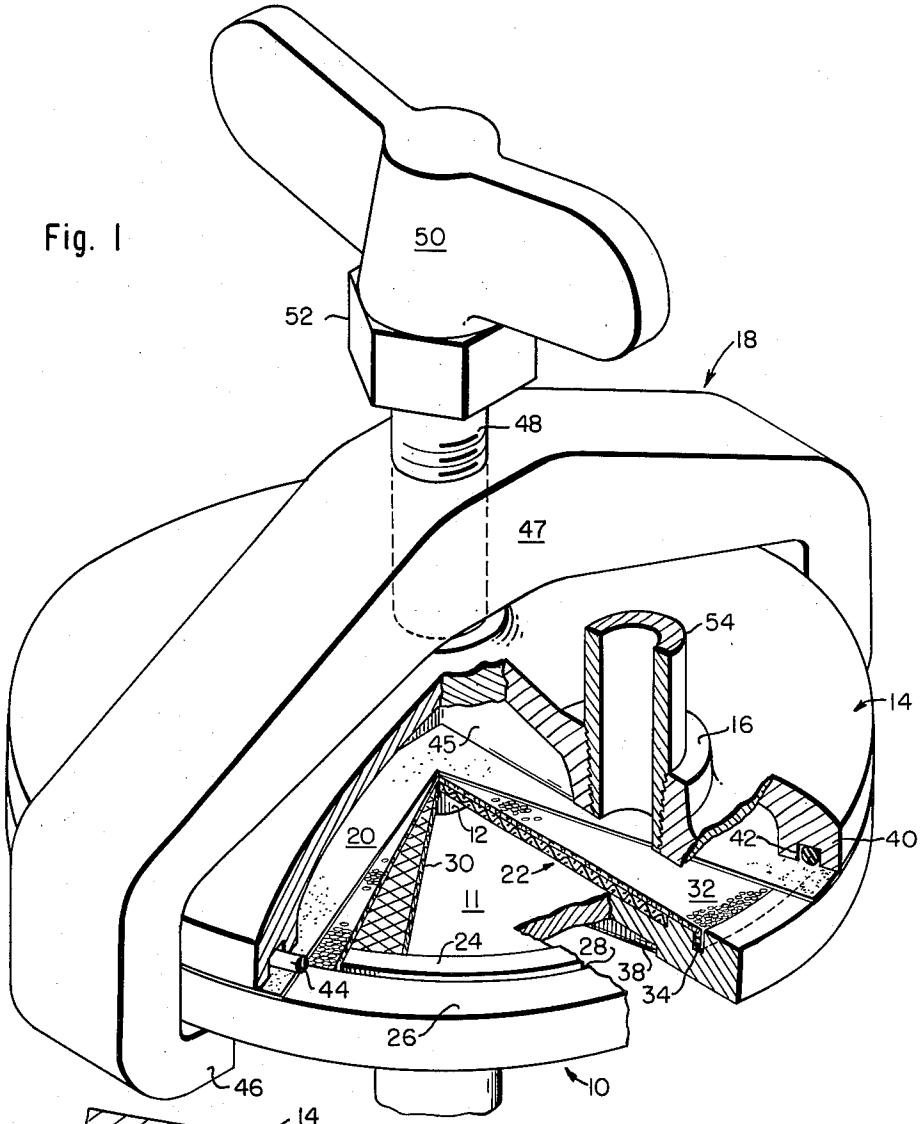
April 24, 1962 V. C. SMITH 3,031,082

FILTRATION APPARATUS

Filed Dec. 11, 1957

Fig. 1



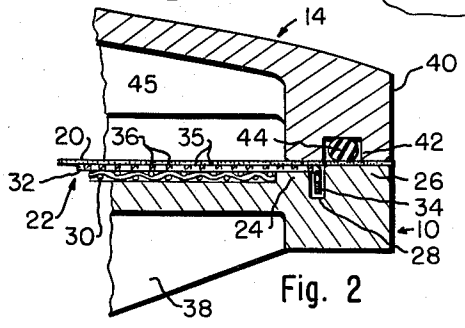


Fig. 2

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FILTRATION APPARATUS

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This invention relates to filtration and consists of a novel apparatus using sheets of filter materials such as microporous sheets capable of removing micro-organisms. The apparatus is particularly designed to permit easy and rapid disassembly as for cleaning or replacement of filter sheets.

Microporous filter materials known to the art consist typically of thin flexible sheets of organic plastic material having transverse pores of effective diameter less than about 5 microns representing a void volume of about 80% of the total volume of the material. The utilization of such materials in filtration operations of relatively large scale, such as in production of purified filtrates, encounters problems based on the fact that the material is relatively fragile and is also rapidly clogged because the filtered particles are retained at the surface of the microporous material. Effective utilization therefor requires that the filter sheet be readily replaceable and that the apparatus be so constructed as not to damage the sheets. The apparatus must provide adequate support while at the same time making adequate utilization of as large an area of the sheet as possible, and must moreover not subject the sheets to the pressure of a sharp corner which would be likely to cause a rupture.

The present invention provides apparatus having these characteristics. In general the apparatus includes a lower tray member having a flat central region provided with a drainage port and surrounded by a raised rim or flange having a flat upper surface. The marginal portion of the sheet of filter material is supported on the upper surface of the flange while the central portion is supported on a foraminous member having a flat upper surface coplanar with the upper surface of the flange and providing drainage passage from beneath the sheet. An upwardly dished cover member provided with an inlet port and having edge portions terminating in a flat surface overlying the upper surface of the flange is assembled with the tray, with the sheet held by its marginal portion between the flat surface of the cover and the upper surface of the flange.

In preferred embodiments the raised outer rim or flange of the tray member is in the form of an inner shoulder and an outer rim having an upper surface raised from the top of the inner shoulder. A foraminous plate is supported on the inner shoulder such that its upper surface is coplanar with the upper surface of the outer rim, and the central portion of this foraminous plate is supported on a woven screen, the edges of which lie just within the inner shoulder such that the screen is held in place by the shoulder. Similarly the edges of the foraminous plate lie just within the outer rim such that the plate is firmly held in place.

With a construction of this type the filter sheet may be readily replaced and the entire construction easily disassembled for cleaning or sterilization.

The preferred embodiment of this invention is described in detail below with reference to the drawings in which:

FIG. 1 is a perspective view of the preferred embodiment of the apparatus, with parts broken away to reveal structural details, and

FIG. 2 is a fragmentary cross section through the edge portion of the apparatus shown in FIG. 1.

In its preferred embodiment the filtration assembly of this invention is organized about a two piece housing which may be separated to permit the parts to be cleaned or replaced. The housing consists generally of a lower tray 10 formed with a flat recessed area 11 having a drainage port 12, and an upwardly dish cover 14 having an offcenter inlet port 16. A clamp 18 holds the housing members together. The sheet of filter material 20 is clamped at its margins between the tray 10 and cover 14 with its central portion supported on a flat foraminous structure designated generally by 22.

In its preferred embodiment the lower tray 10 is in the form of a generally circular plate having a raised marginal flange including an inner shoulder 24 and an outer rim 26 separated from the shoulder by a deep annular groove 28. A woven wire screen 30 having a thickness about equal to the height of the inner shoulder is supported on the flat central portion 11 of the tray within the inner shoulder 24, and a foraminous plate 32 formed with a downwardly flanged edge 34 rests upon the screen 30 and shoulder 24 with its edge 34 received in the groove 28. The outer rim 26 is higher than the inner shoulder 24 by an amount about equal to the thickness of the plate 32 so that the plate presents a smooth flat upper surface coplanar with the upper surface of the outer rim.

The plate 32 is typically a perforated sheet of metal having numerous relatively large openings 35 with flat land regions 36 between them for supporting the filter material 20 without distorting it. The openings are desirably formed with rounded outwardly flared edges so as not to present a sharp corner to the filter material. A suitable plate 32 is one formed from sheet nickel 0.006 inch thick having openings 0.004 inch in diameter arranged triangularly on centers spaced 0.064 inch apart. Openings of this size and spacing serve well to hold and support the filter material 20 in place.

The lower tray is conveniently formed as a cast structure from which the central recessed portion, the inner shoulder, outer rim and separating groove are machined. To reduce the weight of the casting the central plate portion is formed relatively thin and reinforced with radially disposed ribs 38 formed at its lower surface.

The upper cover 14 is formed with an edge portion 40 having a flat surface overlying the upper surface of the rim 26 and cooperating therewith to hold the edge portions of the filter material 20. A tight seal between the members is assured by forming the edge of the cover with an annular groove 42 in which a round gasket 44 of circular cross section is received. The gasket is typically of a soft resilient material, such as rubber, and has a thickness slightly greater than the depth of the groove so as to be placed under compression when the cover 14 and tray 10 are clamped tightly together. Because of its round cross section, the gasket is caused to press against the filter material with a gradient pressure, high at the center of the area contacted by the gasket and lessening toward the edges. A sharp pressure differential on the surface of the filter film is thereby avoided. The cover 14 is also typically a cast metal structure and may be formed with inner radial reinforcing ribs 45.

The tray 10 and cover 14 are held together by a C-shaped clamp 18 having hook-shaped ends 46 adapted to grasp opposite bottom portions of the tray, and a central portion 47 spanning the top of the cover. A threaded bolt 48 located at the center of the clamp 18 engages the center of the cover 14 and permits the two members to be held together under any desired pressure. The bolt 48 is provided with a winged handle 50 and with a polygonal head 52 which may be grasped by a wrench.

The filtration of liquids may be carried out in the apparatus described above simply by introducing the material to be filtered into the inlet 16 of the assembled apparatus and removing filtrate from the outlet 12. The

material to be filtered may be applied under any reasonable pressure as by pumping it through an inlet pipe **54** threaded to the inlet opening **16**. In the apparatus the material to be filtered is free to flow over the top surface of the filter sheet **20** and filtrate will then drain through the entire area of the sheet and through the holes **35** in the plate **32**. The woven screen **30** underlying the plate **32** provides a support for the plate that permits fluid flow in a direction both perpendicular and parallel to its plane. The filtrate is thus free to drain from beneath the plate **32** and to flow along the flat bottom **11** of the tray to the drainage port **16**, from whence it is collected.

From the foregoing description it will be seen that this invention provides a filter apparatus well suited to receive sheets of filter material of numerous types, particularly those of a fragile or brittle nature since a relatively large amount of flat supporting surface is provided and sharp corners or edges are avoided. In applications where the filter material is easily clogged, the apparatus of this invention may be disassembled easily and quickly for rapid replacement of filter material, and where cleaning is necessary the various component parts may be easily removed. Notwithstanding the facility of disassembling the apparatus and removing the component parts it will be seen that the foraminous plate **32** and underlying screen **30** are nevertheless held by the outer rim **26** and shoulder **24** in a manner requiring a deliberate manipulation to remove them. Because the foraminous plate **32** is located not only within the inner edges of the outer rim **26** but is also formed with a downwardly depending flange **34** which is received within the annual groove **23**, the foraminous plate and screen are accurately positioned within the tray and are not likely to be dislodged from the tray accidentally.

Although described in detail with particular reference to the presently preferred embodiment, it is contemplated that obvious modifications will occur to those skilled in the art and familiar with this disclosure and that such modifications may be made without departing from the scope of this invention.

Having thus disclosed my invention and described in detail its preferred embodiment, I claim and desire to secure by Letters Patent:

1. Filter apparatus comprising in combination a lower tray member having a substantially flat central region and a drainage port leading therefrom, a raised inner shoulder having a flat top surface surrounding said central region, and a raised outer rim surrounding said shoulder and separated therefrom by a groove extending between said shoulder and said outer rim, said outer rim having a flat upper surface parallel to and raised above the top surface of said shoulder; a screen permitting flow perpendicular to its plane supported on said flat central region and having an upper surface substantially coplanar with the top surface of said shoulder; a foraminous plate supported at its center portion on the upper surface of said screen and at its marginal portion on the top surface of said shoulder, said foraminous plate having a downturned flange about its periphery received in and removably retained in said groove and having an upper surface substantially coplanar with the upper surface of said outer rim; a sheet of filter material overlying said foraminous plate having marginal portions overlying the upper surface of said outer rim; a cover member having a dished central portion provided with an inlet port, and having edge portions terminating in a flat surface overlying the upper surface of said outer rim and cooperating

therewith to hold the marginal portions of said sheet; and means holding said cover member and tray member in assembled relation, said flange and groove cooperating with each other to maintain said plate and screen in assembled relation with said tray member when said cover is removed.

2. Filter apparatus comprising in combination a lower tray member having a substantially flat central region and a drainage port leading therefrom, a screen permitting fluid flow perpendicular to its plane supported on said central region, an inner shoulder integral with said tray closely surrounding said screen and having a flat top surface substantially coplanar with the upper surface of said screen, a foraminous plate overlying said screen having marginal portions overlying the top surface of said shoulder, an outer rim integral with said tray closely surrounding the edge of said plate and having a flat upper clamping surface substantially coplanar with the upper surface of said plate, a sheet of filter material supported on said foraminous plate having marginal portions overlying the upper surface of said rim, a dished cover member provided with an inlet port and having edge portions terminating in a flat lower clamping surface overlying said flat upper clamping surface of said rim and cooperating therewith to hold said sheet of filter material, and means holding said cover member and tray member in assembled relation.

3. Filter apparatus comprising in combination a lower tray member having a substantially flat central region and a drainage port leading therefrom, a screen permitting fluid flow perpendicular to its plane supported on said central region, an inner shoulder integral with said tray closely surrounding said screen and having a flat top surface substantially coplanar with the upper surface of said screen, a foraminous plate overlying said screen having marginal portions overlying the top surface of said shoulder, an outer rim integral with said tray closely surrounding the edge of said plate and having a flat upper clamping surface substantially coplanar with the upper surface of said plate, a sheet of filter material supported on said foraminous plate having marginal portions overlying the upper surface of said rim, a dished cover member provided with an inlet port and having edge portions terminating in a flat lower clamping surface overlying said flat upper clamping surface of said rim and cooperating therewith to hold said sheet of filter material, a continuous groove formed in one of said clamping surfaces and a continuous gasket of round cross section of diameter greater than the depth of said groove received in said groove, and means holding said cover member and tray member in assembled relation.

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