

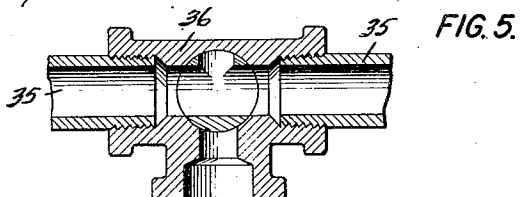
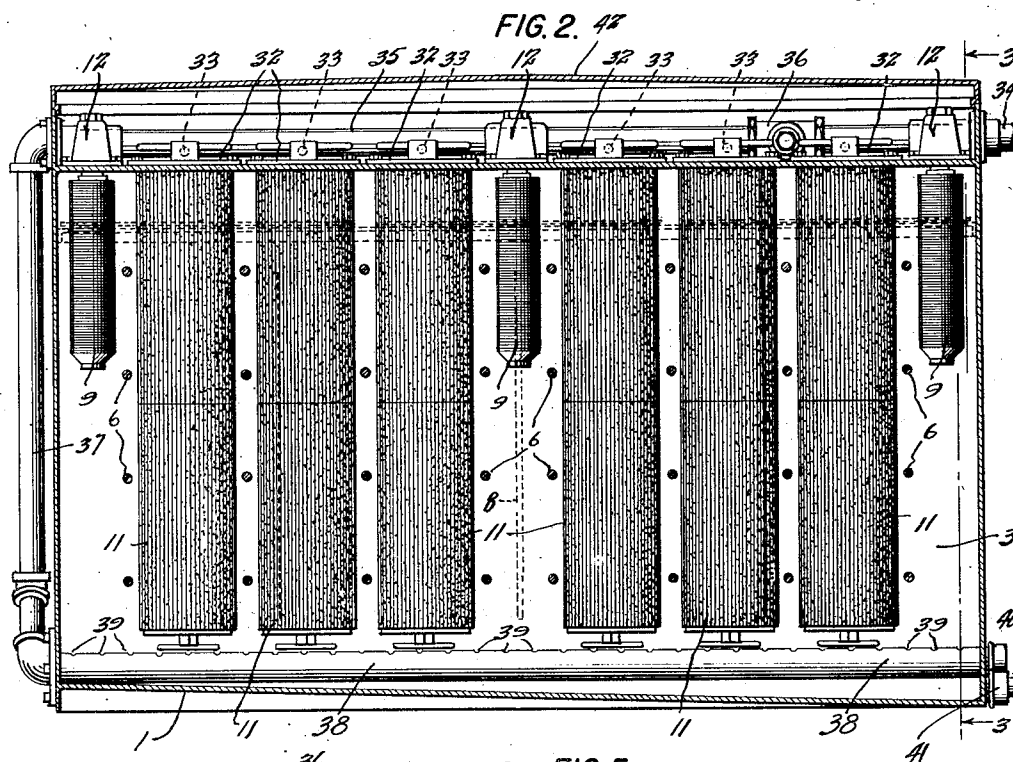
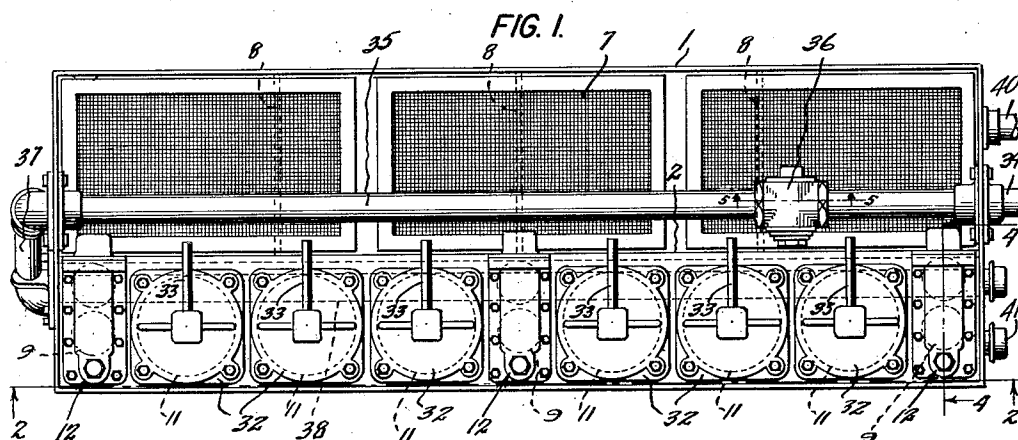
Oct. 30, 1951

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LIQUID CLARIFIER

2,572,971

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7 Sheets-Sheet 1



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FIG. 3.

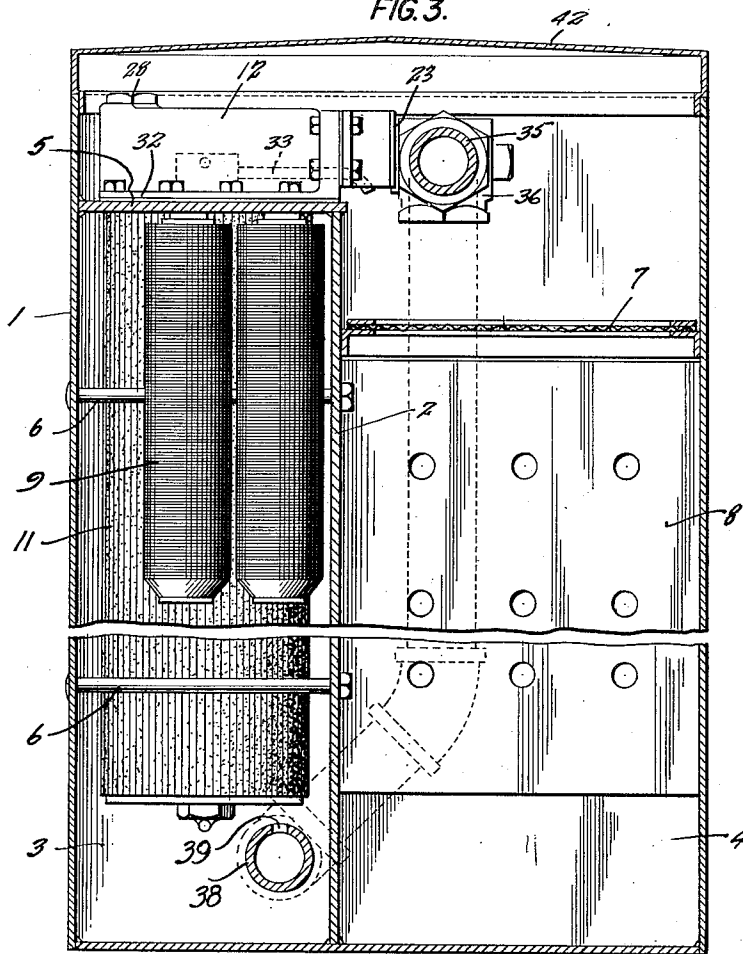
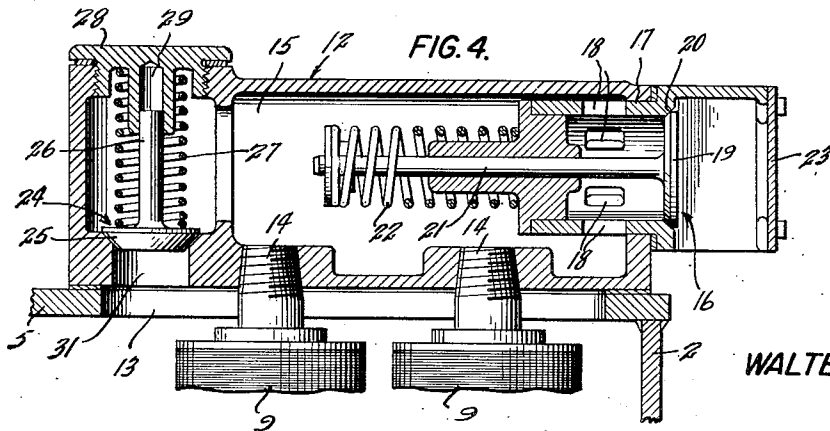


FIG. 4.



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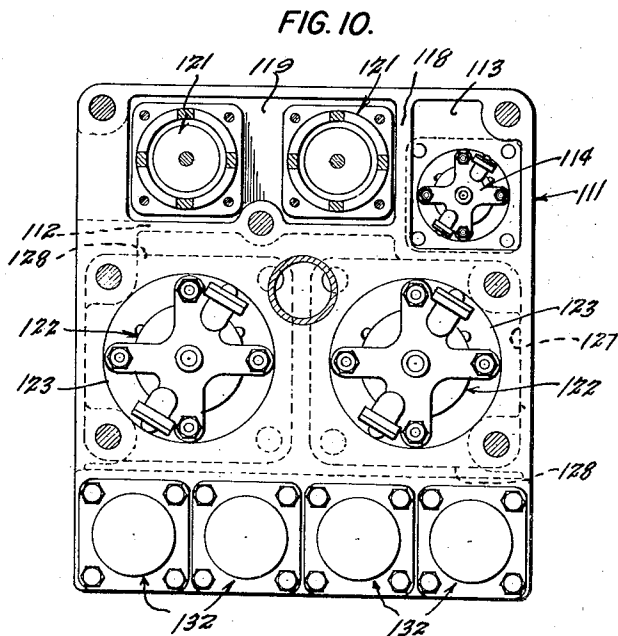
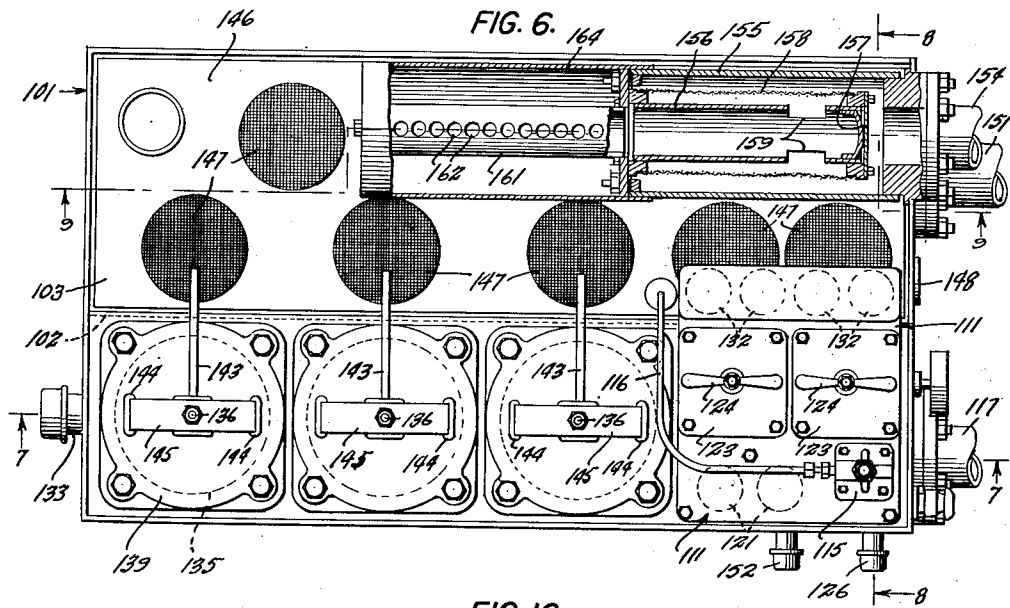
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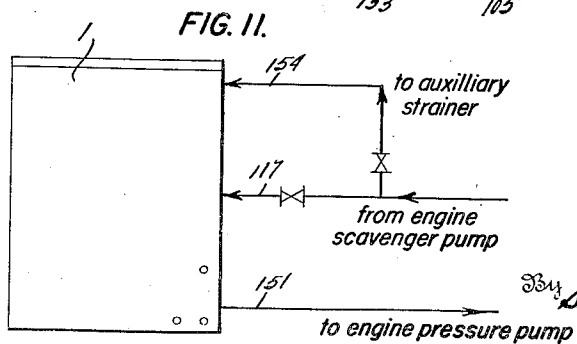
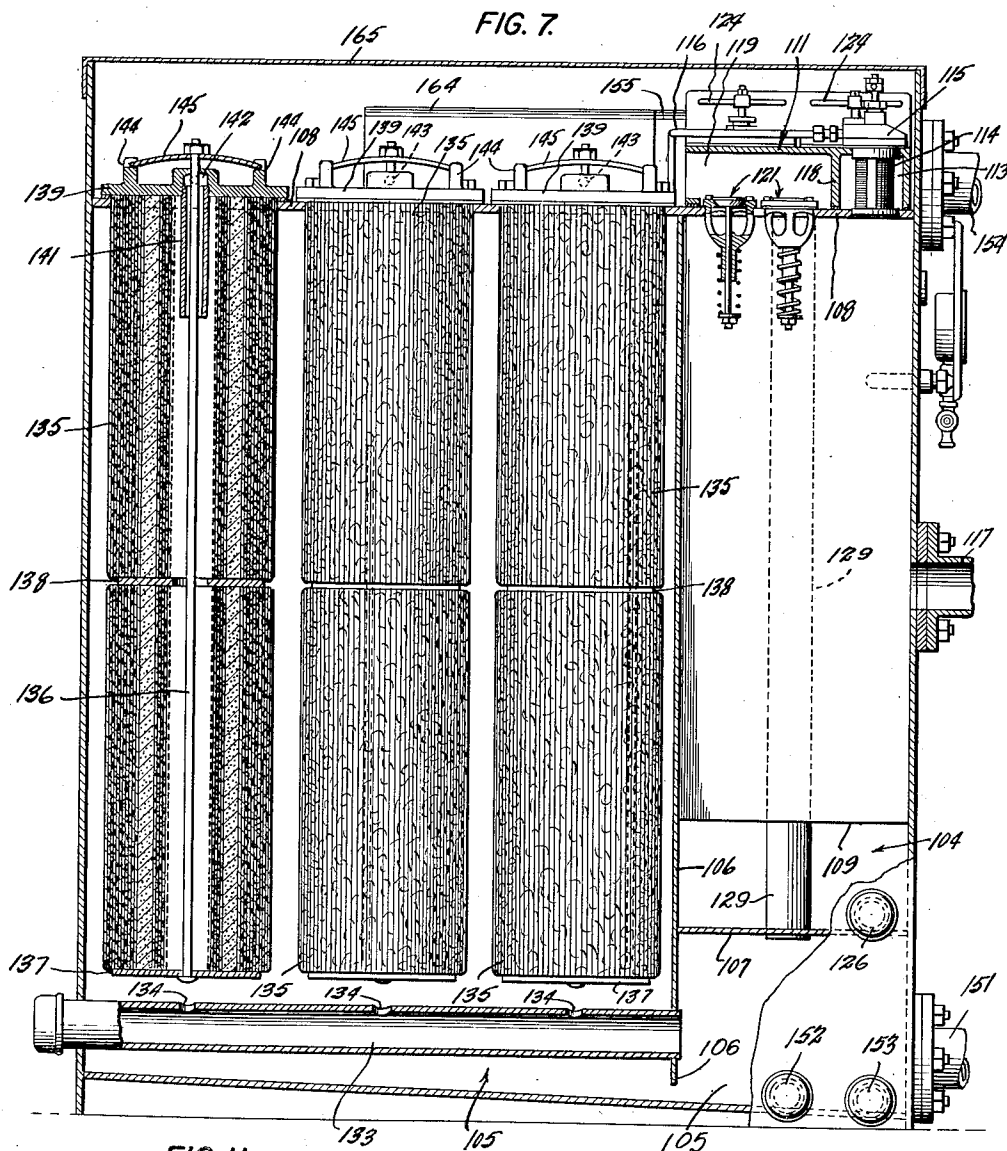
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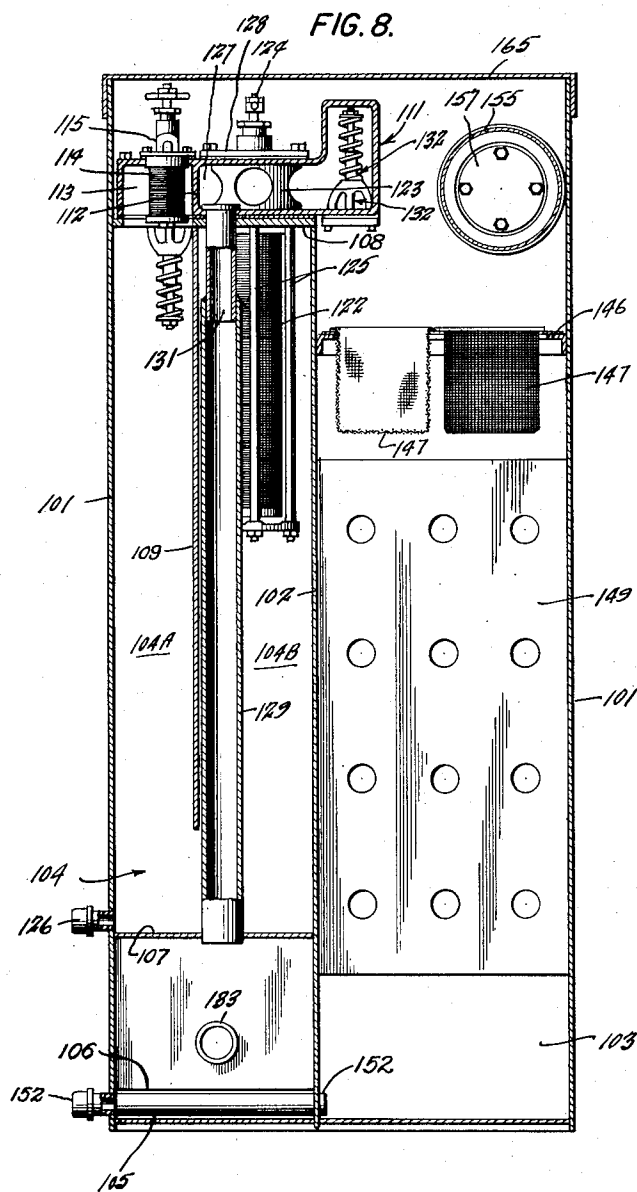
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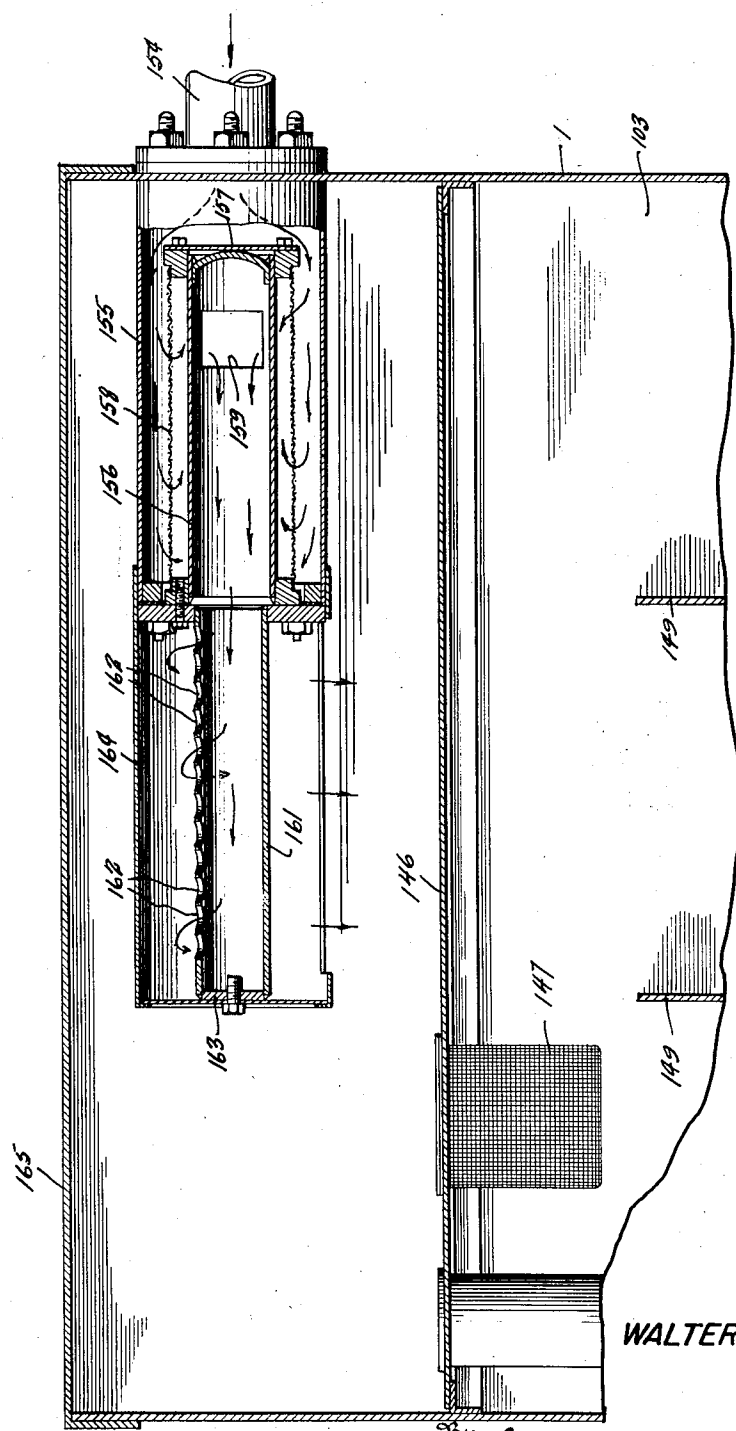
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FIG. 9.



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FIG. 13.

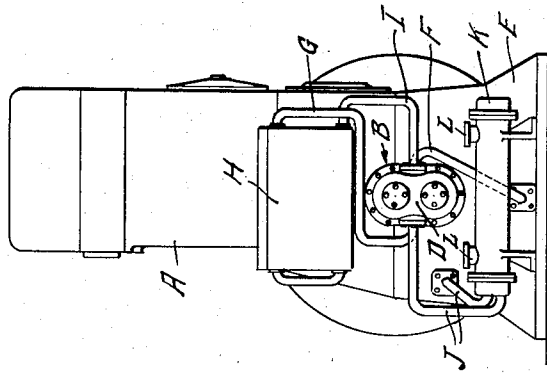
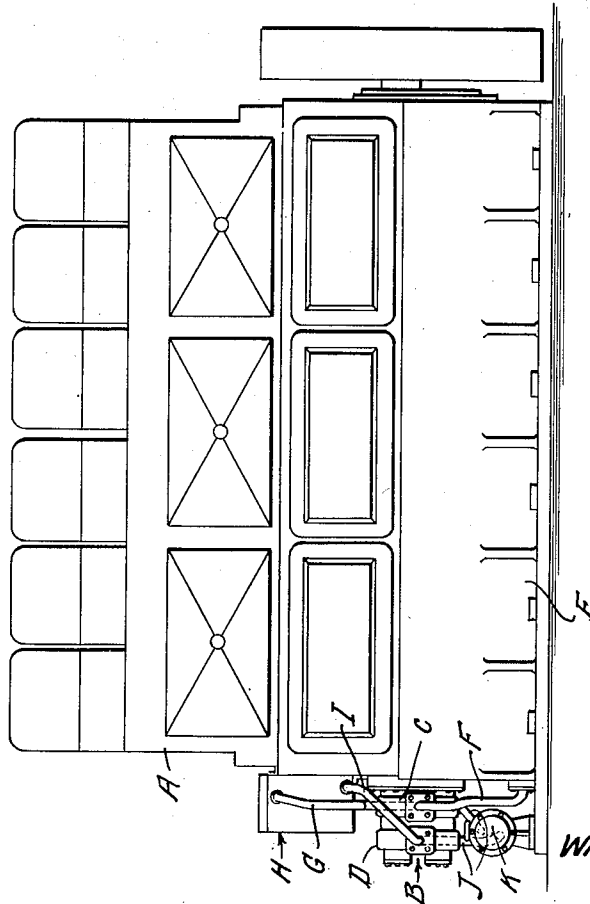


FIG. 12.



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UNITED STATES PATENT OFFICE

2,572,971

LIQUID CLARIFIER

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Application November 25, 1947, Serial No. 787,936

3 Claims. (Cl. 210—184)

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This invention relates to a fluid purification system, and more particularly to a system for purifying the lubricating oil for an engine provided with a dry-sump crankcase and a separate oil storage tank. The present application is a continuation in part of my copending application Serial No. 259,026, filed February 28, 1939, now abandoned, and copending application Serial No. 428,590, filed January 28, 1942, now abandoned. This application discloses subject matter disclosed and claimed in Patent No. 2,447,680 which issued from application Serial No. 491,696, a division of application Serial No. 428,590.

Heretofore clarification systems for engines having a dry-sump crankcase have usually had the filters positioned on the pressure side of a pressure pump. This presents certain disadvantages inasmuch as it has necessitated a relatively heavy construction for the filter, and also increases the possibilities of leakage and injury to the purification system, thus tending to impair the general efficiency of the apparatus. Also, in event of failure of the purifying apparatus, oil pressure to the engine is cut off and the engine may be seriously injured.

Likewise, the prior systems have usually provided the filtering elements separate from the storage tank and also from each other. Obviously such arrangements necessitate an unnecessary amount of line connections, and here again the construction in general must be heavier than is necessary in the system which is the subject of this application. Likewise, special precautions must be taken in the case of such prior systems to avoid leakage.

Furthermore, the previous systems, in general, have provided no adequate means for by-passing the clarification system when it is necessary to make replacements or repairs to the same, and the prior systems have been especially deficient in providing by-passing which will serve to filter the oil even while it is being by-passed around the primary filtering system.

An object of this invention is to provide a purification system which will overcome the above mentioned disadvantages and other disadvantages inhering in the systems of the prior art.

Another object of this invention is to provide a clarifier system which may be positioned on the suction side of the pressure pump and the pressure side of a scavenger pump of a dry-sump crankcase motor.

Yet another object of this invention is to provide an oil clarifier unit in which the filtering

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elements are located within the oil storage tank of a lubricating system for a dry-sump crankcase motor.

Still another object of my invention is to provide an oil clarifier unit composed of a plurality of filtering elements in which the operation of each individual element or group of elements may be readily determined.

A still further object of this invention is to provide an oil purifying system in which provision is made for readily by-passing the system when desired, and particularly where means are provided for filtering the oil when so by-passed.

With these, and other objects in view, my invention in general embraces the concept of providing a purification system which may be positioned between the scavenger and pressure pumps in the lubrication system for an engine of the dry-sump crankcase type. I preferably position the filtering device within the oil storage tank found in the lubricating system for this type of engine. It will be appreciated that the oil in such tank is under substantially atmospheric pressure.

It is usually desirable to provide filters of different capacities—that is, designed to remove foreign matter of different sizes from the oil and in such case the several different filters may be arranged in series or in parallel. In the preferred form of my invention, means are provided for visually observing the operation of the individual elements or group of elements so that it can be readily determined when any one, or group, of such elements needs replacing or repairing.

In the accompanying drawings showing two specific embodiments of my inventive concept, and in which corresponding numerals refer to the same parts:

Figure 1 is a top plan view, with the cover removed, of a clarifying system provided with full flow strainers and filtering elements arranged in parallel.

Figure 2 is a longitudinal sectional view of the device shown in Figure 1, taken along the line 2—2 of Figure 1.

Figure 3 is a cross sectional view taken along the line 3—3 of Figure 2.

Figure 4 is a detailed view of the discharge end, and associated valve arrangement, of the full flow strainers, taken along the line 4—4 of Figure 1.

Figure 5 is a detailed view of the by-pass valve taken along the line 5—5 of Figure 1.

Figure 6 is a top plan view, with the cover

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removed, of a modified form of filtering system in which the full flow strainers and the filtering elements are arranged in series, said device being also provided with certain added features not shown in the form of system illustrated in Figures 1-5.

Figure 7 is a longitudinal sectional view taken along the line 7-7 of Figure 6.

Figure 8 is a cross-sectional view taken along the line 8-8 of Figure 6.

Figure 9 is a detailed view of the by-pass arrangement, provided with straining means, taken along the line 9-9 of Figure 6.

Figure 10 is a view, from beneath, of the casting on which the relief valves, full flow strainers, and air-bleed strainer are mounted.

Figure 11 is a diagrammatic showing of the connections and valves for an installation of a device such as shown in Figures 6-10.

Figure 12 is a side elevational view of a motor upon which is mounted the oil clarifier.

Figure 13 is an end view of the structure shown in Figure 12.

In order to illustrate the invention there is disclosed in Figures 12 and 13 of the drawings, a diesel motor generally designated by the letter A, which is operatively connected by a suitable mechanism to a pump unit, generally designated by the letter B. The pump unit B consists of a scavenger pump C and a pressure pump D.

The crankcase E of the engine is connected to the scavenger pump C by means of a conduit F through which oil is withdrawn from the base of the engine by the action of the scavenger pump C and forced through a conduit G into an oil purifier, generally designated H which forms the basis of this invention.

After the oil has been purified in the unit H, in a manner which will subsequently be described it is drawn through an outlet conduit I into the suction side of the pressure pump D and is then forced through a conduit J which connects the pressure side of the pump to the engine A.

Interposed in the conduit J is a cooler K. The oil in returning to the engine is cooled while passing through the cooler by coming into heat exchange contact with water circulated through the cooler by means connected to the nipples L. These means are not shown.

Referring to the form of purifier device H set forth in Figures 1-5, there is provided a casing or oil storage tank, designated generally by the numeral 1. This tank is divided longitudinally by a wall 2 terminating short of the top of the tank and which forms, in effect, a filtering compartment 3 and an oil reservoir 4 within the tank. The filtering compartment is provided with a top 5 which is suitably apertured to receive the necessary fittings which support the filtering elements and when the fittings are secured in place, serves to maintain the filtering compartment separate and distinct from the oil reservoir 4, even though both compartments are located within the oil storage tank. Stay bolts 6 may be employed to strengthen the dividing wall 2.

A screened cover 7 may be provided for the oil reservoir 4 and serves as a rough strainer for the oil when by-passed, as will be later described. Apertured surge plates 8 are preferably disposed at spaced intervals within the oil reservoir to maintain the surge of the oil therein at a minimum.

Referring more particularly to the individual filtering elements, it will be observed that in the device of Figures 1-5 there are provided both full

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flow strainers 9 and filter cartridges 11, the former to remove coarser material within the oil, and the latter to remove finer material. By "full flow strainer" is meant any type of metallic or fibrous screening material of relatively open mesh but still fine enough so that any dirt particle of sufficient size to damage the engine in one passage through the engine is effectively withheld. As previously mentioned, the full flow strainers and filter cartridges are mounted in parallel so that during one cycle in a normal operation, a portion of the oil will pass through the strainer elements and the remainder through the filter cartridges. The precise form of full flow strainer and the precise form of filter cartridge may be either of the conventional type or of any special design.

Referring particularly to Figures 2 and 4, in the arrangement there disclosed I have provided three pairs of full flow strainers, each pair being supported by a casting 12 which is secured to the cover of the filter compartment, and such casting being disposed over a suitable aperture 13 provided in the cover. The casting is mounted in a fluid-tight fit upon the cover by the use of gaskets or some other suitable means, and supports the full flow strainers 9 by receiving the threaded output nipple 14 of the strainer. The nipples are in fluid communication with a chamber 15 in the casting, and the oil after passing through the full flow strainers 9 enters the chamber 15.

A spring loaded valve, designated generally 16, is mounted in the casting 12 and is composed of a valve body 17 provided with slots 18 which place the interior of the body in communication with the chamber 15. The valve head 19 is provided with a stem 21 and is urged against the valve seat 20 by means of spring 22. The spring 22 of course may be tensioned to afford the desired working pressure for operation of the valve. This pressure is relatively low, and, when exceeded by the pressure of the oil in chamber 15, the valve is opened and the oil from chamber 15 passes therethrough. A splash plate 23 is provided at the discharge end of the valve to direct the discharged oil downwardly. It will be observed from Figure 1 that this oil is discharged onto the screens 7.

In the event that the load on the filter cartridges builds up beyond their designed capacity, which would principally result from one or more of the cartridges being rendered inoperative by virtue of clogging, etc., I have provided for by-passing some of the oil around the full flow strainers 9. These strainers, of course, can accommodate only a certain volume of oil, and such excess passes through a valve 24. This valve consists of a head 25 seated in the casting 12, a stem 26, a spring 27 and a nut 28. The nut 28 is provided with a socket in which the stem 26 may reciprocate, and also serves to hold the spring 27 operatively against the head 25. The nut 28 may be adjusted to provide the desired tension upon spring 27. When the pressure of the oil within the filter compartment 3 exceeds the predetermined amount, the valve 24 is opened, and the oil passes through channel 31, past the valve, and thence into the chamber 15 from which it is discharged through valve 16.

The filter cartridges are suitably mounted upon plates 32 which are secured over apertures provided therefor in cover 5. Discharge spouts 33 are provided on the plates 32 and are in communication with the central bore of the cartridges 11. Therefore, oil, after passing through the car-

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bridges 11, is discharged through the spouts 33 onto the screen cover 7 of the oil compartment.

As stated above, I have disclosed full flow strainers and filter cartridges of conventional construction, in which the oil passes from the outer surface of the elements radially inwardly toward the center of the elements and thence upwardly to the castings 12, in the case of the full flow strainers, and to the plates 32 in the case of the filter cartridges. However, it will be appreciated that strainers or cartridges of different design may be used in my unit, and there may be necessary certain slight modifications for certain types of strainers and cartridges. For instance, any person skilled in the art would recognize the changes that might be necessary if strainers and cartridges were employed in which the oil was filtered by passing longitudinally through the strainers and cartridges, rather than inwardly radially as described above.

As mentioned above, my unit may be placed intermediate the scavenger and pressure pumps in a lubricating system, and the oil from the scavenger pump will enter the unit through connection 34 which is connected with the conduit G illustrated in Figure 12 and thence pass the length of the tank through line 35. A by-pass valve 36 is positioned in line 35, and, as best shown in Figure 5, this valve may be manipulated to send all of the oil to the end of line 35, when in the position shown in Figure 5, or, if the valve is turned 90° clockwise from such position, the incoming oil will be discharged directly onto the screens 7, and thus by-pass the filtering units 9 and 11. Consequently, if it is desired to replace or repair any of the units, this valve may be operated to by-pass the oil while such replacement or repair is being made.

A pipe 37 extends from the line 35 to the base of the tank where it is connected to a manifold 38 provided with apertures 39 along its top. It will therefore be seen that the incoming oil, when not by-passed, is introduced to the filter compartment 3 adjacent its base and beneath the filter cartridges 11 and full flow strainers 9.

A pipe connection 40 corresponding to conduit I in Figure 12 communicates with the oil reservoir 4 near the bottom thereof for flow of oil to the pressure pump of the engine. A capped discharge nipple 41 is provided at the base of the filter compartment 3 to permit a drainage thereof if occasion requires. A cover 42 is provided for the entire tank, and may be removed when it is desired to inspect or work upon the unit.

The operation of this device is believed to be apparent from the foregoing, and consists essentially in the receipt of oil from the scavenger pump and thence the passage of such oil through lines 35 and 37 and discharge of the same through manifold 38 into the filter compartment. It will be observed that the manifold 38 provides for the relative uniform distribution of the incoming oil along the length of the filter compartment, and a portion of this oil passes through the full flow strainers 9 and the remainder through the filter cartridges 11. The proportion of oil passing through the strainers and cartridges will be determined by the setting of valves 16 and 24. To secure, as is the usual practice, a passage of the major portion of the oil through the full flow strainers, the valve 16 will be set to operate at a relatively low pressure. If it is desired to send more of the oil through the filter cartridges, the load on valve 16 may be increased which will thereby build up the pressure within the filter

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compartment 3, and, as a result of this, a greater quantity of oil will pass through the filter cartridge.

One of the salient features of this invention resides in the ability of an operator to easily determine the operation of each of the elements in the unit. For instance, merely by removing cover 42 the operator may observe the discharge from the various spouts 33 and also from the castings 12, and thus determine whether any one of the elements is not operating, or is operating, at a reduced rate.

Referring now to the form of device shown in Figures 6-10, it will be noted that this device is generally similar to the one previously described in that the filtering units are mounted within the oil storage tank, the discharge from the individual cartridges may be readily observed, and that both full flow and filter cartridges are employed. In this case, however, the full flow strainers operate in series with the filter cartridges, an improved by-pass arrangement is provided, and there are also included certain other improvements as will be described in more detail hereafter.

The oil storage tank, designated generally 101, is provided with a longitudinal partition 102 extending from one end of tank 101 to the other. The lower edge of partition 102 engages the bottom of the oil storage tank 101 and the upper edge of the partition is spaced from the top of the tank 101, in the manner best shown in Figure 8. Partition 102 forms one wall of an oil reservoir 103 in the storage tank 101. The space on the side of the partition 102 opposite from reservoir 103 is a contaminated oil compartment divided into oil compartments 104 and 105 by a vertical wall 106 extending from partition 102 to the side wall of the storage tank 101. Referring to Figure 7, it will be seen that vertical wall 106 does not extend to the bottom of tank 101 and that the bottom of the compartment 104 is closed by a horizontal plate 107 secured to the partition 102, vertical wall 106, and the walls of the oil storage tank 101.

Depending from cover plate 108, within compartment 104, is a baffle 109 which subdivides that compartment into areas 104A and 104B.

A casting 111 is mounted over the compartment 104 which casting is provided with a partition 112 to form a compartment 113 which is in communication with the area 104A. Mounted within compartment 113 is a reduced full flow strainer 114, which may be of the so-called "Purolator" type for convenience. This full flow strainer is carried by a mounting 115 which is secured to the top of the casting 111, and there is fitted into the mounting a piece of tubing 116 which extends to a point over the oil compartment 103, as best shown in Figure 6.

The oil from the scavenger pump enters the unit through pipe 117 which empties into the area 104A. The air that is contained in the incoming oil is therefore free to escape, usually in the form of foam, through the strainer 114 and thence through the tubing 116. Any oil that is entrapped in the air is thus directed to the oil reservoir 103.

Referring to Figure 7, it will be noted that one of the walls 118 tending to form compartment 113 provides for a recess 119 in the casting 111, and in the base of this recess, which happens to be the cover plate 108, two spring loaded relief valves 121 are positioned. It will be noted that valves are adapted to open when the pres-

sure within area 104A exceeds the predetermined pressure for which these valves are set. If the pressure in chamber 104 exceeds this predetermined limit, oil is discharged from that chamber into recess 119 and then spills out over the plate 108 and thence into the oil reservoir 103.

Referring again to Figure 8, full flow strainers 122 (two in number for the size unit here disclosed) are mounted in compartment 104 on the side 104B of baffle 109. More specifically, each strainer 122 is rotatably mounted upon a cage 123 which is bolted within the casting 111, and a rod rigidly secured to the strainer 122 extends through the cage 123 and through the top of the casting in a fluid-tight fit. A handle 124 is provided on the top of this rod to enable rotation of the strainer 122.

Rods 125 depend from the cover plate 108, which rods may carry scrapers so that upon rotation of the strainer 122 solid and suspended material that is caught on the surface of the strainer may be removed therefrom and drained from the compartment 104. For purposes of this drainage, a discharge nipple 126 is provided at the base of compartment 104.

It will be noted that the strainer cages 123 are located in a compartment 127 formed in the casting 111, and suitable holes are provided in the top of this compartment to permit the insertion of the strainers 122 and cages 123 therein. Flanged tops of the cages 123 support the strainer assembly and close the apertures in a fluid-tight fit.

Mounted in the base member 107 is a pipe 129 which extends to adjacent the cover plate 108, as best shown in Figure 8. A section of pipe 131 is adapted to extend through the base of casting 111 and cover plate 108, and fits within the upper end of pipe 129.

The oil passes through strainers 122 and thence through the cage 123 into chamber 127. The oil may flow from chamber 127 down through the pipes 131 and 129 to enter the cartridge compartment 105. It will be appreciated that the strainers 122 are materially larger than the strainer 114, and in view of this fact, practically all of the oil received from the scavenger pump will pass through the strainers 122 and only the air and entrained oil will escape through the strainer 114 and tube 116.

Referring to Figures 6 and 8, it will be noted that a series of relief valves 132 are mounted in the compartment 127 of casting 111, and these valves are so loaded that they operate only when a sufficient pressure exists in compartment 127. Such pressure, of course, would be the pressure existing within the cartridge compartment 105, which, in turn, would result from any impairment to the operation of the filter cartridges.

It will be noted that depending wall 106 extends below the base 107 of compartments 104 and to a point only a short distance above the base of the assembled tank. Mounted in this projection, and extending to the end wall of the cartridge compartment, is a manifold 133. It will be noted that there are a number of apertures 134 in this manifold which correspond to the number of filter cartridges, and each aperture is located directly beneath the center of the corresponding cartridge. This feature of the present application, together with the air removal previously described, form the subject matter of my copending application Serial No. 430,961, filed February 14, 1942, now Patent No. 2,401,039. However, briefly, the purpose of this

arrangement of the apertures is to blanket the filter cartridges with the incoming oil. Such oil of course is heated, and consequently upon starting an operation, the cartridges are immediately subjected to the blanket of warm oil. This arrangement, therefore, obviates the lag in time which would be attendant upon heating the entire mass of oil within compartment 105 by the incoming oil. For a more detailed description of this operation, reference is made to my said copending application Serial No. 430,961, now Patent No. 2,401,039.

As in the case of the form of device shown in Figures 1-5, the specific form of full flow strainer and filter cartridge may be optional with the operator. However, I have diagrammatically shown in Figure 7 a cartridge 135 composed of successive layers of filtering material. This may be formed by the use of molded cylindrical blocks of adsorbent material and cellulosic wrapping. Likewise, while each cartridge may be an integral element, if desired, in Figure 7 there are disclosed elements which are made up by axially securing two elements together by means of a rod 136 which extends through the central channel of the two assembled cartridges. A base plate 137 and a gasket-like spacer 138 are used, the tie rod 136 holding the base plate 137 against the bottom of the lower cartridge and securely clamping the two assembled cartridges between the base plate 137 and a cover plate 139. Into the cover plate 139 is screw-threaded a section of pipe 141, such pipe communicating with the central bore of the assembled cartridge and with a recess 142 in the cover plate. Discharge tubes 143 extend from the recess 142 and serve to discharge the oil after passage through the filter into the oil storage compartment 103. The cover plate 139 is provided with two lugs 144, and a leaf spring 145 extends therebetween. The tie rod 136 extends through the spring 145 to clamp the filter cartridge and cover plate in resiliently fixed position.

The cover 108 is provided with apertures to receive the respective filter cartridges, and the cover plates 139 are bolted over such apertures in fluid-tight fit.

Referring to Figures 6 and 8, it will be observed that a cover 146 is provided for the oil compartment 103. Apertures are provided in this cover which are adapted to receive pocket screens 147 to permit the oil which is discharged from the relief valves or the filter cartridges to pass into the oil compartment. Above this cover plate an air vent 148 is provided through which the air from tube 116 may escape to the atmosphere.

Apertured baffle plates 149 are provided in the oil compartment to maintain the surge therein at a minimum. Oil is withdrawn from the oil compartment through discharge pipe 151 and then passes to the pressure pump from whence it is forced to the various bearings of the engines to be lubricated. As best shown in Figure 7, a capped drain pipe 152 is provided to drain the oil compartment when desired, and likewise a capped drain nipple 153 is provided for the purposes of draining the cartridge compartment. This oil may be centrifuged or otherwise cleaned and returned to the storage compartment.

As previously indicated, it is desirable, on occasions, to by-pass the oil around both the full flow strainers and filter cartridges in order to make repair or replacements to some of the elements, and in the form of device here under consideration, I have disclosed a by-pass arrange-

ment which at the same time affords a substantial amount of straining of such by-passed oil. When the oil is to be by-passed in this manner, it enters the unit through pipe 154, rather than through the inlet pipe 117. A schematic flow diagram for both the normal and by-passing operations is set forth in Figure 11.

The by-pass device consists of a cylinder 155 which is bolted to the end wall in communication with inlet pipe 154. Concentrically mounted within such cylinder 155 is a second cylinder 156 having one end closed as at 157. This second cylinder carries in spaced relationship a cylindrical screen 158. Apertures 159 are cut into the cylinder 156 through which oil may pass. As best shown in Figure 9, the incoming oil passes through screen 158 and thence through aperture 159 into the interior of the cylinder 156.

Mounted at the free end of the cylinder 156 is a cylinder 161 provided with a series of apertures 162 along its top side and with a plug 163 at the end opposite the cylinder 156. Therefore the oil after passing through cylinder 156 enters the cylinder 161 and is discharged through the apertures 162. A splash plate 164 surrounds the cylinder 161, save along the bottom, and therefore all of the discharged oil is directed downwardly onto the top of cover 146.

It will be appreciated that by the obvious operation of the valves shown in Figure 11, the oil from the scavenger pump may be directed into the by-pass arrangement, and thence directly into the storage compartment. In this passage the coarser particles of suspended and solid matter will be removed by the cylindrical screen 158. While thus by-passing the oil, the full flow strainers and filter cartridges may be repaired or removed, and at the same time the danger of oil heavily loaded with objectionable matter is obviated.

A removable cover 165 is provided for the assembled unit so that, upon removal, the operation of the individual elements may be observed and such attention given them as may be necessary.

The operation of the device disclosed in Figures 6-10 is believed to be obvious. Normally, oil from the scavenger pump will enter the unit through pipe 117. Any air that is included with such oil will rise in the compartment 104A in the form of foam, be separated by the strainer 114 and pass through the tubing 116. The oil in such foam will flow into the oil compartment 103 through the pocket screens 147 and the air will be removed through air vent 148.

As indicated, inlet 117 is on the side of baffle 109 in which the strainer 114 is located. The air-free oil passes beneath baffle 109 to the opposite side, and then passes through strainer 122 into cage 123 and chamber 127. From chamber 127 the oil flows through pipes 131 and 129 into that portion of the tank beneath the base plate 107 of compartment 104. From there the oil enters the manifold 133 and is discharged through apertures 134.

As previously mentioned, the oil from apertures 134 impinges against the base of the filter cartridges 135 and then ascends upwardly around each cartridge in the form of a film or blanket. This oil, even at the beginning of operations, will be more heated than the oil previously standing in the filter, and thus can permeate the filter cartridges more readily, insuring a practically instantaneous operation of the cartridges. The oil passes through the cartridges to the central

bore of each cartridge and thence upwardly and out through the discharge spouts 143 and into the respective pocket screens. The oil in the oil compartment 103 is then picked up by the pressure pump and distributed to the various bearings of the engine.

The operation of the several relief valves is also believed to be apparent. For instance, if the full flow strainers 122 should become clogged up, the pressure within compartment 104 would thereby be increased. On such increase of pressure, valves 121 are actuated to permit the oil to by-pass both the full flow strainers 122 and the filter cartridges, such by-passed oil being ejected from recess 119 and draining back onto the cover plate 146 of the oil compartment and thence into the body of oil in the storage compartment. On the other hand, if the full flow strainers are operating efficiently, but if the cartridges should become clogged or incapacitated for some other reason, pressure within the cartridge compartment 105 would be increased, and this increase in pressure transmitted to the oil in chamber 127 of the casting. On such increase in pressure within chamber 127, valves 132 would be actuated to permit a by-passing of the oil around the filter cartridges and a discharge of such oil onto the cover plate 146.

And if it is desired to by-pass both the full flow strainers and the cartridges, a filtering of the oil can still be secured by diverting the oil from the scavenger pump into the by-pass arrangement shown in Figures 6 and 9. In this case the oil enters through 154, is filtered through cylindrical screen 158, and then passes onto the cover plate 146 by way of the cylinders 156 and 162.

The advantages of both forms of my device are believed to be apparent from the foregoing discussion, and consist essentially in the provision of filtering equipment intermediate the scavenger and pressure pumps of a lubricating system for dry-sump crankcase engines. It is also to be noted that this filtering takes place within the confines of an oil storage tank, thereby decreasing the amount of piping and connections necessary, not only with the consequent decrease in likelihood of leakage, but even if such leakage should occur, the oil would be recovered within the oil storage tank. Another salient feature of this device is the use of a multiplicity of filtering elements and the ability of an operator to readily observe the operation of the individual elements. The by-pass arrangement, particularly the one operated by valves 132, shown in Figures 6-10, is believed to afford a relatively simple and efficient means of by-passing the oil for a relatively long period of time without the oil becoming unduly loaded with foreign matter. The improvements in certain details will be readily obvious, and in general the device is a simple, efficient and economic filtering apparatus.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

I claim:

1. A liquid clarifier comprising a liquid storage tank having an inlet and an outlet, a partition in the tank separating a liquid reservoir communicating with the outlet from a clarifying compart-

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ment communicating with the inlet, means dividing the clarifying compartment into a filter compartment and a straining compartment, strainers mounted in the straining compartment and filters mounted in the filter compartment, conduit means extending from the strainers to the filter compartment arranged to deliver liquid from the strainers to the filter compartment, said filters having discharge means delivering the liquid to the reservoir, and pressure responsive valve means in communication with the conduit means intermediate the strainers and filters adapted to open when the pressure drop across the filters exceeds a predetermined amount whereby oil from the strainers by-passes the filters.

2. Apparatus according to claim 1 in which each of the filters has a discharge tube terminating above the level of the liquid in the reservoir to allow observation of the condition of the liquid discharged from each of the filters to the oil reservoir.

3. A liquid clarifier comprising a liquid storage tank having an inlet and outlet, a partition in the storage tank separating a clean liquid reservoir therein from a liquid clarifying compartment, a vent maintaining said clean liquid reservoir at substantially atmospheric pressure,

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said reservoir communicating with the outlet to the tank, strainers supported in the clarifying compartment, said strainers being in communication with the inlet to the storage tank, filters supported in the clarifying compartment, said strainers having discharge means including a conduit delivering liquid from the strainers to the filters, a passage to the reservoir, a pressure responsive valve controlling flow through the passage in response to the pressure drop through the filters, and a discharge conduit from each filter.

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