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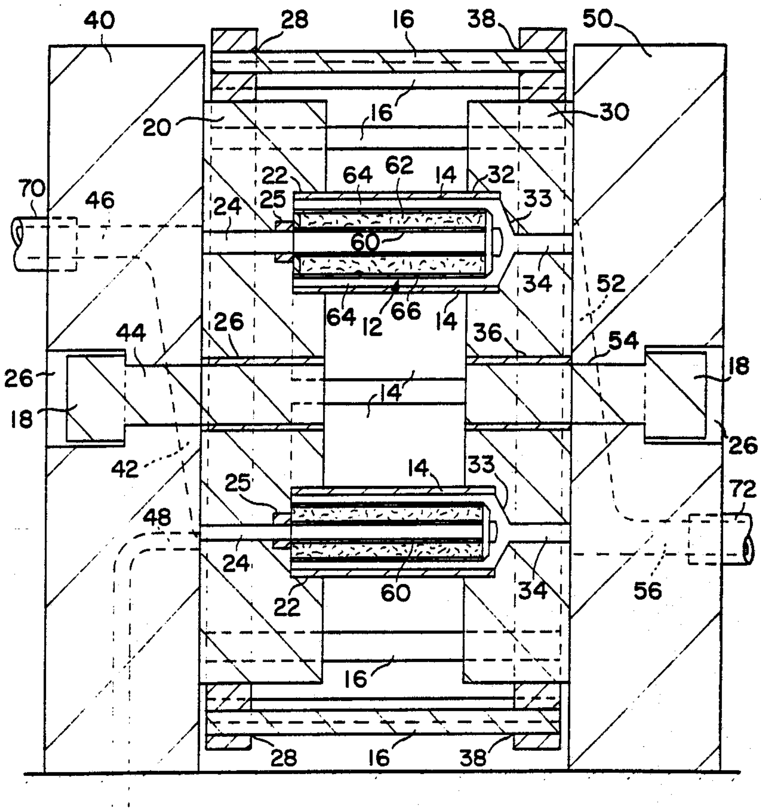
(54) Title: BACKFLUSHABLE ROTARY MELT POLYMER FILTER APPARATUS

(57) Abstract

A continuous, self-cleaning, rotary filtering apparatus is provided having a plurality of filter elements (12) within a rotatable filter housing (10) adapted for rotation between an inlet plate (40) having an inlet manifold (42) and an outlet plate (50) having an outlet manifold (52) so that the liquid to be filtered is passed from the inlet manifold (42) through the filter elements (12) and into the outlet manifold (52). The apparatus is further provided with a backflushing capability whereby the filter housing (10) can be rotated to position where one filter element (12) in alignment with a backflush port independent of the inlet manifold (42) so that a part of the liquid within the outlet manifold (52) will be caused to flow backward through that filter element (10) and backflush port (48) to purge contaminants from the apparatus via the backflush port (48) without interrupting liquid flow through the other filter elements. After backflushing, the filter housing (10) is further rotated to return the backflushed filter element to service.



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BACKFLUSHABLE ROTARY MELT POLYMER FILTER APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates generally to a rotary filter apparatus, and more particularly to a new and improved backflushable, rotary filter apparatus primarily intended for use in filtering high viscosity polymer hot melt feed stocks, which is capable of backflushing the filter surface areas to purge contaminants from the apparatus without interrupting the filtering operation. The filter apparatus of this invention provides a continuous, uninterrupted flow of the hot melt through a plurality of filter elements mounted within a rotatable housing such that the flow of hot melt is smooth, unrestricted and devoid of "dead spaces" where there could be "zero flow" thereby virtually eliminating thermal degradation of the hot melt. The filter housing can be periodically rotated to successively and automatically pass one filter element at a time through a backflush position to thereby automatically and sequentially backflush each filter element to purge filtered contaminates from the apparatus without removing the other filter elements from service or otherwise interrupting the filtering operation, and without the need for any valves to control the backflush operation.

Summary of the Prior Art

There are a number of manufacturing processes involving the formation of products from molten polymer feed stocks, such as nylon, polyesters and other polymers, wherein it is highly desirable to operate on a continuous flow basis. Such processes typically embody extrusion, injection, blow molding, coating spraying techniques, etc., to manufacture a variety of products, such as synthetic textile fibers, plastic tubing, plastic sheets and films, protective coatings, insulation on electrical wire, and the like. Because of the difficulties in initially starting up such processes and cleaning the equipment after a shut down, it is highly desirable to operate such processes on a continuous, uninterrupted flow basis for as long a period of time as can be sustained.

In most of the processes noted above, it is the usual practice to include a filter unit in the "hot melt" flow stream to effect removal of particulate impurities and gel matter which otherwise could result in the production of defective products, or which could cause clogging of downstream equipment such as spinnerettes or extrusion dies. Naturally, such filters must be cleaned or replaced on a periodic basis. Rather than shutting down the process to clean or replace such filters, it is common practice to utilize a dual filter system to permit continued, uninterrupted operation. That is, the process hot melt is routed through only one of the dual filter systems at a time so that the filter system not in use can be cleaned or replaced, and put in stand-by condition so that it can be put into service when it is time to shut down the other filter system for cleaning or replacement.

A diverter valve must be provided to switch the hot melt flow from one filter system to the other.

More recently, self-cleaning filter systems have been introduced which offer fully automatic filter cleaning or changing without the need for any dual filter system, without any notable production delays, and without any operator involvement. One such filter apparatus described in *Melt Filtration Report*, Issue 83-1, April-May, G. F. Goodman and Sons, Inc., Philadelphia, Pennsylvania, utilizes a cylindrical pack of filter screens disposed between a pair of perforated, annular housing cylinders sharing a common axis. In this apparatus, the unfiltered hot melt is passed into an inlet manifold encircling the outer cylinder which is provided with a plurality of inlet ports to feed the hot melt radially inward and through the annular pack of screens, and through a plurality of outlet ports through the inner cylinder which are aligned and registered with the inlet ports in the outer cylinder.

The self-cleaning feature of the apparatus is based on an automatic response to the outlet pressure of the hot melt so that when the pressure drop exceeds a preset limit, the outer cylinder is automatically caused to partially rotate to register an inlet port with an outlet channel whereby hot polymer within the inner cylinder will backflush that inlet port.

Another self-cleaning filter system has recently been introduced by Gneuss Kunststoffechnik GmbH, Oenhausen, Germany, which comprises a plurality of disk type filters disposed in a circular pattern on a disk wheel rotatably mounted between a front and rear end plate. Registered inlet and outlet ports are provided through the end plates so that the hot melt can be passed through one or two of the disk filters disposed between the registered inlet and outlet ports. As the disk filters become clogged, the disk wheel is periodically rotated through a small arc to expose a fresh, clean filter disk or portion thereof, between the inlet and outlet ports as a comparable filter area is rotated out from between the two ports. Each filter disk is eventually rotated to a position not between the two end plates so that a fouled or damaged disk can be removed for cleaning or replacement. In addition, some models rotate the filter disks to a backflush position which is between the two end plates. At this position, a backflush chamber is provided on the back side of a filter disk and a backflush outlet on the other side of the filter disk. A small by-pass port is provided from the outlet port through the back end plate to the backflush chamber to force backflushing hot melt through the filter disk at this position and purge contaminants therefrom. Since a filter disk will always be disposed between the backflush chamber and the backflush outlet port, a shut-off valve is provided on the backflush circuit to minimize the amount of hot melt utilized for backflushing purposes.

SUMMARY OF THE INVENTION

This invention is predicated on a new and improved backflushable, rotary filter apparatus which provides a continuous, uninterrupted flow of hot melt or liquid through all of the plurality of filter elements in the system, which ideally comprise "candle" type filter cartridges to provide a significantly large filter surface area. The filter elements are mounted in a circular, parallel configuration within a rotatable drum, all of which are in service for filtering of hot melt. Upon a partial rotation of the drum, one filter element is revolved through a backflush position to temporarily backflush the entire element sufficiently to purge filtered contaminants completely from the one filter element without removing the other filter elements from service. After a full 360 degree rotation, all the filter elements will have been backflushed one at a time, and returned to service without any interruption of the filter operation. The arrangement is such that any one filter element is only momentarily at the backflush position as the drum is partially rotated so that there is no need for any shut-off valve to minimize the amount of backflush hot melt utilized in backflushing. Accordingly, all filter elements are normally in service for filtering the hot melt, and each successive filter element is completely backflushed automatically with each successive partial rotation of the filter drum without using an excessive amount of hot melt for backflushing purposes and without any need for manual or automatic valves to regulate the amount of hot melt used for backflushing purposes.

The filtration apparatus of this invention backflushes a filter element without even a temporary interruption of the filtering operation. Pursuant to this invention, therefore, there is no need to interrupt the flow of the hot melt or significantly reduce the applied pressure at any time during the operation. Therefore, a rotation cycle can be effected at any desired interval without any need to prolong the rotation cycle time span. It follows therefore, that the rotation cycles can be timed to be at intervals relatively close together to thereby maintain the filter elements in service in a much cleaner condition and able to permit a continuing near optimum output pressure.

It will become apparent that the filtration apparatus of this invention can utilize practically any conventional filter element design including conventional candle-type filter elements; i.e., tubular cartridges or other designs, as opposed to specific and unique filter designs such as annular screen packs. In addition, practically any number individual filter elements in practically any size can be provided, and since all filter elements are normally in service to filter the hot melt, practically any desired filter area can be effected.

Accordingly, the filter apparatus of this invention will permit a truly continuous and automatic use of the apparatus through a large number of filtration and backflushing cycles without need of shutting down the apparatus, or even momentarily halting the flow of hot melt or reducing the outlet pressure of the hot melt below preselected pressures, all without any complicating valve arrangements for controlling the backflush operation.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an elevational side view of one embodiment of the filter apparatus of this invention utilizing eight candle type filter elements.

Figure 2 is a side view identical to that shown in Figure 1 except that the filter apparatus is shown in cross-section with the section taken at line II-II of Figure 3.

Figure 3 is an elevational end view of the filter apparatus embodiment shown in Figures 1 and 2 as viewed from the inlet end.

Figure 4 is an elevational view of the inside face of the inlet end plate of the embodiment shown in Figures 1-3.

Figure 5 is a side view of the inlet end plate shown in Figure 4.

Figure 6 is an elevational view of the inside face of the outlet end plate of the embodiment shown in Figures 1-3.

Figure 7 is a side view of the outlet end plate shown in Figure 6.

Figure 8 is substantially the same as Figure 4 except that it illustrates the relative positions of the filter element inlets with respect to the inlet manifold during a normal filtering operation.

Figure 9 is substantially the same as Figure 8 except that it illustrates the relative positions of the filter element inlets with respect to the inlet manifold during the short period of time that a filter element is being backflushed.

Figure 10 is an inside view of the inlet drum plate of the embodiment shown in Figures 1-3.

Figure 11 is a side view of the inlet drum plate shown in Figure 10.

Figure 12 is an inside view of the outlet drum plate of the embodiment shown in Figures 1-3.

Figure 13 is a side view of the outlet drum plate shown in Figure 12.

Figure 14 is an elevational view of an apparatus for rotating the filter drum illustrated in the above Figures.

DETAILED DESCRIPTION OF THE INVENTION

Reference to the Figures will illustrate one embodiment of a backflushable, continuous rotary melt polymer filter apparatus constructed in accordance with one embodiment of this invention. As shown in Figures 1-3, the filter apparatus illustrated basically comprises a generally cylindrical filter housing (10) containing a plurality of parallel, cylindrically arranged filter elements (12), each disposed within a cylindrical filter sleeve (14). The filter housing (10) comprises an inlet disk (20) and an outlet disk (30) joined together by a plurality of filter housing rods (16) equally spaced around the periphery of the filter housing (10) and rigidly maintaining the inlet disk (20) and outlet disk (30), rigidly positioned with respect to each other. The filter housing (10) is rotatably mounted to trunion posts (18) between a stationary inlet plate (40), provided with an inlet manifold (42), and a stationary outlet plate (50), which is provided with an outlet manifold (52). In the particular embodiment illustrated, there must be twice as many filter housing rods (16) as filter element (12). Therefore, since the embodiment illustrated provides eight filter elements (12) there are sixteen filter housing rods (16). Since the cross-section surfaces illustrated in Figure 2 pass through the axes of only two filters elements (12), only two filters elements are seen in Figure 3; namely, only the outer filter elements in the uppermost and lowermost positions.

Considered in more detail, the rotatable filter housing (10) comprises a circular inlet disk (20) (as illustrated in Figure 10 and 11) which is provided with eight cylindrical recesses (22) partially extending into the inside face of the inlet disk (20) uniformly positioned in a circular pattern at equal distances from the axis or center of the inlet disk (20). An inlet port (24) extends from the center of the base of each circular recess (22) through the remainder of the disk thickness. Each inlet port (24) is provided with a means to retain one end of an elongated filter element (12), such as a threaded recess (25). A large trunion hole (26) is provided through the axial center of inlet disk (20); and a plurality of smaller filter housing rod holes (28) are provided on a common radius around the periphery, which are equal distant from the trunion hole (26) with each adapted to receive one filter housing rod (16). Filter housing rod holes (28) must be positioned such that one filter housing rod hole each is positioned on a radius line extending through the center of radius of the trunion hole (26) and the center of radius of each cylindrical recess (22), and one filter housing rod hole (28) equally spaced on the same common radius between each filter housing rod hole aligned with the recesses (22). Accordingly, eight parallel cylindrical recesses (22) are provided around trunion hole (26) on a specific radius from the trunion hole (26); and sixteen filter housing rod holes (28) encircle the cylindrical recesses (22), with every other filter housing rod hole (28) positioned on a radius line directly over the cylindrical recesses (22).

The circular outlet disk (30) is adapted to form the opposite end of rotatable filter housing (10) and is substantially identical to inlet disk (20) except that the eight cylindrical recesses (32) are provided with a conical base surface (33) Accordingly, an outlet port (34) extends from the conical base (33) of each cylindrical recess (32) through the remainder of the disk thickness. A large trunion hole (36) is provided through the axial center of outlet disk (30), while a plurality of smaller filter housing rod holes (38) are provided around the periphery on a common radius which are equal distant from the trunion hole (36) with each adapted to receive the end of one filter housing rod (16). The relative positions of the conical recesses (32) and all holes are the same as those of the cylindrical recesses (22) and all the holes in the inlet disk (20) so that when the two disks are joined and spaced to form the rotatable drum

(10), the two trunion holes (26) and (36) will be aligned on the same axis for the rotation of filter housing (10), and one each conical recess (32) will be aligned and registered with one each cylindrical recess (22), and one each filter housing rod hole (38) will be aligned with one each filter housing rod hole (28). Unlike the inlet disk (20), the outlet ports (34) in the outlet disk (30) are not provided with any means for attaching a filter element (12).

When properly assembled, the rotatable drum (10) will have an elongated candle-type filter element (12) secured at the base of each cylindrical recess (22) (e.g., by threading an end of the filter element into each threaded recess (25)) and positioned to permit inlet ports (24) to communicate with the interior of the perforated support cores (60) (Figure 3) of the filter elements (12). Ideally, therefore, the diameter of inlet ports (24) should be the same as the inside diameter of filter cores (60) to provide a smooth, unobstructed flow from ports (24) into filter cores (60). Each filter element (12) is surrounded by a filter sleeve (14), the forward ends of which are recessed and sealed within the cylindrical recesses (22) to form a hot melt tight seal, and the rearward ends recessed within cylindrical recesses (32) to again form a hot melt tight seal. The filter housing rods (16) are then positioned around the periphery of the two disks (20) and (30) and tightened to bias them toward each other, thereby sealing filter sleeves (14) in place between the opposed disks (20) and (30). As can be seen in Figure 2, a hot melt passageway is defined from the inlet ports (24) to the interior of perforated filter support cores (60) so that the hot melt will then move radially outward through the filter medium (62) on the filter elements (12) and into the annular chamber (64) positioned between filter medium (62) and filter sleeves (14). Annular chambers (64) are defined by the cylindrical outer surfaces of the filter elements (12) and the interior surfaces of the filter sleeves (14). From annular chambers (64), the filtered hot melt will pass into outlet ports (34) via the conical recesses (32).

As previously noted, the entire filter housing (10) is adapted for rotation between inlet plate (40) and outlet plate (50) by being rotatably mounted on cylindrical trunion posts (18). As shown in Figures 3 and 4, inlet plate (40) is provided with a trunion hole (44) through the center which is adapted to receive a trunion post (18). An inlet manifold (42) is machined into the inside face of inlet plate (40) which comprises a U-shaped channel in an incomplete toroidal configuration partially encircling trunion hole (44). Inlet manifold (42) must be positioned to correspond and communicate with the eight inlet ports (34) through inlet disk (30). A feed inlet port (46) extends entirely through inlet plate (40) communicating with manifold (42) at the upper center portion. As can be seen in Figure 8, inlet manifold (42) has a channel width which is the same as the diameter of the inlet ports (32). The base of manifold (42) is rounded with a radius equal to the radii of inlet ports

(32) and is sloped (Figures 2 and 5) so that its cross-sectional area is at a maximum at the upper center portion where the hot melt feed inlet port (46) is positioned, with a progressively decreasing cross-sectional areas moving towards the extremities of manifold (42). The extreme ends of manifold (42) are also rounded with a radius equal to the radii of inlet ports (34) to avoid any dead spaces. Accordingly, the shape and cross-section of manifold (42) is designed to uniformly feed incoming hot melt from feed inlet port (46) into each inlet port (34) and filter core (60) with a minimum of turbulence and pressure differentials and the absence of any dead spaces. A backflush outlet port (48) is provided through the inside face of inlet plate (40) with one opening thereto located at the same radial distance from trunion hole (44) as that of manifold (42) midway between the two extreme ends of manifold (42) so that it will be aligned and registered with each filter element core (60) passing adjacent thereto and the other opening located in the base of inlet plate (40).

As shown in Figures 5 and 6, the outlet plate (50) is quite similar in configuration to inlet plate (40) having a trunion hole (54) at the center and an outlet manifold (52) having a U-shaped cross-section and toroidal configuration completely encircling the trunion hole (54) with a feed outlet port (56) extending from the base of manifold (52) entirely through outlet plate (50) at the lowermost position. The outlet manifold (52) and outlet feed port (56) in outlet plate (50) are substantially the same as inlet manifold (42) and inlet feed port (46) in inlet plate (40) except that their relative positions of the feed ports (46) and (56) are reversed, and while outlet manifold (52) is in the form of a complete toroidal cavity, inlet manifold (42) is in the form of a truncated or incomplete toroidal cavity. The base of outlet manifold (52) is like inlet manifold (42) in that its base is rounded with a radius equal to that of outlet ports (34) and, as can be seen in Figures 5 and 7, the base is sloped so that its cross-sectional area is at a maximum at the lower center portion where the hot melt feed outlet port (56) is positioned, with a progressively decreasing cross-sectional areas moving towards the extremities of manifold (52). Like the inlet manifold (42), the outlet manifold (52) must be positioned to correspond and communicate with the eight outlet ports (34) through outlet disk (30), and shaped to uniformly receive incoming hot melt from outlet ports (34) and feed it into feed outlet port (56) with a minimum of turbulence and pressure differentials and the absence of any dead spaces. In order to avoid any "zero flow" dead space between the two uppermost outlet ports (56), and thus a body of non-moving hot melt which could become thermally degraded, it is preferred that the point of minimum cross-sectional area in outlet manifold (52) be positioned directly over one of the two uppermost outlet ports (56) to thereby promote some flow of hot melt across this span. Unlike the inlet plate (40), there is no backflush outlet port provided in the outlet plate (50) since the base of outlet manifold

(52) does occupy space opposed to backflush port (48) and will function to feed the backflush as will be described subsequently.

A means for rotating cylindrical filter housing (10) through a succession of 22.5 degree rotations is also provided which, as shown in the Figure 14, comprises a hydraulic cylinder (80) activating a push hook (82) against the filter housing rods (16). As can be seen in Figure 14, hydraulic cylinder (80) is pivotally secured to base member (84) associated with the filter apparatus by pin (86) and horizontally disposed so that push hook (82) can engage one of the upper filter housing rods (16) and push it through a 22.5 degree rotation to thereby position a filter element (12) at the backflush position. Withdrawal of the push hook (82) will cause it to engage the next adjacent filter housing rod (16) so that it too can be pushed through a 22.5 degree rotation to return the backflushed filter element to service.

During normal filter operation, the unfiltered hot melt is fed into the apparatus via suitable piping (70) which will feed the hot melt through inlet feed port (46) and into inlet manifold (42). Reference to Figure 8 will illustrate the relative positions of the filter element inlets; i.e., the respective filter support cores (60), designated by the circles with an "X" therein. As previously noted, the surfaces of the manifold (42) should be smooth with the base rounded so that the incoming unfiltered hot melt can be most effectively passed into the inlet ports (24) and filter support cores (60) without turbulence and without having any dead spaces. Therefore, the extremity end portions of manifold (42) should be radiused to correspond to and register with the radius of the inlet ports (34) and filter cores (60). In this normal filtering position, there will be no filter element core (60) or inlet port (24) registered with backflush port (48), as is clearly shown in Figure 8. As is obvious, the hot melt fed into the core (60) of filter elements (12) will be forced to exit therefrom through the annular filter medium (62) disposed around support cores (60) to effectively filter the hot melt as it passes into annular chambers (64). From annular chambers (64), the filtered hot melt will then pass through conical recesses (32) and through outlet ports (34) and into outlet manifold (52). As in the case of the inlet manifold (42), the outlet manifold surfaces should be smooth and rounded so that the outgoing filtered hot melt can be most effectively passed through the outlet manifold (52) and into the outlet conduit (72) without turbulence and without having any dead spaces. Therefore, the extremity end portions of outlet manifold (52) should be radiused to correspond to the radius of the outlet ports (34).

During continuous use of the filter apparatus as described above, the filter elements (12) will become progressively fouled and contaminated with contaminants filtered from the hot melt, with the contaminants collecting at the inside peripheral surfaces of the filter medium (62). To effect a backflush operation, the filter housing (10) must be revolved through a 22.5 degree rotation so that one inlet port (24) and filter element core (60) is revolved from the extreme end of manifold (42) and aligned and registered with the backflush outlet port (48), as depicted in Figure 9. In contrast to Figure 8, Figure 9 depicts the positions of the filter element cores (60) with respect to the inlet manifold (42) during a backflush operation, with the positions of the filter element cores (60) depicted by the circles containing an "X". Accordingly, the one inlet port (24) at this lowermost position is no longer registered with the inlet manifold (42); but the associated outlet port (34) remains registered with the outlet manifold (52). In this position the pressure of the filtered hot melt within the outlet manifold (52) will force a small portion of the filtered hot melt to flow backwards through the lowermost outlet port (34) and associated conical recess (32), and chamber (64), and radially inward through the lowermost filter medium (62) backflushing the contaminants from the inner surfaces of the medium and washing the contaminants out of the apparatus through backflush outlet port (48). From outlet port (48) the contaminated hot melt can be returned to the upstream portion of the manufacturing facility for further processing, or discarded depending on operator preferences. It should be apparent that until such time as a filter element core (60) becomes aligned with the backflush port (48) at the lowermost position of the drum rotation, no filtered hot melt can be backflushed through backflush port (48). It should also be noted that in the backflushing position, inlet ports (24) are not positioned at the extreme ends of the inlet manifolds (42), thereby providing a small dead space at the extreme ends of the manifold. However, since the backflushing operation is rather brief, as discussed below, the dead spaces created during the backflushing operation are of no adverse consequence.

Experience has shown that the backflushing operation is very quickly achieved to effectively purge the filter element of most contaminates. Therefore, it is not necessary to leave the backflushed filter element in the backflush position for more than a few seconds before the filter housing (10) is rotated through and additional 22.5 degrees to reposition all filter elements (12) in the normal operating position as depicted by Figure 8. Accordingly, a filter element rotated to the lowermost position can be rather quickly backflushed and rotated again returning it to service as a cleaned (i.e., backflushed) filter element. Even during that short period of time while one filter element is being backflushed, it can be seen that the filtration operation will continue through the other seven filter elements not in the backflush position. Accordingly, the backflushing operation does not represent any interruption in the filtering operation; and since the backflush time is rather short, and backflushing does not normally reduce the hot melt pressure by any significant amount.

In normal operation, it is preferred that the rotation interval be determined automatically on the basis of back pressure created by the slow clogging of the filter elements. Accordingly, when pressure is reduced to a predetermined level, the filter housing (10) is automatically rotated through 22.5 degrees, positioning one filter element at the lowermost rotation position to backflush that filter element, and then rotated an additional 22.5 degrees to return the filter element back into service. With one cleaned filter element returned to service, the feed pressure will increase until the total filter area again becomes sufficiently clogged to cause another rotation and another filter element to be backflushed and returned to service, and so on. Obviously, each partial rotation of filter housing (10) should be in the same direction so that each succeeding filter element will be backflushed. As can be seen, each rotation of filter housing (10) through a 1/8 full circle turn; i.e., 45 degrees, will cause each of the filter elements (12) and associated inlet and outlet ports to be rotated; i.e., shifted to the next adjacent normal filtering position. Accordingly, as a fresh, backflushed filter element is first rotated into position where it will be aligned with the two manifolds (42) and (52) so that it will filter the incoming hot melt in combination with the other seven filter elements so aligned, it will remain in service through seven more partial rotations before it is again removed from service for backflushing. As each filter element is removed from service it will be the only one that has gone through seven partial rotations, and accordingly, will be the most fouled of the filters in service and the one most in need of backflushing.

With regard to the filter elements (12), it should be apparent that if candle-type filter elements are utilized, their structure will have to be somewhat different from those conventionally utilized in other forms of filtering apparatus. This is because conventional candle-type filter elements are normally utilized in equipment that utilizes only one direction of flow of the hot melt which is normally radially inward through the filter medium supported against a tubular filter core member. In the apparatus of this invention, however, the hot melt will have to flow through the filter medium at high pressure in both directions. Therefore, no matter what filter medium is utilized, it will have to be supported on both sides so that the medium is not dislodged from the support. As depicted in Figure 3, the filter elements (12) are shown to have a support tube on both sides of the filter medium (62); i.e., a conventional tubular filter core (60) on which the filter medium (62) is supported from the inside, and a perforated outer support tube or jacket (66) against the outer surface of the medium (62). Accordingly, filter elements (12), as depicted, are well adapted to withstand the vigors of the two-way hot melt flow. The blunt forward ends of filter elements (12) are preferably provided with a conical or rounded tip for the purpose of guiding the hot melt through the conical recess (32) with a minimum of turbulence. In a like manner, inner-cones (not shown) can be provided within filter cones (60) as may be necessary to occupy volume and reduce turbulence within the cores (60).

In addition to the above described features of the filter apparatus of this invention, it should be obvious that additional components will be required, such as associated conduit lines for feeding the hot melt to and from the filter apparatus, heating means for keeping a hot melt at temperature, and means for coupling the components together as necessary to maintain tight interfaces of the component parts and yet permit rotation of the filter housing (10) without any leaking of the hot melt at the interfaces between the stationary and rotating parts. Such connecting means, including adjustable interface pressure controlling means, are within the skill of the art and need not therefore be described here.

It should be apparent from the above description that numerous modifications and alternate embodiments could be utilized without departing from the spirit of the invention. For example, while an eight filter element apparatus has been depicted in the above described detailed embodiments, it is apparent that any desired number of multiple filter elements could be incorporated, provided all are equally spaced on a given radius from the axis of rotation so that each partial rotation will cause the successive filter elements to be revolved through the backflush position and returned to service. As another alternative, it should be appreciated that the filter apparatus can include more than one circular arrangement of filter elements. For example, two or more concentric arrangements can be provided with individual and concentric inlet and outlet manifolds, or one each of said manifolds which extend to the plural circular arrangements. Such an arrangement could backflush two filter at a time, one from each concentric circular arrangement, or backflush one filter at a time by properly staggering the backflush outlet ports.

It should also be apparent that a large number of differing arrangements could be utilized to mount the filter elements and filter sleeves to effect hot melt passageway through the filter housing. Even a one-piece housing could be utilized having a plurality of filter sleeves machined therethrough, or other techniques utilized to seal the ends of individual sleeves. As another example, more than one backflush position can be provided if such is desired for any reason, as well as incorporating one or more "dead" positions where the filters therein are neither in service nor being backflushed, should such be desired. It should also be appreciated that while elongated candle-type filter elements have been depicted in the above description, practically any type of filter element can be utilized by suitably modifying the housing to accommodate such a modified filter element. While candle-type filter elements will provide a comparatively large filter area, it should be appreciated that in applications where large filter areas are not necessary, the use of other types of filter elements will provide for a significantly reduced depth of the cylindrical filter housing.

In addition to the above considerations, it has already been noted that in most prior art filtration apparatus utilizing candle-type filter elements, the normal practice is to utilize a filter element having a perforated core upon which the filter medium is supported, and then passing the liquid to be filtered radially inward through the filter medium and into the area defined by the core. This structure is ideal for one-way applications in that the core will physically support the body of the medium and expose the outer surface of the medium for filtration (which naturally has the greater surface area) and therefore increases the life of the filter. In the filter elements of this invention, however, the medium must be supported on both sides in view of the fact that the hot melt will be passed through the filter medium in both directions; i.e., in one direction for filtering, and in the opposite direction for backflushing. While the above-described embodiment of the invention filters the hot melt as it is passing radially outward through the medium, the reverse arrangement could be utilized, which would in fact provide a larger filter medium surface area. The arrangement as described-above has been preferred, however, because it has been found that the contaminants are more easily purged from the apparatus through the core (60), as opposed to the annular chamber (64). Furthermore, since the apparatus is basically intended to clean the filter elements and return them to service, the reduced filter medium surface area is not detrimental to the overall life of the filter elements. Additionally, the above-described embodiment has utilized candle type filter elements whereby only one end is secured, i.e., the forward end secured to inlet disk (20). Obviously, other means for securing the individual filter elements could be utilized, such as mounting them to the outlet disk (30), or to both the inlet and outlet disks, or to the sleeve (14).

It should further be appreciated that the above described method for rotating the cylindrical filter housing utilizing a hydraulic cylinder represents but one technique out of many that could be utilized. Other examples could include the provision of ratchet teeth on the filter housing instead of filter housing rods, or an electric motor with suitable gear linkage or chain linkage, as well as others which are within the skill of the art and need not be described here.

While the above description of the apparatus of this invention has been primarily addressed to the use of the apparatus in filtering polymer hot melts, it should be apparent that the apparatus could be utilized in any type of process to filter any material where continuous filtration and backflushing would be helpful.

CLAIMS

What is claimed is:

1. A continuous, self-cleaning, filter apparatus for filtering a liquid material comprising: a filter housing constructed and arranged for rotational motion about an axis of said filter housing, having an inlet manifold and an outlet manifold, a plurality of filter elements disposed in a circular pattern around said axis, secured within said filter housing each of said plurality having an inlet means adjacent to said inlet member and an outlet means adjacent to said outlet member, said inlet member having an inlet manifold sufficient to communicate with each said inlet means when said filter housing is rotationally positioned at a full filtering position, said inlet manifold defines a partial toroidal cavity, a circular side of which is registered and in communication with each of said inlet means when said filter housing is rotationally positioned at a full filtering position outlet manifold sufficient to communicate with each said outlet means, means for introducing a liquid to be filtered into said inlet manifold so that said liquid will pass through said inlet means and said filter elements to filter contaminants therefrom and thereafter pass through said outlet means into said outlet manifold, means to permit said liquid to exit from said outlet manifold, and means for partially rotating said filter housing with respect to said inlet manifold to rotate one of said filter elements to a backflush position wherein the inlet means of said one filter element will be aligned with a

backflush port within said inlet member independent of said inlet manifold, thereby causing a portion of said liquid within said outlet manifold to flow through said filter element in a direction opposite to the direction of flow during filtration at said backflush position to flush contaminants from said one filter element and purge said contaminants from the apparatus via said backflush port, and thereafter to further rotate the backflushed filter element into communication with said inlet manifold and full filtering position.

2. A filtering apparatus according to claim 1 in which said inlet manifold has a width equal to the width of said inlet means, and has a sloped base so that said liquid can pass through said inlet manifold with a minimum of turbulence, pressure variation, and no significant dead spaces.

3. A filtering apparatus according to claim 1 in which said outlet manifold defines a full toroidal cavity, a circular a side of which is registered and in communication with each of said inlet means.

4. A filtering apparatus according to claim 3 in which said outlet manifold has a width equal to the width of said outlet means, and has a sloped base so that said liquid can pass through said outlet manifold with a minimum of turbulence, pressure variation, and no significant dead spaces;

and said outlet manifold has a width equal to the width of said outlet means.

5. A filtering apparatus according to claim 1 in which said inlet member is an inlet plate and said inlet manifold is machined into the face of said inlet plate, and said outlet member is an outlet plate and said outlet manifold is machined into the face of said outlet plate.

6. A filtering apparatus according to claim 1 in which said filter housing comprises a generally cylindrical housing structure having an inlet disk adjacent to said inlet member and an outlet disk adjacent to said outlet member, a plurality of filter sleeves disposed between said inlet member and said outlet member, and a filter element disposed within each of said filter sleeves.

7. A filtering apparatus according to claim 6 in which said inlet disk is provided with a plurality of inlet ports constructed and arranged to be aligned and registered with said inlet manifold while said filter housing is rotationally positioned at full filtering position to permit passage of said liquid from said inlet manifold through said filter elements, and said outlet disk is provided with a plurality of outlet ports constructed and arranged to be aligned and registered with said outlet manifold to permit passage of said liquid from said filter elements into said outlet manifold.

8. A filtering apparatus according to claim 7 in which said filter elements are attached to said inlet ports.

9. A filtering apparatus according to claim 7 in which said filter elements comprise elongated candle-type filter elements.

10. A filtering apparatus according to claim 9 in which said filter elements comprise an elongated perforated core, a filter medium supported on said core, and a perforated jacket surrounding said filter medium.

11. A filtering apparatus according to claim 10 in which said inlet ports are constructed and arranged to convey the liquid to be filtered into the interior of said perforated core, thereby permitting said liquid to be filtered as it passes radially outward through said filter medium.

12. A filtering apparatus according to claim 1 in which said filter housing further comprises a plurality of filter housing rods disposed around the periphery of said filter housing having their axes parallel to said axis and interposed between said inlet disk and said outlet disk.

13. A filtering apparatus according to claim 12 in which said means for partially rotating said filter housing functions by releasably and sequentially engaging said filter housing rods.

14. A filtering apparatus according to claim 13 in which said means for partially rotating said filter housing comprises a hydraulic cylinder constructed and arranged to engage one of said filter housing rods to hydraulically cause said partial rotation, and thereafter engage the next adjacent filter housing rod to effect the next partial rotation.

15. A filtering apparatus according to claim 1 in which said means for partially rotating said filter housing comprises a hydraulic cylinder.

16. A continuous, self-cleaning, filter apparatus for filtering a liquid material comprising: a generally cylindrical filter housing constructed and arranged for rotational motion about an axis of said filter housing between a stationary inlet plate and a stationary outlet plate, a plurality of filter elements secured within said filter housing arranged in a circular pattern and uniformly spaced from said axis, said filter housing having an inlet port adjacent to each filter element each of which inlet ports are adjacent to said inlet plate, said filter housing having an outlet port adjacent to each filter element each of which outlet ports are adjacent to said outlet plate, said inlet plate having an inlet manifold formed into a face thereof said inlet manifold defines a partial toroidal cavity, a circular side of which is registered and in communication with each of said inlet means when saaid filter housing is rotationally positioned at a full filtering position sufficient to communicate with each said inlet ports when said filter housing is rotationally positioned at a full filtering position, said outlet plate having an outlet manifold formed into a face thereof sufficient to communicate with each said outlet ports, inlet means for introducing a liquid to be filtered into said inlet manifold so that said liquid will pass through said inlet ports and said filter elements to filter contaminants therefrom and

thereafter enter through said outlet ports into said outlet manifold, means to permit said liquid to exit from said outlet manifold, and means for partially rotating said filter housing with respect to said inlet plate and said outlet plate sufficient firstly to permit at least one of said filter elements to be rotated to a backflush position wherein the inlet port of said filter element will be aligned and registered with a backflush port within said inlet plate independent of said inlet manifold, thereby causing a portion of said liquid within said outlet manifold to backflow through said filter element at said backflush position to backflush contaminants from said filter element and purge said contaminants from the apparatus via said backflush port, and secondly to further rotate the backflushed filter element into communication with said inlet manifold and full filtering position.

17. A filter apparatus according to claim 16 in which said toroidal cavity has a u-shaped cross-section, whereby a circular side of said cavity is registered with all of said inlet ports when said filter housing is rotationally positioned at a full filtering position.

18. A filter apparatus according to claim 16 in which said outlet manifold defines a full toroidal cavity having a u-shaped cross-section, whereby a circular side of said cavity is registered with all of said outlet ports, regardless of the rotational position of said filter housing.

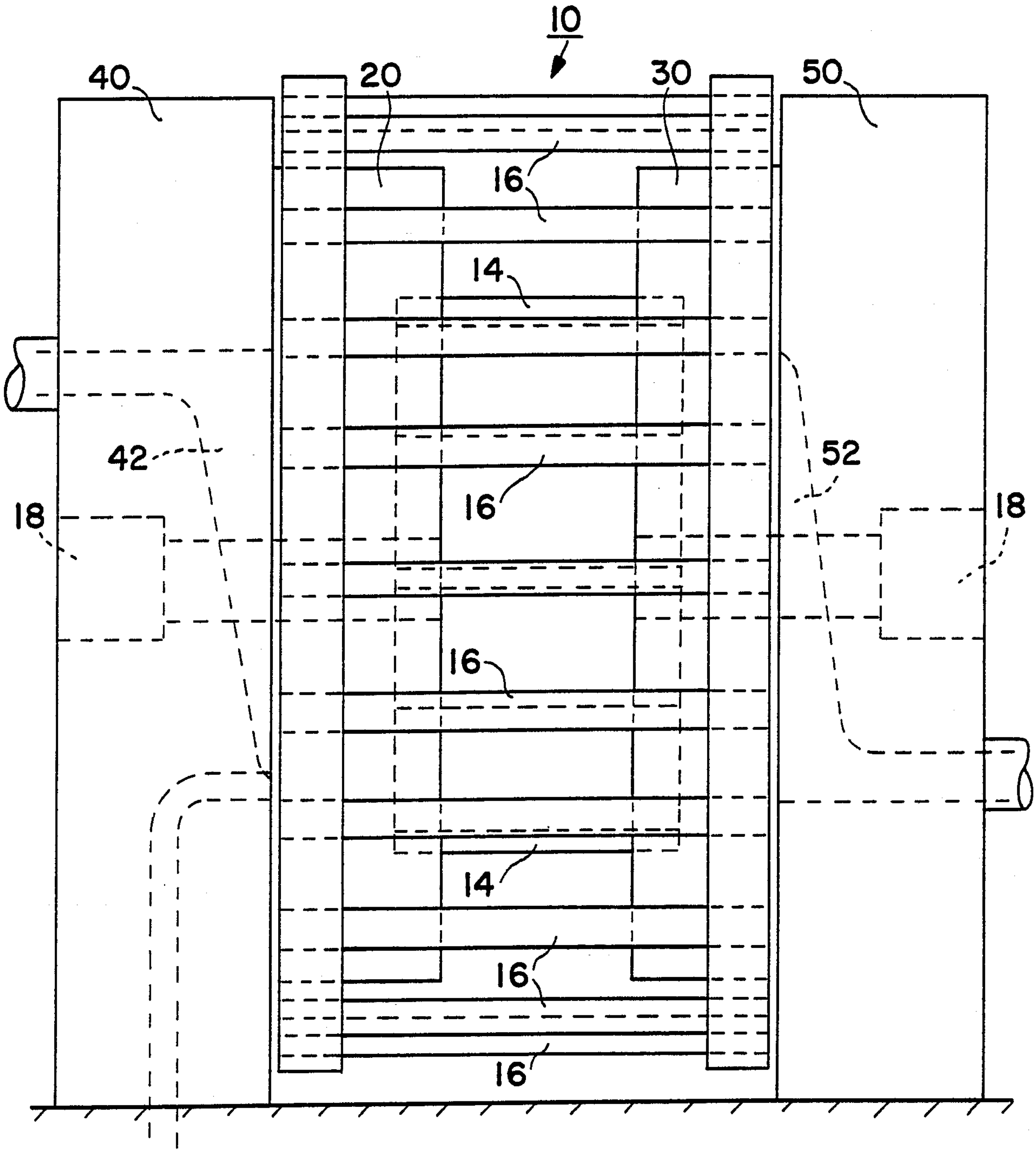

FIG. 1

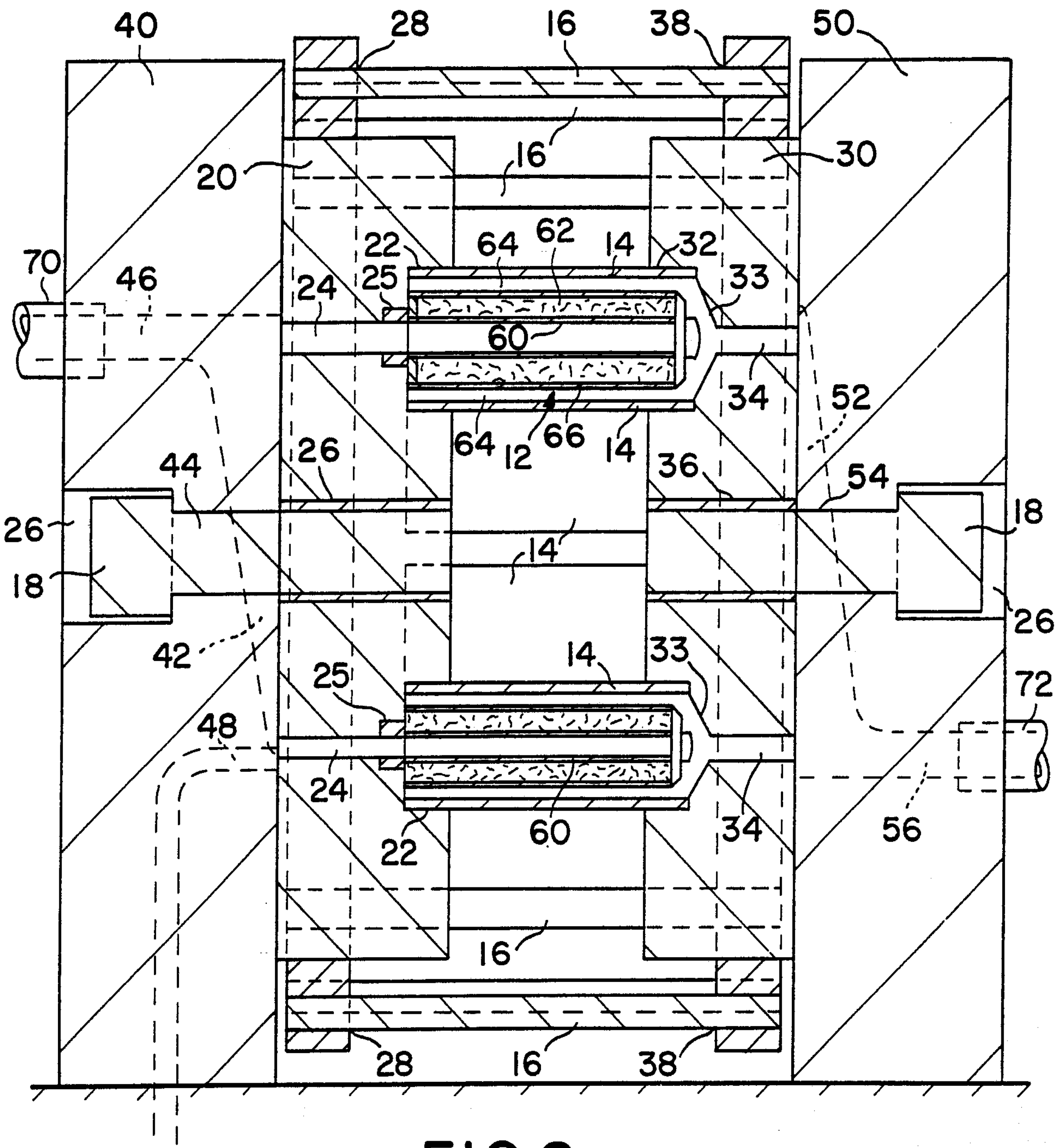
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FIG. 2

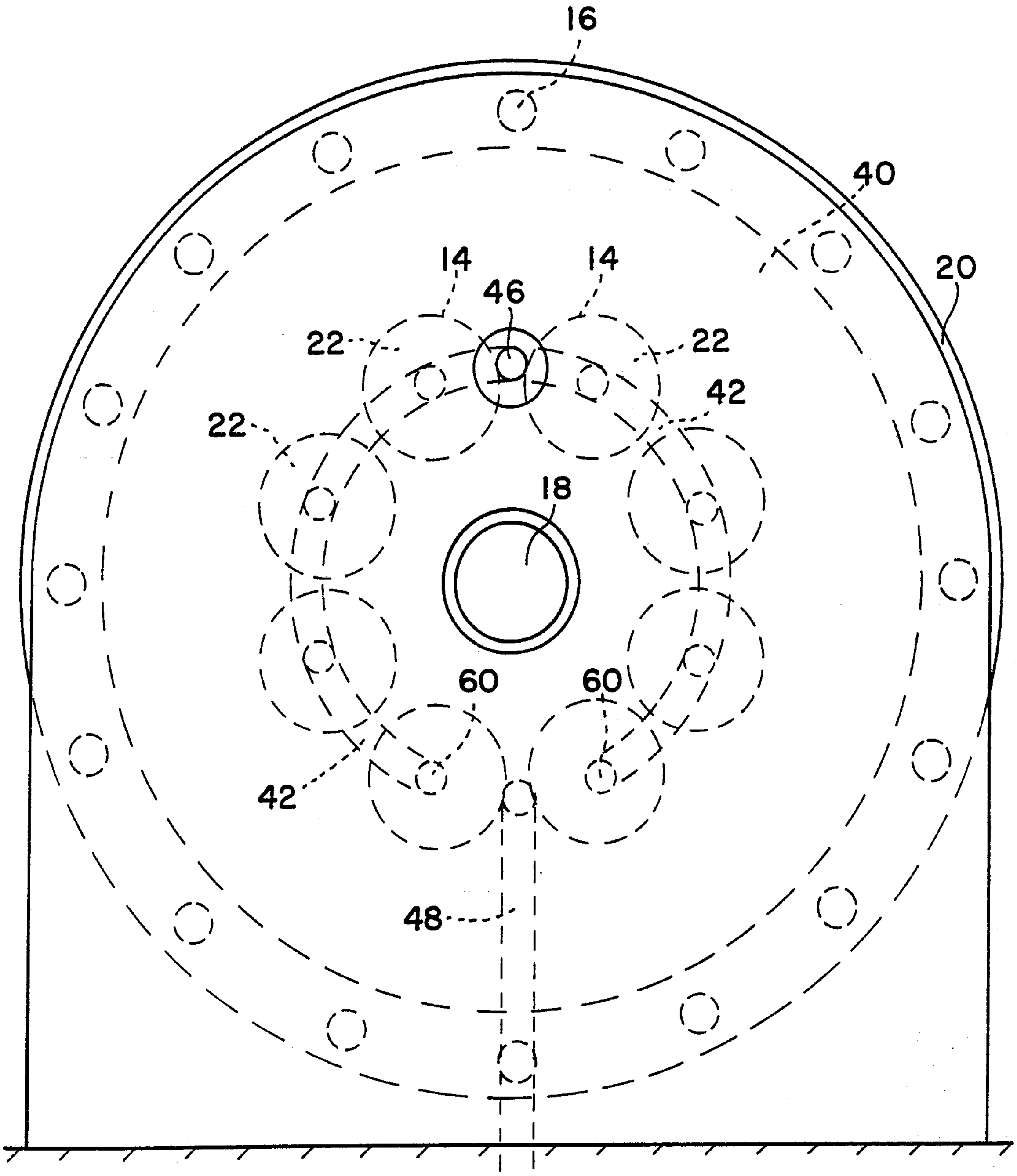


FIG. 3

FIG. 5

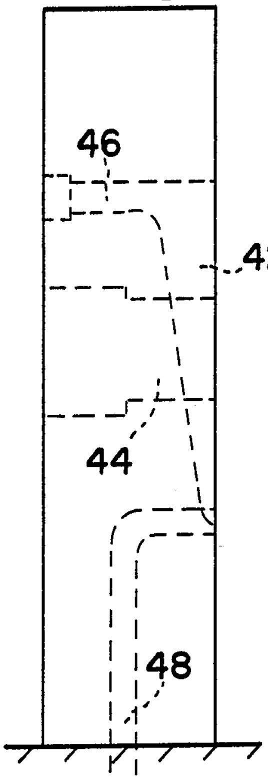
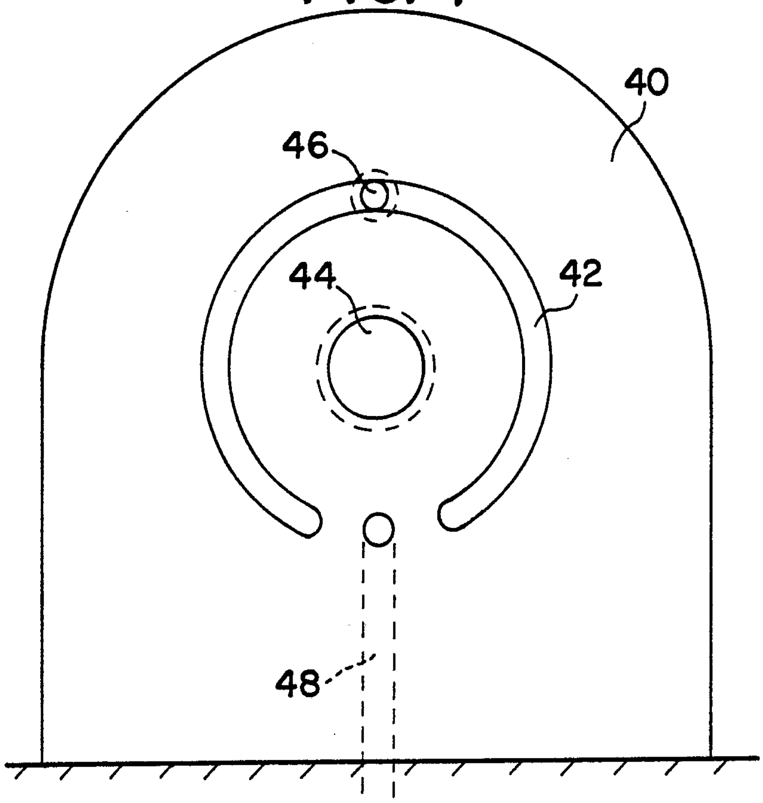


FIG. 4



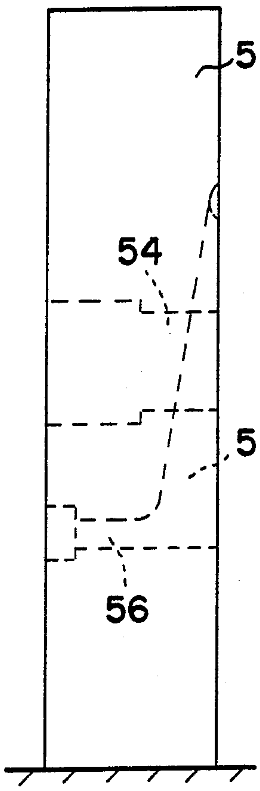


FIG. 7

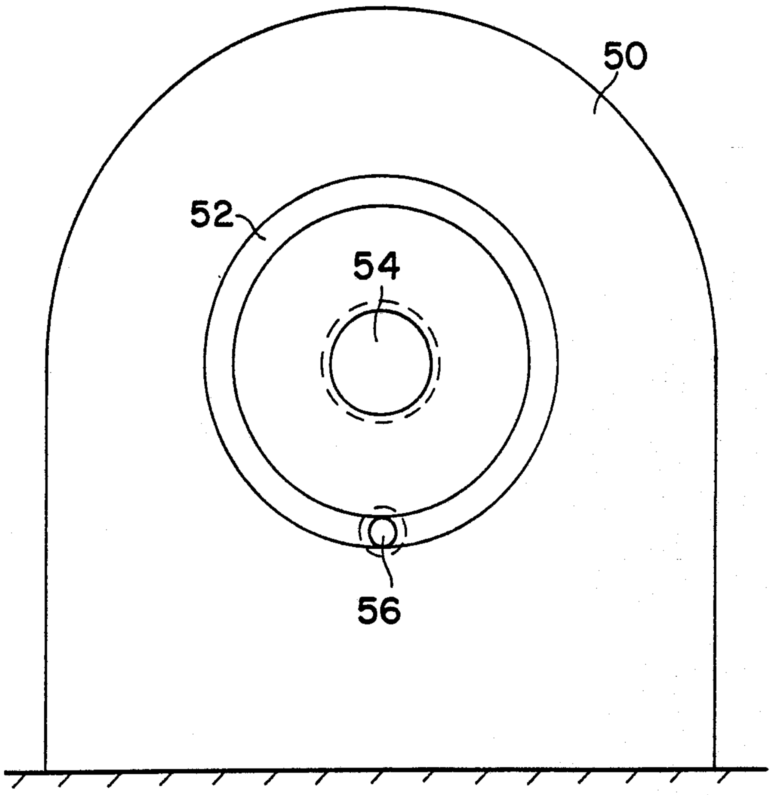


FIG. 6

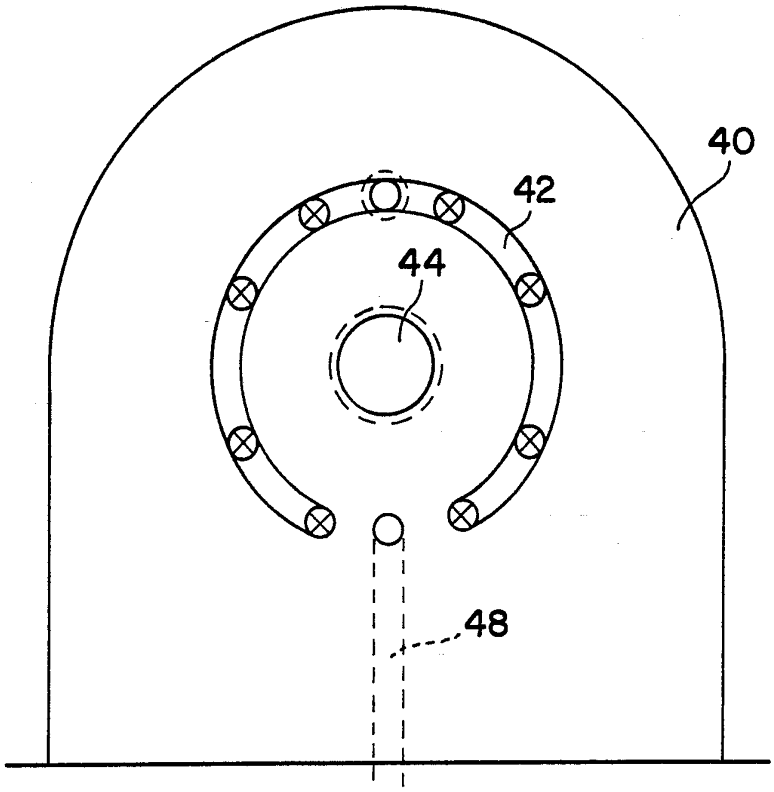


FIG. 8

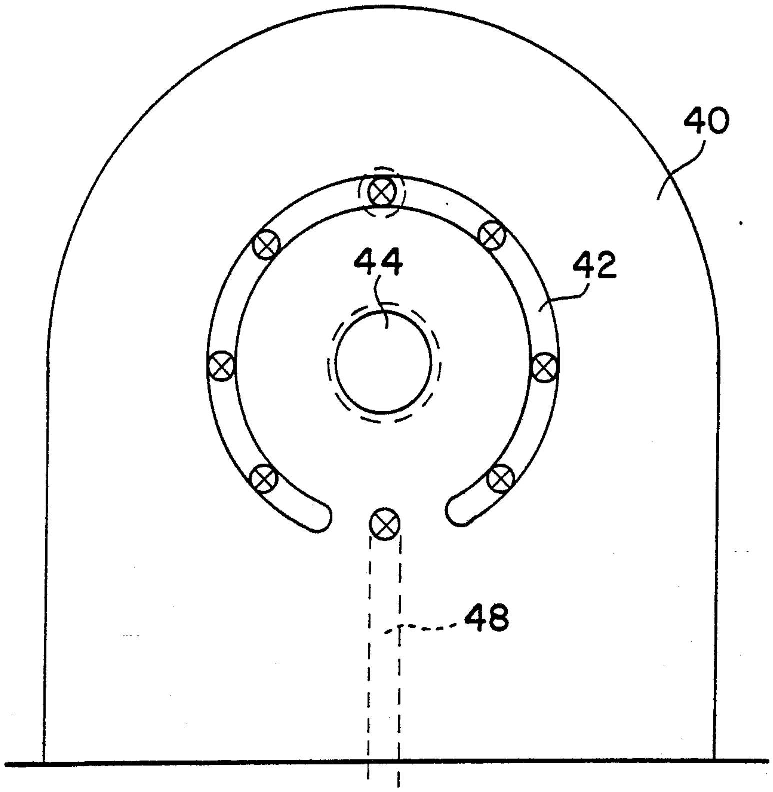


FIG. 9

FIG. 11

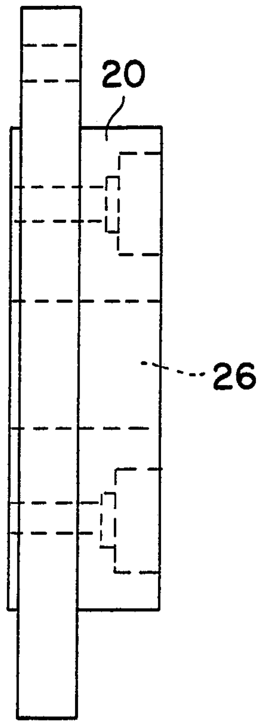
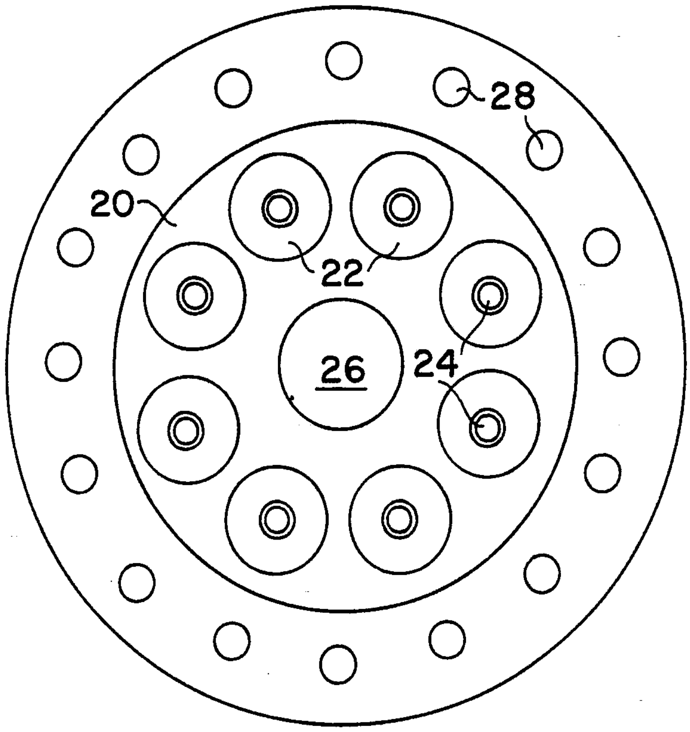


FIG. 10



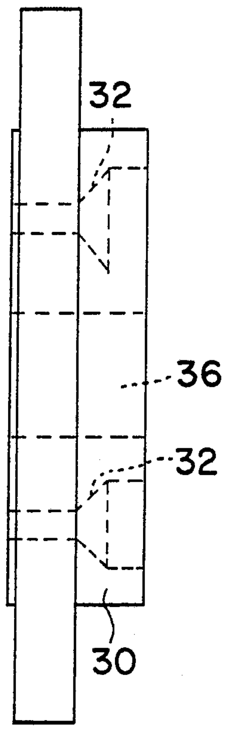


FIG. 13

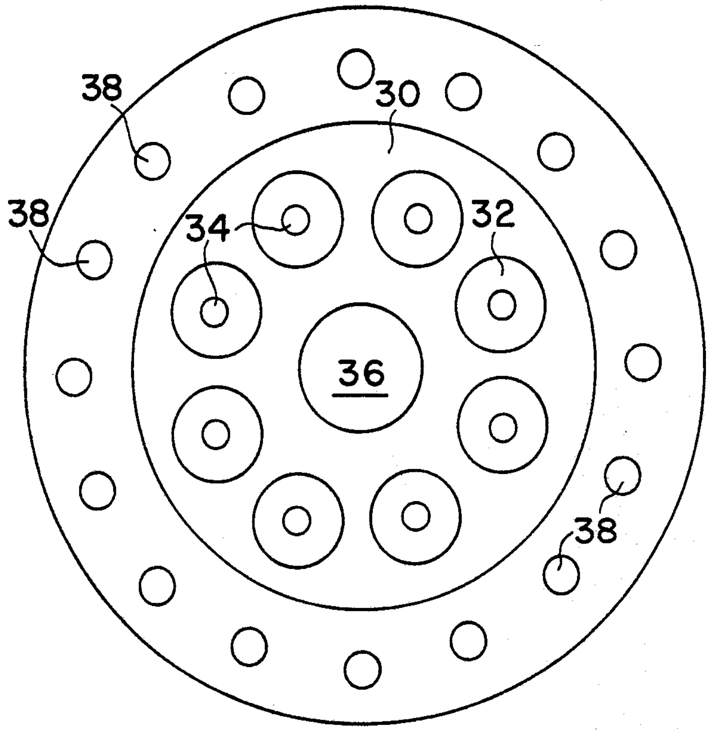


FIG. 12

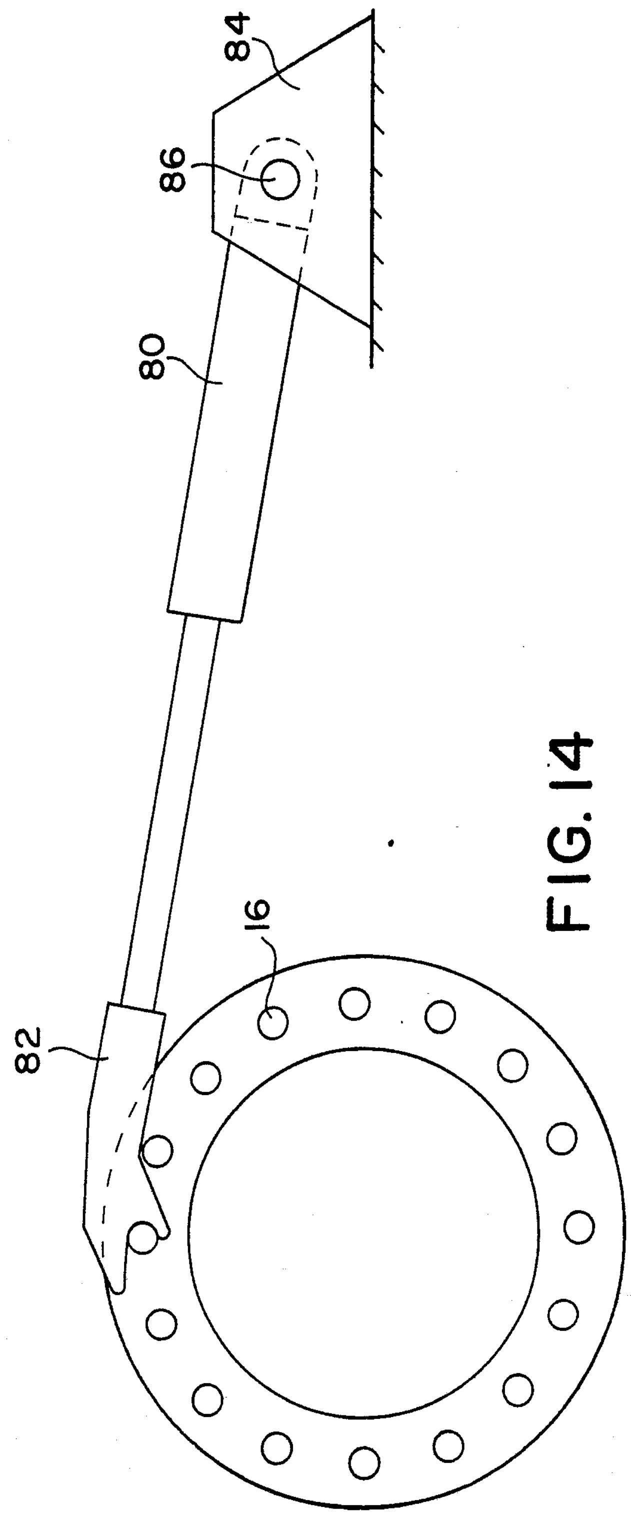


FIG. 14

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US92/02819

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): B01D 33/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	210/ 323.2, 324, 330, 333.01, 333.1, 359, 493, 411

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	US, 3,823,830 (Tsukishima Kikai Co. Ltd.) 16 July 1974.	
A	US, 4,486,304 (Neuman) 04 December 1984.	
A	US, 4,775,487 (Consolidation Conl Co.) 04 October 1988.	
A	Melt Filtration Report, Issue 83-1, April/May, 1983 G.F. Goodman & Son, Inc. Philadelphia, Pennsylvania	
A	Filtration of Plastic Melts, Gneuss Kunststoffenchnik GmBH, Bad Oeynhause, Germany, 1988.	
A	Filtraton of Plastic Melts, Gneuss Inc., Langhorne, Pennsylvania, unknown date.	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
17 June 1992	30 JUN 1992
International Searching Authority	**Signature of Authorized Officer**
ISA/US	Andre Robinson Stanley Siverman

Form PCT/ISA/210 (second sheet) (Rev.11-87)