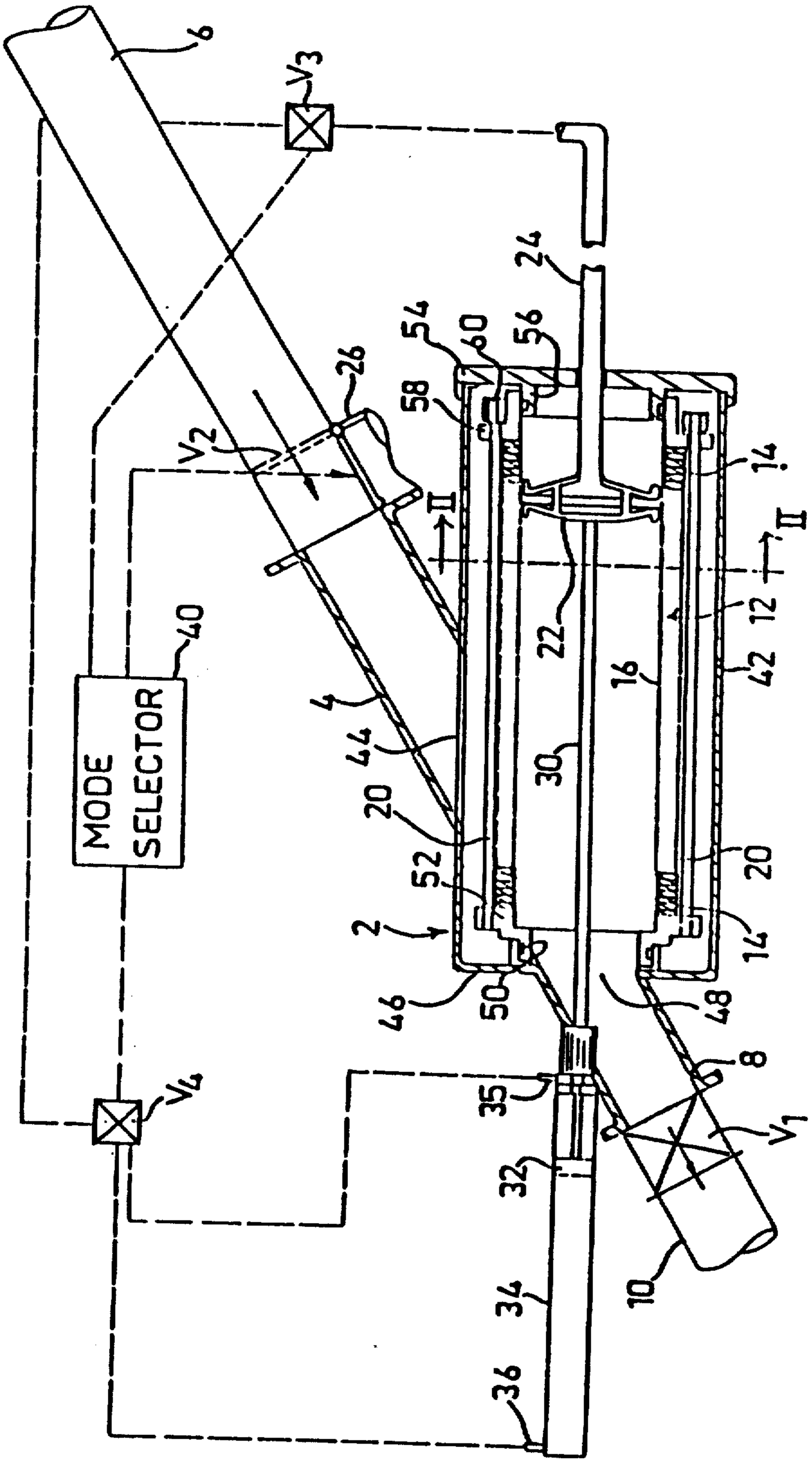
6
V3
24
54
60
56
58
26
V2
II
14
II
22
12
42
16
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4
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20
30
MODE SELECTOR
52
20
2
14
46
50
48
8
V4
35
V1
32
10
34
36

FIG 1

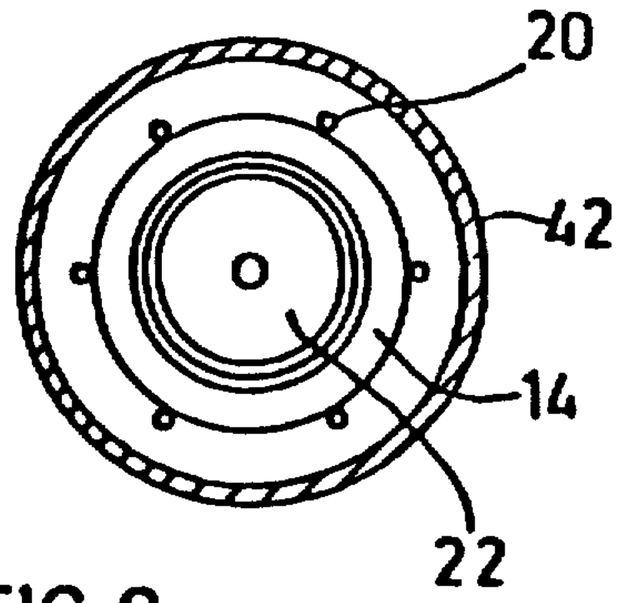

FIG 2

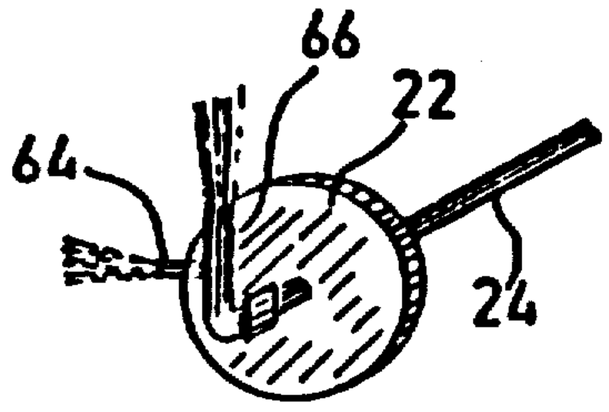

FIG 3

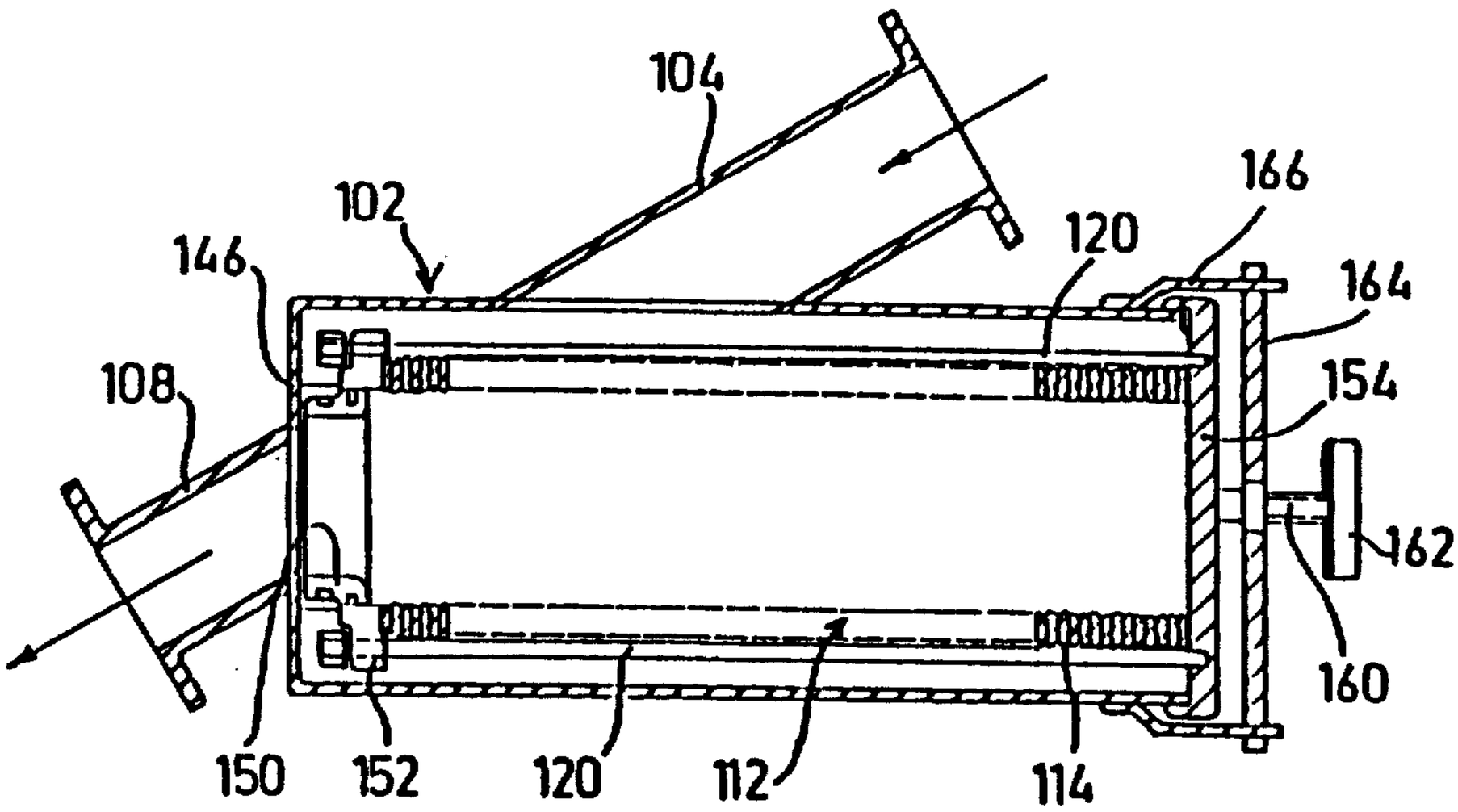

FIG 4

EASILY-CLEANABLE FILTERS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This application is a continuation of application Ser. No. 07/148,211, filed Jan. 25, 1988 now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to easily cleanable filters, and particularly to filters of the multiple disc type.

The multiple-disc type filter is now widely used in a number of different applications for filtering fluids, particularly for removing dirt particles in water irrigation systems. Briefly, this type filter includes a plurality of filter discs disposed in a stack within the filter housing, with the side faces of adjacent discs being ribbed and contacting each other to provide a large number of narrow passages for filtering the fluid flowing through the stack of discs in the radial direction. Cleaning the filter may be done manually by opening the filter housing and rinsing the discs with a water spray or automatically by including a backwash nozzle which is automatically made operative by a differential-pressure device sensing the pressure drop across the stack of filter discs.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a multiple-disc type filter having an improved construction which better facilitates cleaning the filter, particularly when the filter is automatically cleaned by a backwash nozzle.

According to a broad aspect of the present invention, there is provided a filter including a housing having an inlet and an outlet, and a plurality of filter discs each formed with a central opening and all disposed in a stack within the housing with the side faces of adjacent discs contacting each other for filtering the fluid flowing through the housing from its inlet to its outlet; characterized in that the filter discs are maintained in a stack by a plurality of axially-extending rods arranged in a circular array around the outer faces of the discs and circumferentially spaced from each other to permit the filter disc stack to be cleaned by passing a cleaning nozzle through the central openings of the filter discs in the stack.

Further features and advantages of the invention will be apparent from the description below.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. **1** illustrates one form of filter constructed in accordance with the present invention;

FIG. **2** is a transverse section along the lines II—II of FIG. **1**;

FIG. **3** illustrates one form of cleaning nozzle which may be used in the filter of FIG. **1**; and

FIG. **4** illustrates another type of multiple-disc filter constructed in accordance with the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

The filter illustrated in FIG. **1** comprises a housing **2** including an inlet **4** connectable to an upstream supply pipe **6** for the pressurized water (or other fluid) to be filtered, and an outlet **8** connectable to the downstream pipe **10** for the filtered water. Disposed within housing **2** is the filter body **12** in the form of a stack of circular filter discs **14**, each of which discs is formed with a central opening **16**. As noted earlier, such filter discs include ribbed side faces which contact each other to provide a [larger] *large* number of narrow passages for filtering the water as it flows radially inwardly from the inlet **4** to the outlet **8**, the edges of the large central openings **16** of the discs constituting the inner or downstream face of the filter body. Since such filter discs are now well-known further details of their construction are not deemed necessary.

In the usual construction, however, the filter discs **14** are supported at their [control] *central* openings **16** by a pipe or cage, with the outer or upstream faces of the discs presenting a relatively smooth surface. Such a construction is particularly used in the self-cleaning type filters which include a cleaning nozzle since the cleaning nozzle is usually located very close to the other faces of the filter discs in order to more effectively draw out by suction the dirt particles accumulating on the outer faces of the discs.

In the present invention, however, the filter discs **14** are secured in the form of the stack by a plurality of rods **20** arranged in a circular array around the outer faces of the discs and extending axially through the filter housing **2**. These rods **20** are circumferentially spaced from each other to permit the discs to be cleaned by passing a cleaning nozzle **22** through the central openings of the discs **14** in the stack **12**. Thus, the stack **12** of discs presents an inner cylindrical surface which is substantially smooth and uninterrupted for accommodating the cleaning nozzle **22** and permitting it to be moved axially through the stack very close to the inner surfaces of the discs.

Cleaning nozzle **22** is not of the conventional suction type which draws out the dirt particles by suction, but rather is of a pressurized type which blows out the filter particles from between the filter discs. The cleaning nozzle is thus connected by a pipe **24** to the supply pipe **6** for feeding to the nozzle the same fluid, namely water, which is filtered by the filter body **12**. Pipe **24** connecting nozzle **22** to the upstream supply pipe **6** is controlled by a value V_3 so that the pressurized water is supplied to nozzle **22** only during the cleaning operation, and not during the normal filtering operation.

The illustrated filter includes a further valve V_1 connected between housing outlet **8** and the downstream pipe **10**, which valve is open during the normal filtering operation but closed during the cleaning operation. Housing **2** further includes a dirty-water purging outlet **26**, and a further valve V_2 between that outlet, the housing inlet **4**, and the upstream supply pipe **6**. Valve V_2 is in the full-line position illustrated in FIG. **1** during a normal filtering operation for directing the water from the upstream pipe **6** to the filter inlet **4**, but is moved to the broken-line position illustrated in FIG. **1** during a cleaning operation in order to disconnect the housing inlet **4** from the upstream supply pipe **6**, but to connect same to the dirty-water outlet **26**.

During a cleaning operation, the filter nozzle **22** is moved axially within the filter body **12** by means of a stem **30** connected to a piston **32** displaceable within a cylinder **34** fixed to the valve housing **2**. Piston **32** is displaced by the pressure of the water within supply pipe **6** controlled by a further valve V_4 such that during a cleaning operation pressurized water is supplied into an inlet port **35** at one side of piston **32** to move nozzle **22** in one direction (leftwardly in FIG. **1**), and then into another port **36** to move the piston in the opposite direction.

All the foregoing valves are controlled by a mode selector, generally designated by box **40**, which may be controlled to effect either a normal filtering mode of operation during which the filter body **12** filters out dirt particles carried by the water as the water passes through the filter from its inlet **4** to its outlet **8**, or a cleaning mode of operation during which nozzle **22** cleans the filter body **12** of the dirt particules accumulated therein.

Filter housing **2** is mainly constituted of a cylindrical wall **42** formed with an opening **44** at its juncture with the inlet **4**, which cylindrical wall is closed by a pair of end walls. One end wall **46** is formed with an opening **48** at its juncture with the outlet **8**, and with an inwardly-extending annular rib **50** for removably receiving within it end ring **52** of the filter stack body **12**. The opposite end wall **54** is removable and is also formed with an inwardly-extending annular rib **56** for receiving an end ring **58** at the opposite end of the filter stack **12**. The rods **20** are secured to the two end rings **52** and **[56]** *58* and are fixed thereto by fasteners **60**.

It will thus be seen that the filter stack assembly **12**, including the filter discs **14**, rods **20**, and the end rings **52** and **58**, may be inserted within the housing **2** and supported as an assembly by annular ribs **50** and **56** of the two end walls **46** and **54**, respectively, of the housing. The filter discs **14** may be cleaned within the housing **2** by the use of the cleaning nozzle **22**, or may be removed from the housing by removing end wall **54** and then sliding out the assembly as a unit, for more thorough cleaning if desired.

One form of cleaning nozzle **22** which may be used is shown if FIG. **3**, wherein it will be seen that it includes two outlets **64**, **66** both issuing jets at substantially right angles to each other. Outlet **64** is eccentrically mounted so that jet issuing therefrom will apply a rotary moment to the nozzle **22** to rotate the nozzle within the filter disc assembly **12** during the cleaning operation.

The filter illustrated in FIGS **1–3** may be operated as follows:

During a normal filtering mode of operation, as selected by the mode selector **40**, the latter controls the various valves, as follows: Valve V_1 is opened, thereby connecting the filter outlet **8** to the downstream pipe **10**; valve V_2 is moved to its full-line position, thereby connecting the upstream supply pipe **6** to the filter inlet **4**, and disconnecting the latter to the dirty water outlet **26**; valve V_3 is closed, thereby interrupting the supply of pressurized water to the cleaning nozzle **22**; and valve V_4 is closed, thereby interrupting the flow of water to the piston **32** drive for the cleaning nozzle **22**. Accordingly, during this operation, the water from supply pipe **6** will be fed through the filter inlet **4**, through the stack **12** of filter **[**disc**]** *discs* **14**, and then through the outlet **8** to the downstream pipe **10**.

Whenever the stack **12** of filter discs is to be cleaned, mode selector **40** is moved to effect a cleaning mode of operation, whereupon the valves are controlled as follows: Valve V_1 is closed to interrupt the flow of water from the housing outlet **8** to the downstream pipe **10**; valve V_2 is moved to the broken-line position, thereby disconnecting the supply pipe **6** from the housing inlet **4**, and connecting the latter to the dirty-water outlet **26**; valve V_3 is opened, thereby supplying pressurized water via pipe **24** to the cleaning nozzle **22**; and valve V_4 is opened, thereby supplying pressurized water first to port **34** at one side of piston **32**, and then to port **36** at the opposite side to effect a reciprocatory movement of cleaning nozzle **22**. During this mode of operation, the cleaning nozzle **22** is reciprocated along the inner surface of the stack **12** of filter discs **14** by piston **32**, and is also rotated by the reaction force from its eccentric outlet **64**, so as to apply pressurized water to the complete inner face of the stack of discs and thereby to blow out the dirt particles accumulating between the discs. These dirt particles are washed out through the dirt-purging outlet **26**.

It will be appreciated that mode selector **40** can be operated either manually, or automatically, e.g. by sensing the pressure drop across the filter stack **12** and, upon sensing a predetermined pressure drop indicating a large accumulation of diet particles, automatically switching the system from the normal filtering mode to the cleaning mode, as described above.

It will also be appreciated that the stack **12** of filter discs **14** may be conveniently removed as an assembly by merely removing end wall **54** and slipping out the assembly from the filter housing **2**, whereupon the filter discs **14** may also be cleaned as an assembly, or may be separated for more thorough cleaning.

FIG. **4** illustrates another embodiment of the invention particularly useful for manual cleaning of the filter discs in the stack by removing them from the housing. Thus, the housing **102** also includes an inlet **104**, an outlet **108**, an end wall **146** fixed at one end of the housing, and a removable end wall **154** at the opposite end. The stack **112** of filter discs **114** is also supported as an assembly by means of a plurality of axially-extending rods **120** arranged in a circular array around the outer faces of the discs **114** of the stack **112**, and secured at one end to end ring **152** supported by annular rib **150** fixed to the housing end wall **146**. Rods **120** are supported at their opposite ends by being received within openings formed in the removable end wall **154**. The latter end wall is normally secured to the end of housing **102** by a clamp **160** having an enlarged head **162** at its outer end, with its inner end being threaded through an opening in a rod **164** whose opposite ends pass through openings in a pair of brackets **166** fixed to the opposite sides of the housing **102**.

Thus, whenever it is desired to open the filter housing **102** for cleaning the stack **112** of filter discs **114**, it is only necessary to remove clamp **160** and then remove rod **164**, which thereby permits the housing end wall **154** to be removed to provide access into the interior of the filter housing. The stack **112** of discs **114** may be removed with end wall **154** as an assembly, or the end wall **154** may first be removed and the discs **114** of the stack **112** may then be individually removed.

While the invention has been described with respect to two preferred embodiments, it will be appreciated that many other variations, modifications, and applications of the invention may be made.

What is claimed is:

1. A filter including

a housing having an inlet, an outlet, and a dirt-purging opening;

a plurality of circular filter discs in said housing with each disc being formed with a central opening, and all the discs being disposed in a stack with the side faces of adjacent discs contacting each other for filtering the fluid flowing through the housing from its inlet to its outlet;

a pair of end rings at the opposite ends of said stack of filter discs and of larger outer diameter than said filter discs, said end rings being formed with a plurality of openings therethrough around a circle of larger diameter than said filter discs;

a circular array of axially-extending rods passing through said openings in said end discs and circumferentially-spaced from each other;

the outer surfaces of said filter discs constituting upstream side of the filter discs and facing said housing inlet and dirt-purging opening, and the inner surfaces of said filter discs defined by their central openings constituting the downstream side of the filter stack and facing said housing outlet; and

a cleaning nozzle movable axially within said central openings of the filter discs for cleaning the filter disc stack, said cleaning nozzle including means for connecting it to a pressurized source of the fluid to be filtered for blowing out the filtered particles from between the filter discs in the stack through said circumferential spaces between the axially-extending rods and said dirt-purging opening, said cleaning nozzle also including means for outletting a fluid jet eccentric to the axis of the nozzle so as to rotate the nozzle by the reaction force applied thereto by said eccentric jet.

2. The filter according to claim 1, wherein said cleaning nozzle outlets fluid in the form of a jet and includes means for rotating the nozzle at the time of the issuance of the jet.

3. The filter according to claim 2,

further including a mode selector for selecting either a filter mode of operation or a cleaning mode of operation and valve means effective during the [cleaning] *filter* mode of operation to direct the fluid from said housing inlet through the filter stack to the housing outlet, and during the cleaning mode of operation to direct the fluid through the nozzle, the filter stack, and out through said dirt-purging opening in the housing.

4. A filter comprising:

a housing having an inlet and an outlet opening;

a filter element disposed in said housing and having a central longitudinal axis, said filter element having a central open area arranged along said longitudinal axis of said filter element, an inner surface surrounding said central open area and an outer surface, the outer surface defining an upstream side of the filter element and the inner surface of the filter element defining the downstream side of the filter element;

a cleaning nozzle for emitting a pressurized fluid jet, said cleaning nozzle being disposed within said central open area and communicating with a source of pressurized fluid;

means for imparting rotation to said cleaning nozzle by outletting an eccentrically directed fluid jet such that the cleaning nozzle is rotted by a reaction force applied thereto by said eccentric jet; and

means for imparting axial motion to said cleaning nozzle.

5. A filter according to claim 4 and wherein said means for imparting axial motion includes means for automatic sensation of particle accumulation.

6. A filter according to claim 4 and wherein said means for imparting axial motion comprises automatically actuable means for imparting axial motion to said cleaning nozzle.

7. A filter according to claim 4 and wherein said means for imparting axial motion comprises manually actuable means for imparting axial motion to said cleaning nozzle.

8. A filter according to claim 4 and wherein said source of fluid comprises a source of a fluid to be filtered.

9. A filter according to claim 4 and wherein said filter element comprises a stack of cooperating filter discs.

10. A filter comprising:

a housing having an inlet and an outlet;

a filter element disposed in said housing and having a central longitudinal axis, said filter element having a central open area arranged along said longitudinal axis of said filter element, an inner surface surrounding said central open area and an outer surface, the outer surface defining an upstream side of the filter element and the inner surface of the filter element defining the downstream side of the filter element, and wherein said filter element comprises a stack of cooperating filter discs;

a cleaning nozzle for blowing out particles accumulating on said filter discs, said cleaning nozzle being disposed within said central open area and communicating with a source of pressurized fluid;

means for imparting rotation to said cleaning nozzle by outletting an eccentrically directed fluid jet such that the cleaning nozzle is rotated by a reaction force applied thereto by said eccentric jet; and

means for imparting axial motion to said cleaning nozzle.

11. A filter according to claim 10 and wherein said means for imparting axial motion includes means for automatic sensation of particle accumulation.

12. A filter according to claim 10 and also comprising:

a pair of end rings at the opposite ends of said stack of filter discs, said end rings being formed with a plurality of openings therethrough and

an array of axially-extending rods passing through said openings in said end discs.

13. A filter according to claim 10, and wherein said means for imparting axial motion comprises automatically actuable means for imparting axial motion to said cleaning nozzle.

14. A filter according to claim 10 and wherein said means for imparting axial motion comprises manually actuable means for imparting axial motion to said cleaning nozzle.

15. A filter according to claim 10 and wherein said source of fluid comprises a source of a fluid to be filtered.

16. A filter comprising:

a housing having an inlet and an outlet;

a filter element disposed in said housing and having a central longitudinal axis, said filter element having a central open area arranged along said longitudinal axis of said filter element, an inner surface surrounding said central open area and an outer surface, the outer surface defining an upstream side of the filter element and the inner surface of the filter element defining the downstream side of the filter element;

a cleaning nozzle for emitting a pressurized fluid jet for cleaning said filter element and for emitting a fluid jet directed eccentrically relative to said longitudinal axis

of said filter element so as to apply a rotary moment to said fluid jet, said cleaning nozzle being disposed within said central open area and communicating with a source of pressurized fluid; and

means for imparting axial motion to said cleaning nozzle.

17. A filter according to claim 16 and wherein said filter element comprises a stack of cooperating filter discs.

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