Dec. 16, 1958 H. M. HUNTER 2,864,503

FILTRATE DRAINAGE SYSTEM FOR ROTARY FILTERS

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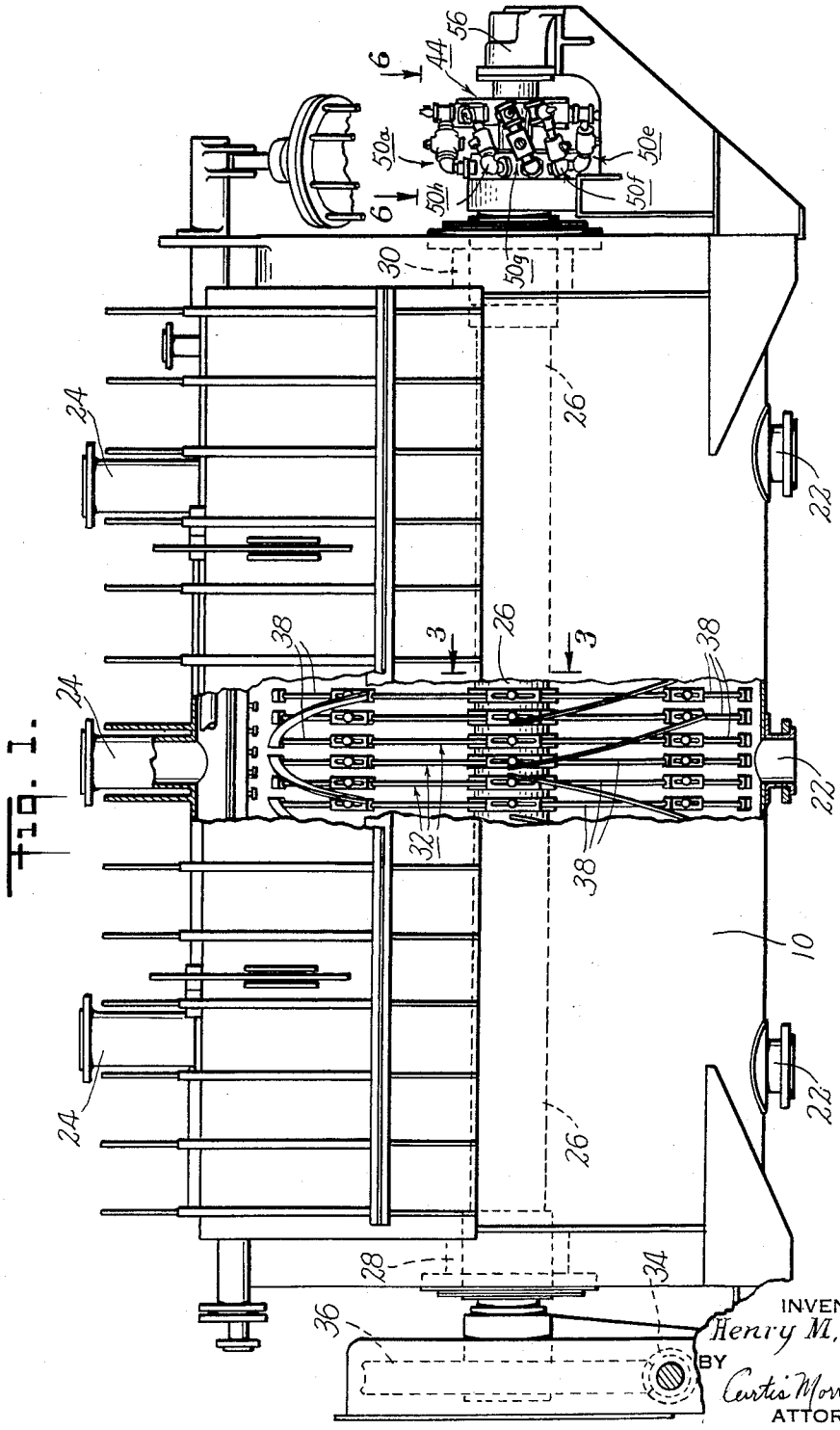


Fig. 1.

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Fig. 2.

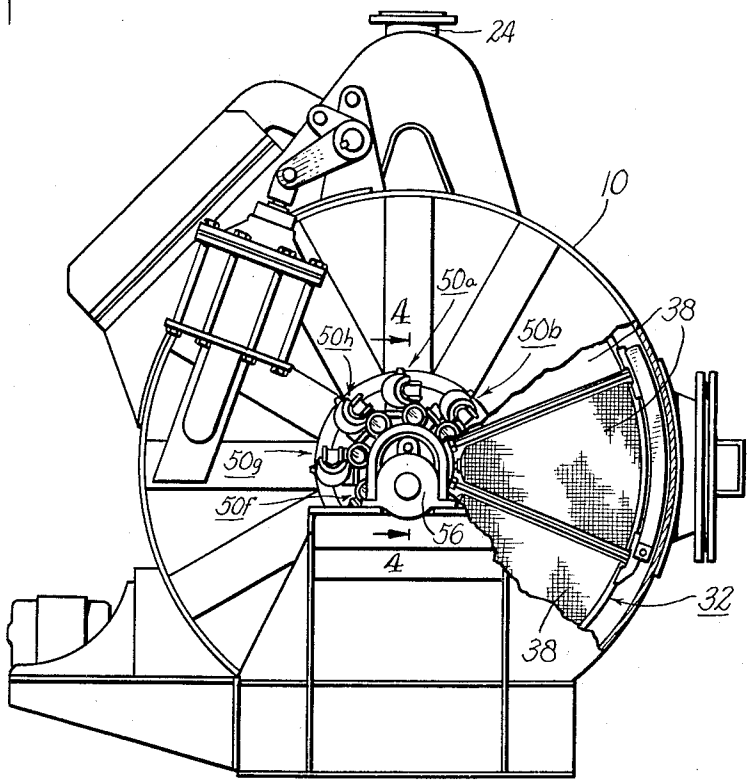
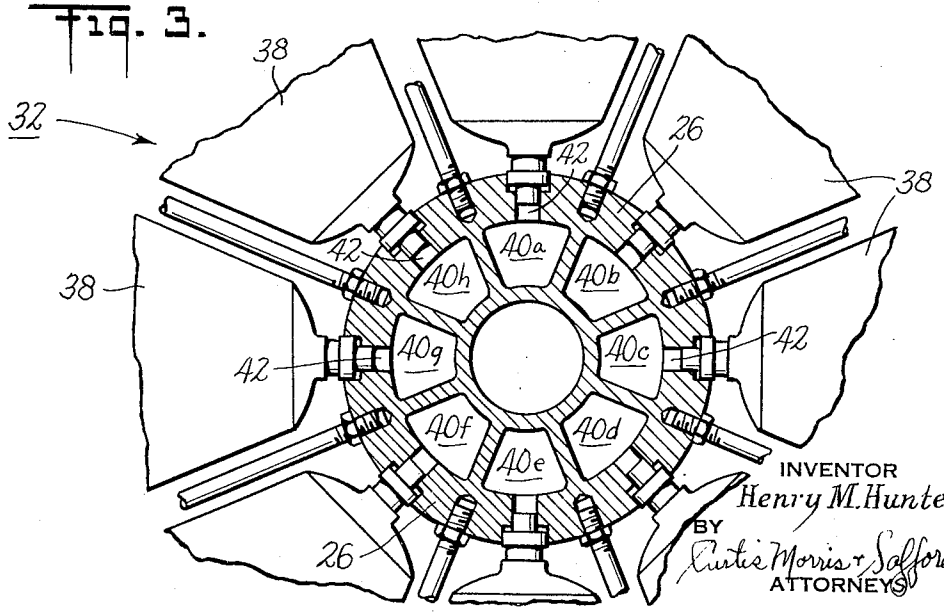


Fig. 3.



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FILTRATE DRAINAGE SYSTEM FOR ROTARY FILTERS

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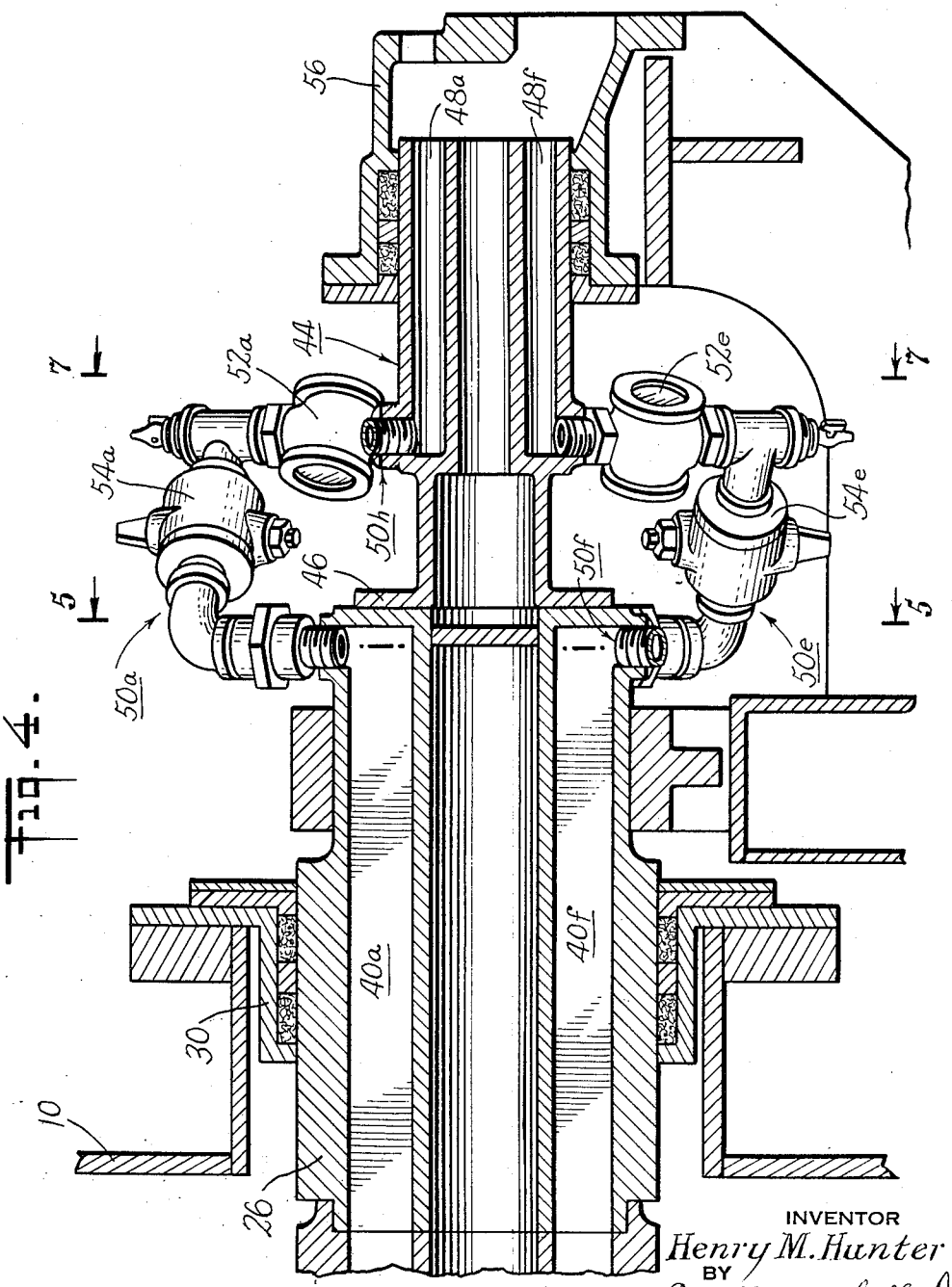


Fig. 4.

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FILTRATE DRAINAGE SYSTEM FOR ROTARY FILTERS

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Fig. 5.

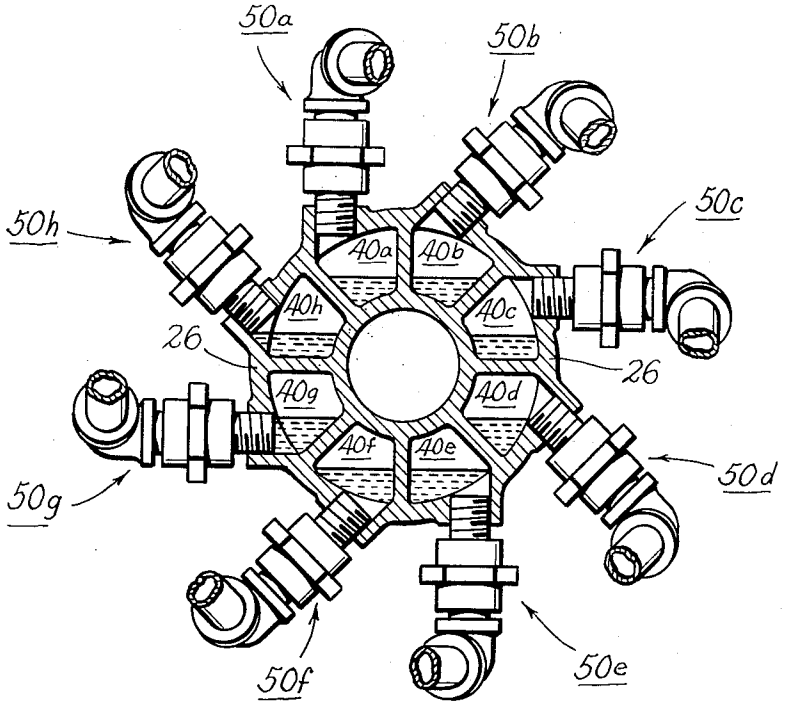
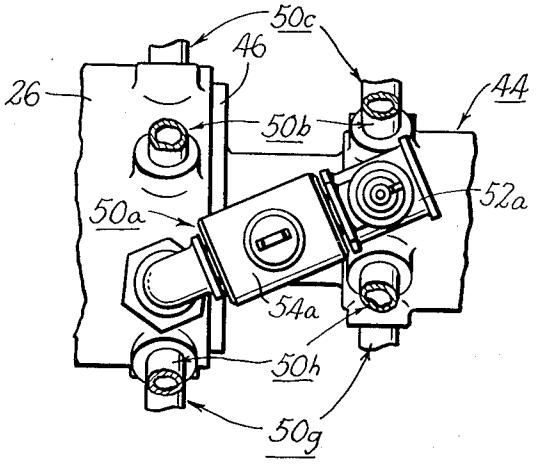


Fig. 6.



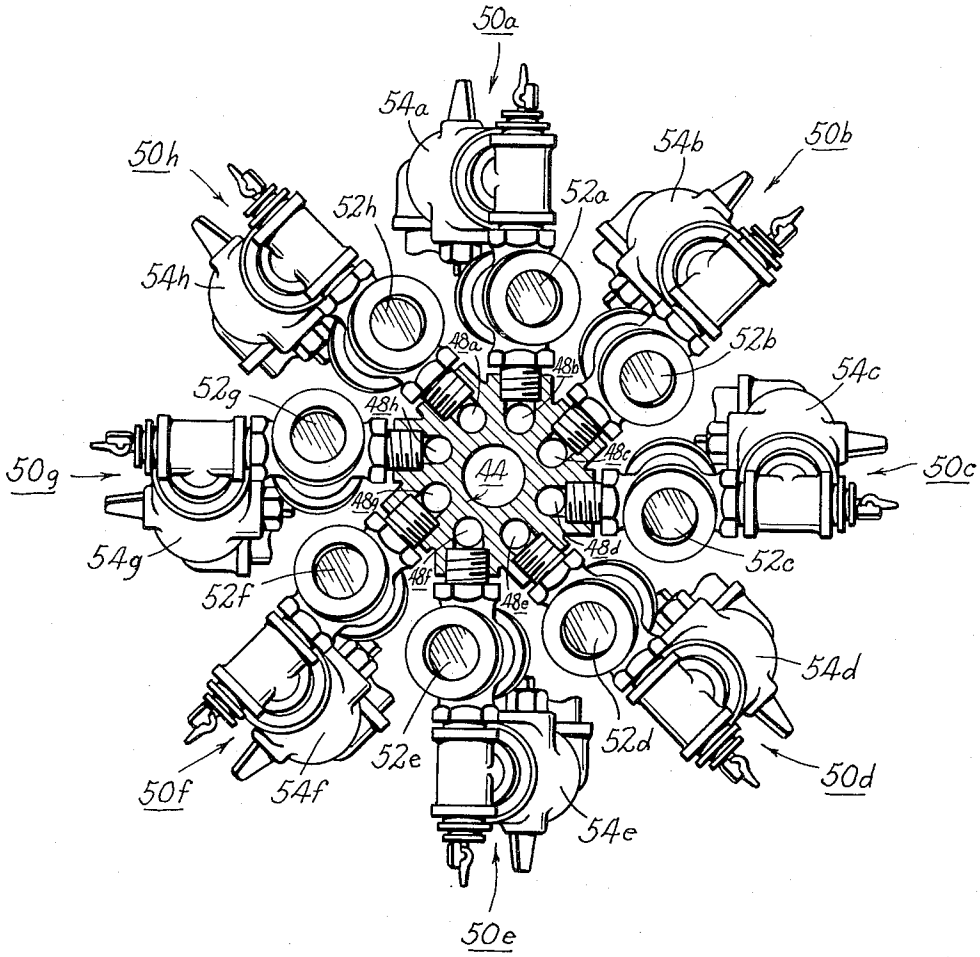
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FILTRATE DRAINAGE SYSTEM FOR ROTARY FILTERS

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Fig. 7.



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FILTRATE DRAINAGE SYSTEM FOR ROTARY FILTERS

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Fig. 8.

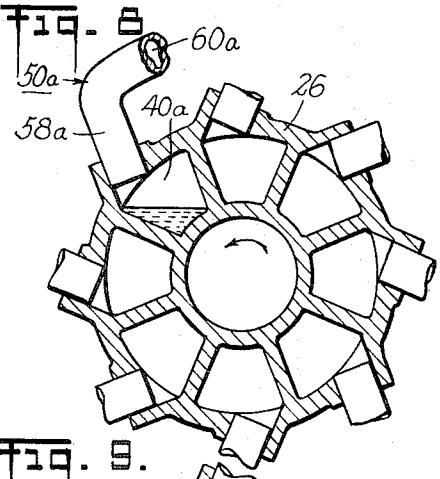


Fig. 9.

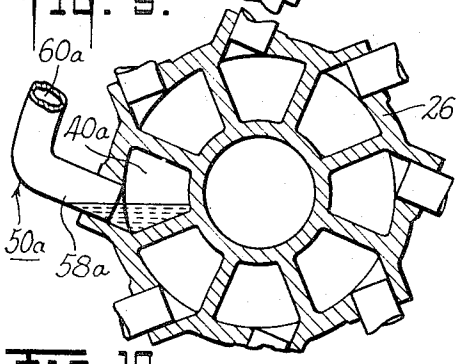


Fig. 10.

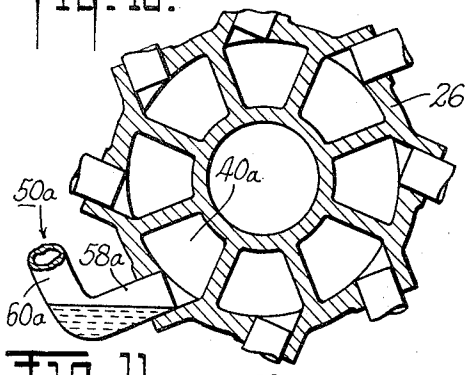


Fig. 11.

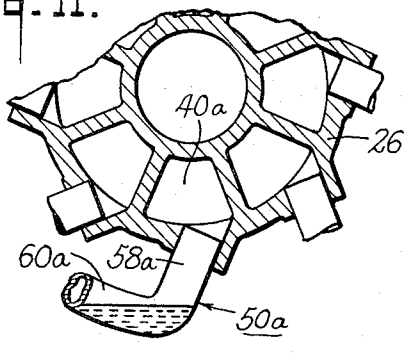


Fig. 12.

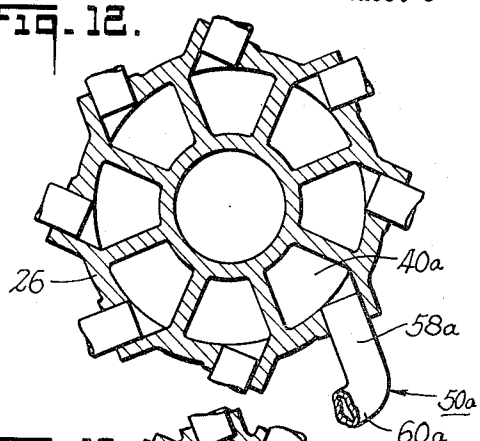


Fig. 13

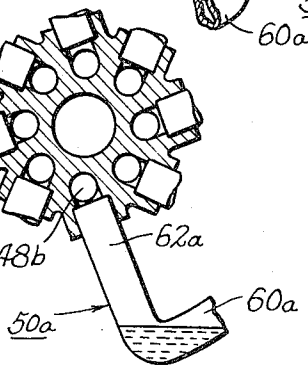


Fig. 14.

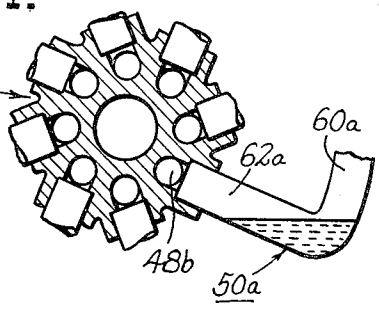
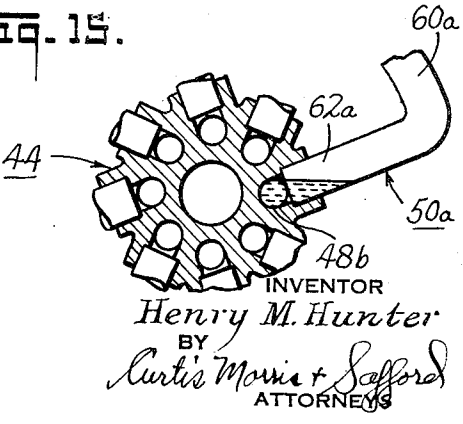


Fig. 15.



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2,864,503

FILTRATE DRAINAGE SYSTEM FOR ROTARY FILTERS

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Application June 6, 1956, Serial No. 589,700

9 Claims. (Cl. 210—93)

This invention relates to rotary filters and more particularly to an improved filtrate discharge system for such filters. The system of the present invention is especially useful in conjunction with rotary leaf filters of the type that have a horizontal rotatable shaft with longitudinal drainage channels therein into which filtrate flows from leaf filter elements circumferentially arranged around the shaft and will be illustratively described as applied to such a filter. However, as the description proceeds it will become apparent that the present drainage system can be used with other types of rotary filters and in fact in any case where it is desired to control liquid drainage from an internally channeled horizontal rotatable shaft.

Rotary leaf filters with which the present invention may be usefully employed may be sectionalized cyclic pressure filters of the general type disclosed in U. S. Patent 2,696,916 issued to C. L. Peterson, C. J. Peterson and H. M. Hunter. Such filters commonly comprise a chamber adapted to contain a material to be filtered and having therein a hollow horizontal rotatable shaft that is internally divided to form longitudinal filtrate drainage channels. Vertically arranged on the shaft are a series of spaced leaf filter discs, each disc being made up of a number of filter segments and each segment being connected to one of the longitudinal channels of the shaft. Filtrate flows from the interior of each filter segment into one of the shaft drainage channels and is removed at the end of the shaft.

In the operation of such filters it has been found desirable to provide individual control means for controlling the filtrate discharge from the several channels of the central shaft. The filtering surfaces of the filter segments, which are commonly made of a fabric, eventually wear out and permit unfiltered material to flow into the filtrate channels. By providing independent controls for the separate drainage channels, each aligned set of filter segments can be cut off independently. Hence when the filtering surface of one segment develops an imperfection the channel to which it is connected can be cut off and the filter can be continued in service for a further period of time, e. g. until the end of the normal filtering cycle. In this way a shut-down of the filter for repair purposes can be postponed until a convenient time for making such repairs occurs.

To effect such independent control of the filtrate drainage it has been the practice to mount at the discharge end of the channeled shaft a filtrate discharge member having passages aligned with the several channels of the shaft and to connect the channels and passages by transfer conduits, each of which contains a shut-off valve and a sight glass. When an imperfection develops in the filtering surface of one of the filter segments, thus permitting solid materials to flow into the filtrate channel that is connected thereto, the resulting turbidity of the filtrate can be observed in the sight glass of the transfer conduit through which the turbid filtrate is flowing, and the shut-off valve in this transfer conduit can be closed to shut-off the connected channel.

While a filtrate drainage control system of this type has been found quite useful in extending the effective operating period of cyclic pressure leaf filters, it is subject to certain disadvantages. At the end of the filtering cycle it is customary to remove the suspension from the filter casing and shut the filter down for removal of the filter cake from the filter elements. During removal of the suspension from the casing the filter elements are rotated and a certain amount of filtration continues to occur. As the liquid level in the casing drops, the transfer conduits tend to act as traps which retain a portion of the filtrate that is flowing from the shaft channels to the discharge member passages, and as the shaft continues to rotate a portion of this trapped filtrate flows back into the channels of the shaft and into the filter segments as well. This reverse flow of filtrate is undesirable since it tends to remove the filter cake from the filter elements before the suspension has been completely removed from the casing.

It is accordingly an object of the present invention to provide a filtrate drainage control system for a rotary filter which will drain each channel of the shaft of the filter completely during each revolution of the shaft. It is another object of the invention to provide a simple and economical structure for effecting such complete drainage of the shaft channels. Other objects of the invention will be in part obvious and in part pointed out hereafter.

The many objects and advantages of the present invention can best be understood and appreciated by reference to the accompanying drawings which illustrate a rotary filter incorporating a preferred embodiment of the invention and wherein:

Figure 1 is a general side view of the filter broken away at the center to show a portion of the central shaft and a number of filter discs mounted thereon. Also shown in Figure 1, at the right-hand end of the central shaft, is a series of transfer conduits which are spirally arranged with respect to the shaft as more fully described below;

Figure 2 is an end view of the filter further showing the arrangement of the filtrate transfer conduits;

Figure 3 is an enlarged vertical section taken on the line 3—3 of Figure 1 and showing the channels in the central shaft and the manner in which the filter segments are connected to the channels;

Figure 4 is an enlarged, approximately vertical axial section taken on the line 4—4 of Figure 2 and showing two of the filtrate channels of the filter shaft, two of the filtrate passages of the filtrate discharge member and two of the interconnecting transfer conduits;

Figure 5 is a vertical section taken on the line 5—5 of Figure 4 and further showing the filtrate channels of the shaft and the way in which the transfer conduits are connected thereto;

Figure 6 is an enlarged top plan view of the structure shown at the right-hand side of Figure 1 taken on the line 6—6 of Figure 1, with all but one of the transfer conduits removed;

Figure 7 is a vertical section taken on the line 7—7 of Figure 4 and further showing the filtrate passages of the filtrate discharge member and the way in which the transfer conduits are connected thereto;

Figures 8–15 comprise a series of diagrams of the shaft channels and filtrate member passages illustrating the way in which the spirally arranged transfer conduits of the present structure drains the shaft channels completely during each revolution of the shaft.

Referring to the drawings and more particularly to Figure 1, the filter there shown comprises an outer tank

or casing **10** of generally cylindrical configuration and having the connections **22** in the bottom thereof through which a suspension to be filtered can be fed to the interior of the tank and accumulated solids can be discharged from the tank. At its top, the filter tank is provided with connections **24** which can be used to vent air from the tank as it is filled and also to introduce washing liquids to remove the filter cake from the filter segments.

Extending through the center of the tank **20** there is a horizontal shaft **26** mounted for rotation at its opposite ends in bearings **28** and **30**. Supported on shaft **26** for rotation therewith are a series of spaced leaf filter discs **32** which, as described below, communicate with the interior of shaft **26**. The shaft together with its associated filter discs **32** is driven at its left-hand end by a suitable motor (not shown) through a worm gear **34** and worm wheel **36**.

Referring now to Figures 2 and 3, each of the filter discs **32** is composed of eight essentially independent filter segments or sectors **38**. The shaft **26** is hollow and is internally sub-divided into eight channels **40***a*—**40***h*, each corresponding to a filter segment **38** of one of the discs **32**. As shown in Figure 3, the interior of each sector **38** is connected through a passage **42** with one of the channels **40***a*—**40***h*. Thus each channel of shaft **26** communicates with a longitudinally aligned series of segments **38** of the discs **32**.

In the operation of the filter, the suspension to be filtered is pumped into the tank **20** through one of the connections **22** under a suitable pressure and flows into contact with filtering surfaces of the filter segments **38**. The filtrate accumulating within each segment flows through one of the passages **42** into one of the channels of shaft **26**. As is usual in such filters, the filter is shut down from time to time for removal of the accumulated filter cake from the external surfaces of the filter sectors **38**.

As explained above, when a defect develops in the filtering surface of one of the segments **38** through wear or for other reasons solids can flow to the interior of the filter sector and into one of its channels **40***a* to **40***h*. When this happens it is desirable to have a means of shutting off the particular channel that is connected to the defective filter element so that the filtering cycle can be completed without a shut down for repairs.

Referring to Figures 4 to 7 and more particularly to Figure 4, in order to permit this individual control of filtrate flow through the channels **40***a* to **40***h*, a filtrate discharge member **44** is provided having a flanged left end **46** through which it is secured to the right-hand end of shaft **26**. The discharge member **44** is provided with a series of circumferentially arranged passages **48***a* to **48***h* that are aligned with the passages **40***a* to **40***h* repectively of shaft **26**. Each of the channels **40***a* to **40***h* is connected to one of the passages **48***a* to **48***h* by a transfer conduit **50***a* to **50***h*. However, the transfer conduits do not connect aligned channels and passages, but rather are spirally arranged in order to effect complete drainage of the channels **40***a* to **40***h* as hereafter explained. More particularly the transfer conduit **50***a* interconnects channel **40***a* of shaft **26** with passage **48***b* of the discharge member **44**. In like manner transfer conduits **50***b* to **50***h* interconnect channels **40***b* to **40***h* repectively of shaft **26** with passages **48***c* to **48***a* respectively of discharge member **44**. In other words the discharge connection of each transfer conduit is radially displaced approximately 45° with respect to its inlet connection.

Each of the transfer conduits **50***a* to **50***h* is provided with a sight glass **52***a* to **52***h* respectively through which the filtrate may be observed to determine whether it is turbid and a shut-off valve **54***a* to **54***h* respectively which can be used to shut off the flow of filtrate through the transfer conduit if the filtrate passing therethrough becomes turbid. Filtrate flowing into the passages **48***a* to **48***h* passes therethrough to a collector chamber **56** and thence to a suitable point of storage or use.

Figures 8 to 15 illustrate diagrammatically, with particular reference to transfer conduit **50***a*, the manner in which the spirally arranged transfer conduits of the present structure effect a complete drainage of the shaft channel. In these figures the channel-connected arm of conduit **50***a* is designated **58***a*, the circumferentially extending portion of the conduit is **60***a*, and the passage-connected arm of the conduit is **62***a*. Figure 8 shows channel **40***a* just about to descend due to the counter-clockwise movement of the shaft **26**, with the arm **58***a* of transfer conduit **50***a* at a small angle with respect to the vertical. Figure 9 shows that as the arm **58***a* approaches the horizontal, filtrate from channel **40***a* starts to flow into the arm. In the position shown in Figure 10 the filtrate from channel **40***a* has flowed completely out of the channel into lower end of the arm **58***a* and to some extent to the section **60***a* of the transfer conduit. Figures 11, 12 and 13 show that as the transfer conduit moves through the lowest point in its revolution the filtrate, due to the spiral arrangement of the transfer conduit, flows away from the arm **58***a* and toward the arm **62***a* of conduit **50***a*. Figures 14 and 15 show the manner in which the filtrate flows through arm **62***a* and drains into passage **48***b* of discharge member **44** as the transfer conduit continues to revolve with the shaft. It will of course be understood that the transfer conduits **50***b* to **50***h* operate in the same manner as conduit **50***a* which is specifically illustrated in Figures 8 to 15.

From the foregoing description it is apparent that the present invention provides a structure permitting attainment of the several objects set forth at the beginning of the specification. Individual control of the filtrate drainage from the separate banks of filter sectors is provided and each of the filtrate channels of the shaft is drained completely during each revolution of the shaft. It is of course to be understood that the foregoing description is illustrative only and that numerous modifications can be made within the scope of the invention. Thus the number of channels in shaft **26** can be varied by changing the number of radial partitions therein. Also the shaft **26** can be transversely partitioned at its center and a discharge member and its associated transfer conduits provided at both ends of the shaft. Moreover the number of shaft channels and discharge passages need not be identical, since more than one shaft channel can be connected to a single discharge passage and more than one discharge passage can be connected to a single shaft channel. Other modifications within the scope of the invention will be apparent to those skilled in the art.

I claim:

1. In a rotary filter of the type that includes a rotatable central shaft having longitudinal drainage channels therein through which the filtrate flows, apparatus for controlling the discharge of filtrate from said filter comprising a filtrate exhaust member rotatable with said shaft and having a filtrate passage corresponding to each of said drainage channels and a series of filtrate transfer conduits each having an inlet end connected to one of said channels and a discharge end connected to one of said passages, the discharge end of each conduit being circumferentially spaced with respect to its inlet end to insure complete drainage of the connected channel during each revolution of said shaft.

2. In a rotary filter of the type that includes a rotatable central shaft having longitudinal drainage channels therein through which the filtrate flows, apparatus for controlling the discharge of filtrate from said filter comprising a filtrate exhaust member rotatable with said shaft and having a filtrate passage corresponding to each drainage channel of said shaft and a series of filtrate transfer conduits each having an inlet end connected to one of said channels and a discharge end connected to one of said passages, at least a portion of each of said conduits

being located radially outward of the peripheries of said shaft and exhaust member, the discharge end of each conduit being circumferentially spaced with respect to its inlet end to insure complete drainage of the connected channel during each revolution of said shaft.

3. A rotary filter according to claim 2 and wherein each of said conduits contains a shut-off valve.

4. A rotary filter according to claim 2 and wherein each of said conduits contains both a shut-off valve and sight glass.

5. In a rotary filter of the type that includes a rotatable central shaft having longitudinal drainage channels therein through which the filtrate flows, apparatus for controlling the discharge of filtrate from said filter comprising a filtrate exhaust member rotatable with said shaft and having a plurality of filtrate passages, and a plurality of transfer conduits each having an inlet end connected to one of said channels and a discharge end connected to one of said passages, said transfer conduits being spirally arranged with respect to said shaft and filtrate exhaust member with the inlet end of each transfer conduit positioned circumferentially in advance of its discharge end to insure complete drainage of the connected channel during each revolution of said shaft.

6. In a rotary leaf filter of the type that includes a rotatable central shaft having longitudinal drainage channels therein into which filtrate flows from leaf filter elements circumferentially arranged around said shaft, apparatus for controlling the discharge of filtrate from said filter comprising a filtrate exhaust member rotatable with said shaft and having a filtrate passage aligned with each drainage channel of said shaft, and a series of filtrate transfer conduits each having an inlet end connected to one of said channels and a discharge end connected to one of said passages, at least a portion of each of said conduits being located radially outward of the peripheries of said shaft and exhaust member, the discharge end of each conduit being connected to the filtrate passage adjacent to the filtrate passage that is aligned with the drainage channel to which the inlet end of said conduit is connected, whereby complete drainage of the connected channel during each revolution of said shaft is insured.

7. In a rotary leaf filter of the type that includes a rotatable central shaft having longitudinal drainage channels therein into which filtrate flows from leaf filter elements circumferentially arranged around said shaft, apparatus for controlling the discharge of filtrate from said filter comprising a filtrate exhaust member rotatable with said shaft and having a filtrate passage corresponding to each drainage channel of said shaft, and a series of

generally U-shaped transfer conduits each having an inlet end connected to one of said channels and a discharge end connected to one of said passages, the discharge end of each conduit being circumferentially spaced with respect to its inlet end to insure complete drainage of the connected channel during each revolution of said shaft.

8. In a rotary leaf filter of the type that includes a rotatable central shaft having longitudinal drainage channels therein into which filtrate flows from circumferentially arranged leaf filter elements supported on said shaft, apparatus for controlling the discharge of filtrate from said filter, comprising a filtrate exhaust member rotatable with said shaft and having a filtrate passage aligned with each drainage channel of said shaft, and a series of generally U-shaped filtrate transfer conduits each having an inlet end connected to one of said channels and a discharge end connected to one of said passages, the discharge end of each conduit being connected to the filtrate passage adjacent to the filtrate passage that is aligned with the drainage channel to which its inlet end is connected, whereby complete drainage of the connected channel during each revolution of said shaft is insured.

9. In a rotary leaf filter of the type that includes a rotatable central shaft having longitudinal drainage channels therein into which filtrate flows from circumferentially arranged leaf filter elements supported on said shaft, apparatus for controlling the discharge of filtrate from said filter comprising a filtrate exhaust member rotatable with said shaft and having a filtrate passage aligned with each drainage channel of said shaft, and a series of generally U-shaped filtrate transfer conduits each having an inlet end connected to one of said channels and a discharge end connected to one of said passages, the discharge end of each conduit being connected to the filtrate passage adjacent to the filtrate passage that is aligned with the drainage channel to which its inlet end is connected, whereby complete drainage of the connected channel during each revolution of said shaft is insured, each of said conduits containing a shut-off valve and a sight glass.

References Cited in the file of this patent

UNITED STATES PATENTS

1,259,139	Salisbury	Mar. 12, 1918
1,793,289	Naugle	Feb. 17, 1931
2,207,618	Grill et al.	July 9, 1940

FOREIGN PATENTS

356,806	Great Britain	Sept. 14, 1931