Feb. 25, 1936. R. N. BURCKHALTER ET AL 2,031,589

FILTER

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Fig. 1

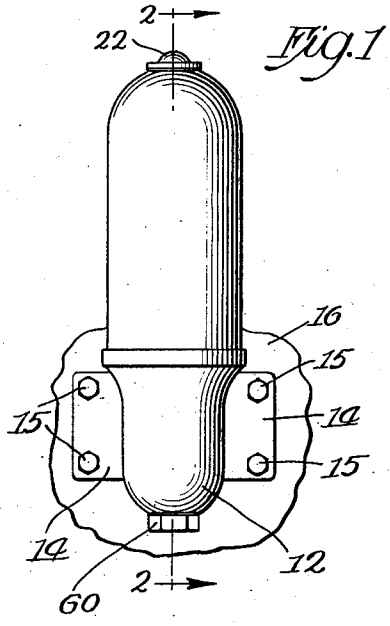


Fig. 2

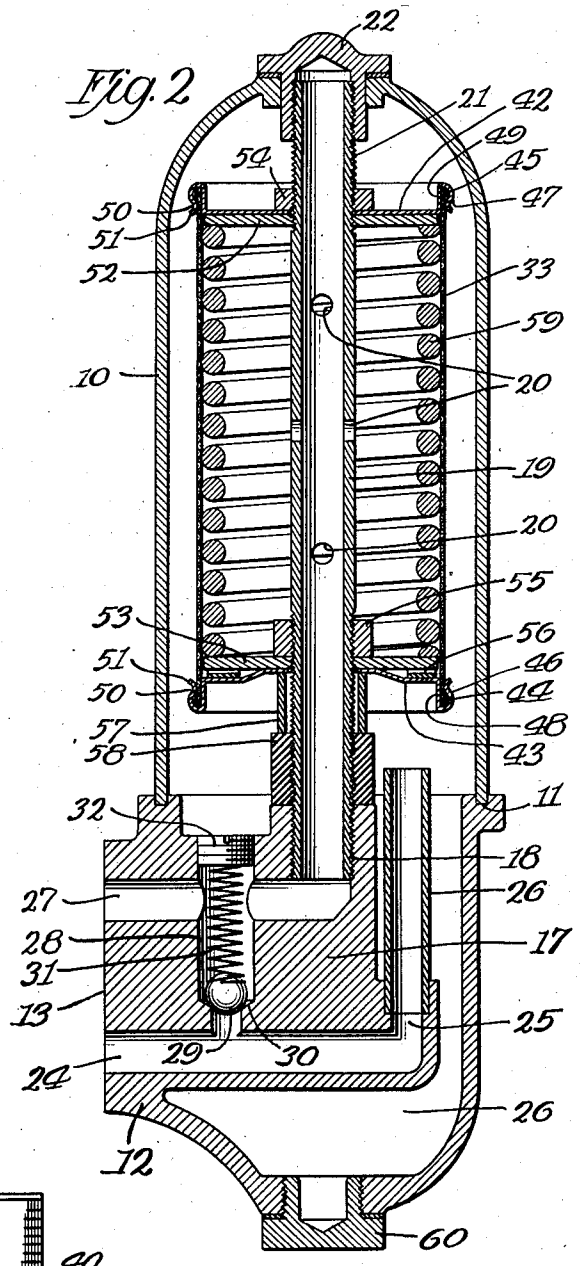


Fig. 3

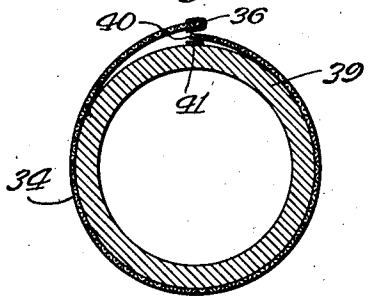
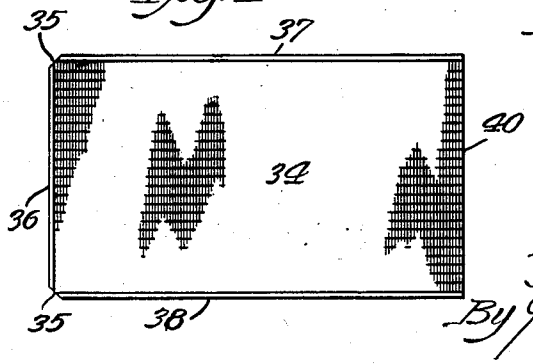


Fig. 4



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FILTER

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Fig. 5

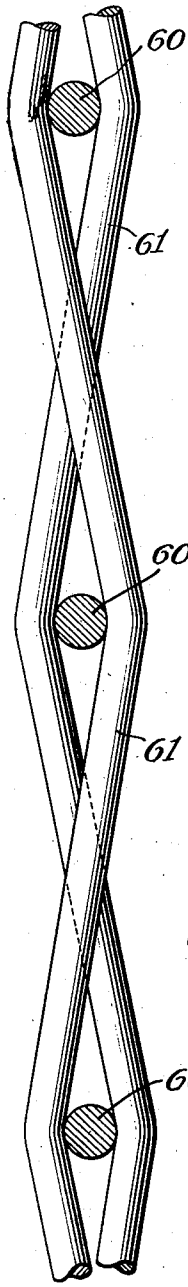


Fig. 6

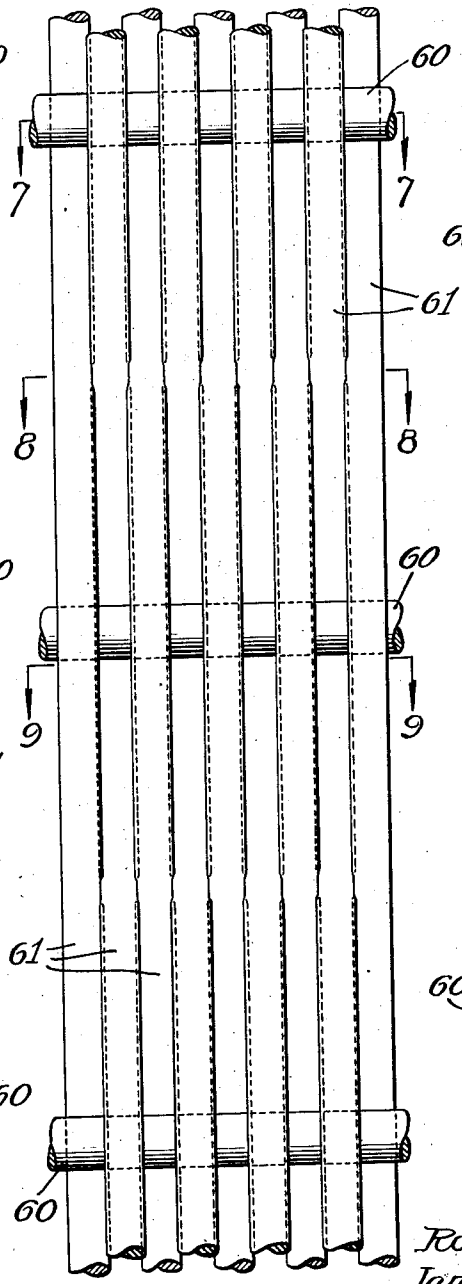


Fig. 7

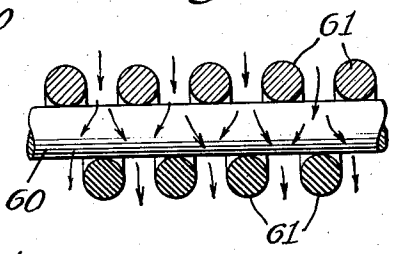


Fig. 8

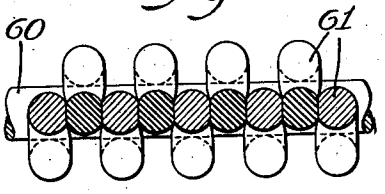
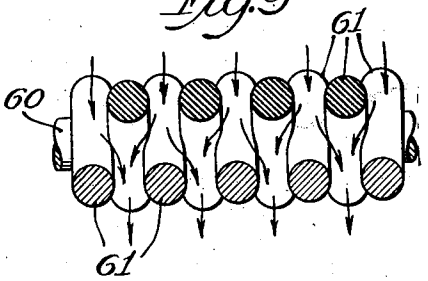


Fig. 9



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UNITED STATES PATENT OFFICE

2,031,589

FILTER

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Application July 11, 1932, Serial No. 621,905

10 Claims. (Cl. 210—165)

The principal object of this invention is to provide a filter that will pass lubricating oil rapidly while restraining practically all matter that would injure bearings, that will be substantially self-cleaning, and that will endure indefinitely in service.

Further objects and advantages of the invention will be revealed as the disclosure proceeds and the description is read in connection with the accompanying drawings, in which

Fig. 1 is an elevation of the complete filter mounted on the crank case of an engine;

Fig. 2 is a vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse section illustrating one step in the manufacture of the filter element proper;

Fig. 4 is a plan view of a blank used in making the filter element proper;

But these drawings and the corresponding specific description are used for the purpose of illustration and disclosure, and are not intended to impose limitations on the claims.

The filter casing includes a shell 10 about 4⅛" outside diameter drawn from 12 gauge sheet steel, the lower end of which fits in a groove 11 in the top of a base casting 12 of aluminum, cast iron, or the like. This casting is substantially in the form of a cup having a machined face 13, at one side extended by flanges 14 to receive bolts 15 for mounting the filter on the crank case 16, or other place that it is to be used. There is an integral projection 17 extending inwardly from the machined face and provided with a threaded bore 18 aligned with the axis of the shell 10, to receive the lower threaded end of the tube 19, 1⅛" outside diameter, and 7/8" inside diameter, which has a number of relatively large perforations 20 along the intermediate portion of its length, and is threaded at the top 21 to receive a cap nut 22 by which the shell 10 is made fast to the base. The tube 19 is locked to the base casting by a nut 58.

The base is bored horizontally at 24 and vertically at 25 to form an inlet passage which is extended upwardly by tube 26 to a point above the top of the base casting, whereby substantially the entire interior of the base is made available as a sump, or collecting chamber 26 for foreign matter intercepted by the screen, and commonly called sludge.

The base is also bored horizontally at 27 to the lower end of the bore 18 forming an outlet passage.

As oil becomes more viscous as the temperature drops, many engineers require a by-pass for all filter installations, so that the bearings may not be starved by tardy flow of cold oil through the filter. To meet this requirement the outlet and inlet are connected by a by-pass 28 in the form of a vertical bore in the base casting which is normally closed by a ball 29, held against a seat 30 by a spring 31 compressed by a nut 32.

As thus far described, the structure is well known and has been selected to illustrate an application of the filter embodying the present invention.

The actual filtering of the oil is done by a barrel-shaped wire element 33 comprising 208 vertical wires per inch of circumference, each about five-thousandths of an inch in diameter and interwoven with 16 horizontal wires per inch vertically about seven-thousandths of an inch in diameter. Both Monel metal and phosphor bronze have been found satisfactory in use and, of course, other metals may be used.

In making this filter element a rectangular blank 34 (Fig. 4) is cut from a sheet and the corners 35 are beveled. The edges 36, 37 and 38, are dipped first in flux and then in molten solder, the blank is rolled about a mandrel 39 and the edges 36 and 40 brought into overlapping relation on an aluminum strip 41, after which they are soldered by applying heat and pressure, as by running a heavy soldering iron along the overlapping edges.

The ends of the barrel thus formed are sealed with two sheet metal heads 42 and 43, by folding the marginal portion, as best shown in Fig. 2, to grip what was formerly the edge portions 37, 38. The solder that has been picked up on these edge portions forms beads 44 and 45.

When the screen is being assembled with the heads, the outer flanges 46 and 47 are spaced from the inner flanges 48 and 49, and they are bent to the position shown in Fig. 2 by rolling along the area indicated by 50, which has the effect of folding the sheet metal about the soldered bead and leaving the edge 51 slightly spaced from the screen so that there will be no danger of cutting. The joint thus formed is practically a seal against the passage of oil, or at least against the passage of any foreign matter sought to be excluded.

The heads 42 and 43 are held in proper spaced relation by disks 52 and 53 of 12 gauge sheet steel threaded on the sleeve 19. In the process of assembly, disk 52 is threaded on the sleeve and locked by the nut 54. A nut 55 is threaded on the lower end of the sleeve and run down

to a point indicated by a suitable gauge and the disk 53 is screwed on against it.

The screen 33 is assembled with the head 42 and the flange 47 rolled down, as before mentioned. These heads being made of 22 gauge sheet steel, the operation and apparatus will be obvious.

A corrugated spring 56 is placed on the disk 53 and the head 43 brought in position and put under slight pressure, after which the flange 46 is rolled down. A spacer sleeve 57 is placed against the inner portion of the head 43 and clamped by a nut 58.

The tube 19, and parts assembled thereon, forms a unit to be sold in commerce and assembled in suitable casings, which is accomplished in the instance shown by screwing the lower end of the sleeve into the bore 18, emplacing the shell, and screwing up the cap nut 22.

In operation the oil enters through the inlet 24 and passes into the shell, filters through the wire element 33, runs through the openings 20 into the tube 19, and passes to the outlet 27, provided, of course, it is not too viscous to filter, in which case the ball 29 will rise and the flow will be shunted directly from the inlet to the outlet.

In the normal operation, however, with oil in the usual temperatures of service, all flow will be through the filter. The solid matter will, of course, collect against the wires forming the filter element and there will be an appreciable pressure from without, tending to collapse it. This tendency is resisted in the present instance by a grating 59 formed of 9 gauge steel wire wound in a helix with the convolutions $\frac{7}{16}$'' on centers.

As the pressure on the inlet side rises the wire element will bend inwardly between the convolutions of the grating 59 and the corrugated spring 56 and the head 43 will yield sufficiently to make this bending quite appreciable. Upon the pressure being relieved, however, as for instance by slowing down or stopping the motor, the wire element will resume its normal position under the reaction of the spring 56 and the inherent resiliency of the head 43, with the result that a great deal of the accumulated foreign matter will be shed and settle down into the sump 26, from which it may be drawn away from time to time by removing the plug 60.

It has been found in practice that this flexure and recovery of the screen throws off about eighty (80%) percent of the accumulated sludge, hence, the efficiency of the screen to pass oil is maintained over a considerable period of use determined by the foulness of the oil and the volume of the sump.

The bending of the vertical wires about the convolutions of the grating tends to localize the strain and relieve the joints between the screen and the heads.

The horizontal (warp) wires 60 are practically straight while the vertical wires 61 are bent in and out to pass between each two adjacent horizontal wires and each vertical wire crosses and contacts with each of two vertical wires next to it. (Figs. 5 to 9 are an attempt to show the relation on a large scale).

The 208 vertical wires five-thousandths of an inch in diameter would actually present a combined width of one and forty-thousandths (1-40/1000'') when laid parallel and in contact, but in the fabric described they are compacted within an inch of horizontal width, (the forty-thousandths of an inch excess being absorbed at the intersections where they each contact is theoretically a point).

As a result, the vertical wires present a complete wall to flow normal to the filter surface or radial to barrel. The passages through the fabric are indirect and irregular. Their maximum dimension at entrance and exit is less than the diameter of a vertical wire (.005''), and their maximum dimension between the entrance and exit is less than the diameter of a horizontal wire (.007''). From these maxima it tapers to zero.

Just why such a structure has high efficiency in filtering is a question that experts may answer differently and perhaps with conflict. An attempt to explain the operation in detail might result in error. The above description of and the drawings showing the best known construction for use in filtering oil used with internal combustion engines is sufficient for this disclosure. Many such filters (having a barrel-shaped element $7\frac{1}{16}$'' long and 3'' in diameter with the by-pass adjusted for a pressure differential of $3\frac{3}{4}$ lbs. to 4 lbs.) have given excellent service with four and six cylinder truck engines.

Appropriate modifications for various uses are contemplated and intended to be covered.

We claim as our invention:—

1. In a filter of the type comprising a casing having an inlet and an outlet and a perforated tube within the casing in communication with the outlet, the combination of a barrel grating surrounding the tube, a barrel screen surrounding the grating and sustained by the grating against inlet pressure, heads sealed to the tube and the end of the barrel screen and means for yieldingly resisting the shortening of the screen barrel.

2. In a filter of the type comprising a casing having an inlet and an outlet and a perforated tube within the casing in communication with the outlet, the combination of a barrel grating surrounding the tube, a barrel screen surrounding the grating and sustained by the grating against inlet pressure, heads sealed to the tube and the end of the barrel screen, one thereof being flexible in an axial direction, the barrel screen comprising a great many fine wires lengthwise and a small number of fine wires crosswise whereby the passages through it are long and narrow, and spring means for resisting the longitudinal contraction of the screen.

3. In a filter of the type comprising a casing having an inlet and an outlet and a perforated tube within the casing in communication with the outlet, the combination of a barrel grating surrounding the tube and having continuous circumferential ribs, a barrel screen surrounding the grating and sustained by the grating against inlet pressure and heads fast on the tube adjacent to the ends of the grating and sealed to the ends of the screen, one thereof being yieldable and spring means resisting the shortening of the screen.

4. In a filter of the type comprising a casing having an inlet and an outlet and a perforated tube within the casing in communication with the outlet, the combination of a barrel grating surrounding the tube, a barrel screen surrounding the grating and sustained by the grating against inlet pressure, and heads sealed to the tube and the end of the barrel screen, at least one of the heads being yieldable to tension on the screen whereby the latter may bend into the passages of the grating under the inlet pressure.

5. In a filter of the type comprising a casing having an inlet and an outlet and a perforated tube within the casing in communication with the outlet, the combination of a barrel grating comprising a helical coil surrounding the tube, a longitudinally contractible barrel screen surrounding the grating and sustained by the grating against inlet pressure heads sealed to the tube and the ends of the barrel screen, and spring means resisting the shortening of the screen.

6. A commercial unit for filters comprising a central tube perforated along the intermediate part of its length, a pair of heads fast on the tube, one beyond each end of the perforated part, a barrel screen extending between the heads and sealed to them, the screen having a multitude of fine longitudinally elongated perforations, a series of circumferential ribs for sustaining the screen against external pressure, and spring means resisting the longitudinal contraction of the screen.

7. A commercial unit for filters comprising a wire screen having fine woof strands in juxtaposed relation and relatively widely spaced warp strands, and resilient means for resisting the shortening of the screen in the direction of its woof strands by surface pressure.

8. In a filter, in combination, a cylindrical screen formed of flexible material, means for directing the flow through the screen inwardly, a series of spaced ribs forming a backing for the screen against the inlet pressure, and resilient means for resisting inward bowing of the screen between the ribs.

9. In an oil filter, a casing having inlet and discharge passages, a filter member within said casing between said passages, said member comprising a screen element of woven wire having an unfolded substantially smooth surface and having a multiplicity of fine, indirect elongated passages therethrough, means for resiliently resisting the distortion of said member by the pressure of oil on said surface, and a sump beneath said filter member.

10. In an oil filter, a barrel screen of fine woven wire, resilient means to mount the screen at its ends and yieldingly tension it, and means to support the screen against inlet pressure.

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