March 6, 1951 C. C. S. LE CLAIR 2,544,269

OIL FILTRATION SYSTEM

Filed April 24, 1947 2 Sheets-Sheet 1

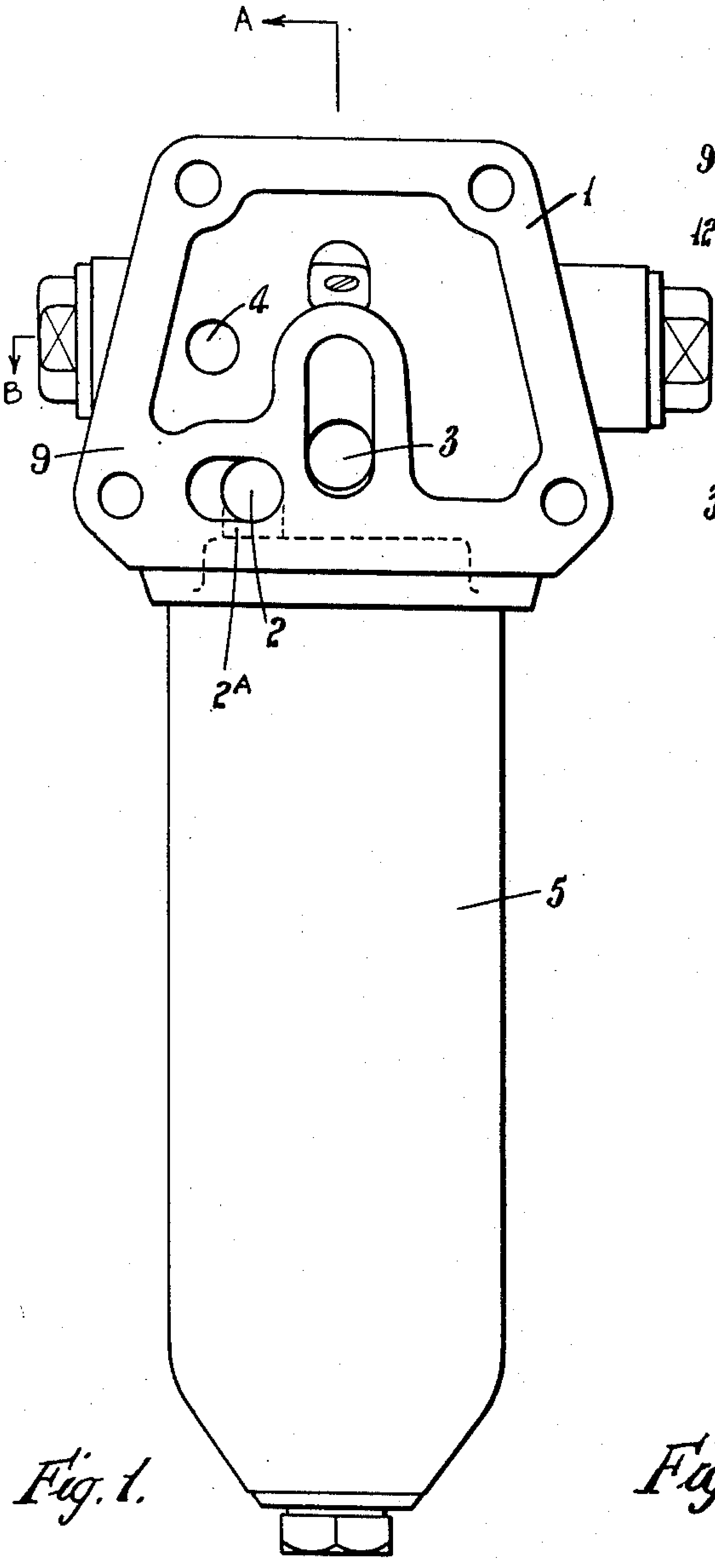

Fig. 1.

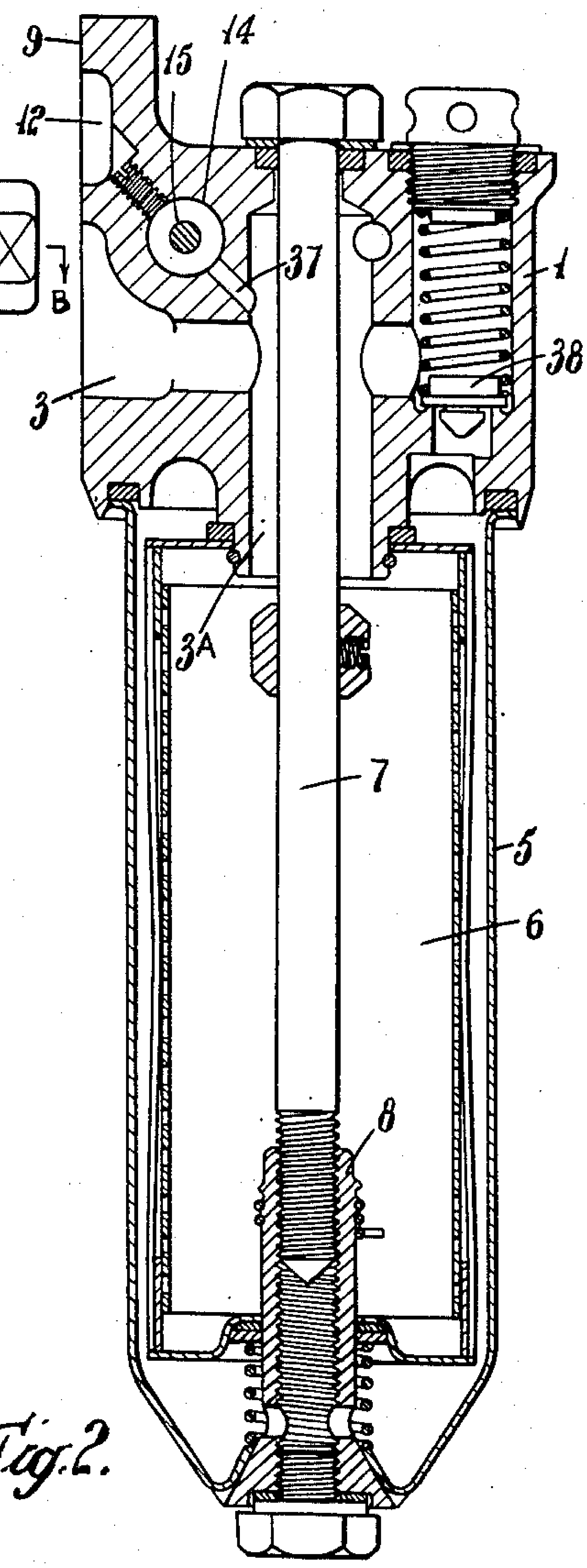

Fig. 2.

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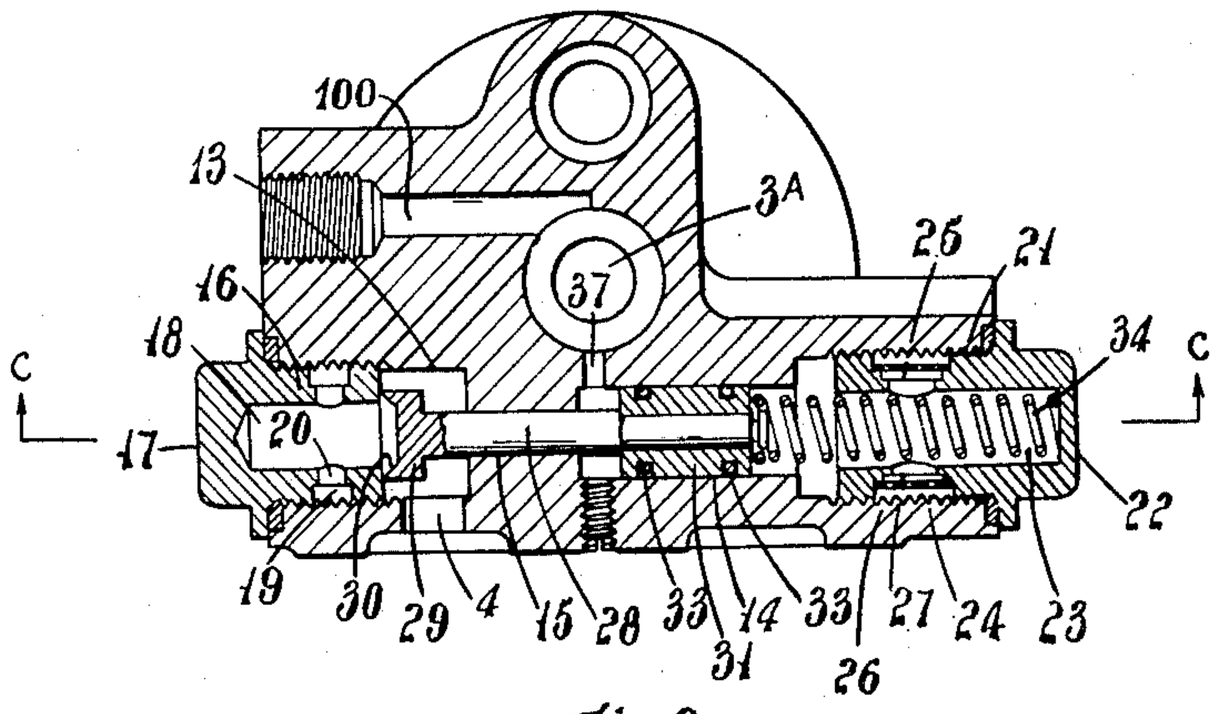

Fig. 3.

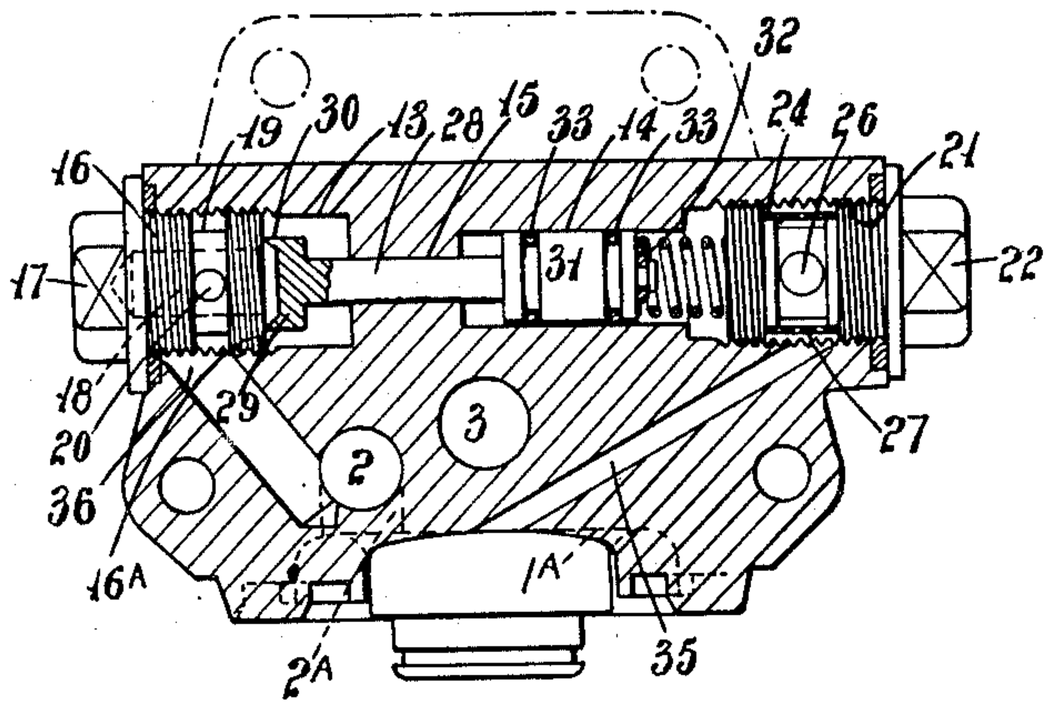

Fig. 4.

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UNITED STATES PATENT OFFICE

2,544,269

OIL FILTRATION SYSTEM

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6 Claims. (Cl. 260—62)

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This invention relates to oil filtration systems, particularly those dealing with engine oil, and more specifically to filters for use in such systems.

One object of the invention is to provide an improved filter for use in filtration systems of the kind described and claimed in my United States Patent No. 2,423,329, issued July 1, 1947.

In the oil filtration system described in the above mentioned specification unfiltered oil was pumped through the filter inlet into the filter container and thence around and through the filter element in the latter, the filtered oil then flowed to the bearings via a main outlet passage which was connected to the bearings and which communicated both with the interior of the filter element and with a cylinder in which a spring-urged control valve of the piston type was slidable. The function of the control valve was to allow unfiltered oil to return to the sump from the filter container through an auxiliary outlet when the pressure of filtered oil in the main outlet passage exceeded a predetermined figure. In this manner, no unfiltered oil could reach the bearings and, further, the amount of oil passing through the filter element was only the net amount required by the bearings.

It has been found in practice that the control of the return of unfiltered oil to the sump by means of a slidable piston-type control valve may not be entirely satisfactory, since particles in the unfiltered oil may penetrate into the clearances between the piston and its cylinder and may lodge between the cut-off edges.

This disadvantage is overcome by the present invention, whereby the flow of unfiltered oil back to the sump or other container is controlled by a seated, dirt cutting valve and not by a valve of the piston type.

The present invention, therefore, provides a filter, which comprises a control valve member adapted to allow unfiltered oil to return to the sump or other container from the filter through a subsidiary outlet when the pressure of filtered oil in the main outlet passage exceeds a predeterminer figure, the said control valve member comprising a valve head having a dirt-cutting edge arranged to cooperate with a valve seat surrounding a pasage which communicates permanently with the oil inlet side of the filter and which, when the valve is unseated, communicates with the subsidiary outlet, so that unfiltered oil from the filter can return to the sump or other container, and a piston part which is operatively connected to the valve head and is exposed on one side to the filtered oil pressure and on the other

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side both to the unfiltered oil pressure, which exerts a thrust equal and opposite to the thrust on the valve head, and also to the thrust of a control spring which acts to hold the said dirt-cutting edge upon its seat except when the pressure of the filtered oil exceeds a predetermined figure.

Thus, the valve head will be balanced if the area of the face of the piston part upon which the unfiltered oil pressure acts is made equal to the area of the valve head.

In a preferred construction, the dirt-cutting edge of the valve head is hardened and cooperates with a hardened valve seat on a hollow closure member which is aranged in a valve head cylinder and which communicates permanently with the unfiltered oil inlet to the filter. The cylinder communicates permanently with the subsidiary outlet from the filter between the valve seat and the end of the cylinder, the piston part of the control valve member being slidable in a separate cylinder which, on one side of the piston part is in permanent communication with the unfiltered oil space of the filter container and, on the opposite side of the piston part, is in permanent communication with the main outlet for filtered oil from the filter.

In this construction, the end of the cylinder in which the piston part of the control valve member is slidable, opposite to its end which communicates permanently with the main outlet for filtered oil from the filter, receives its oil from a hollow closure member arranged in a recess communicating with the cylinder, the interior of the closure member being in permanent communication with the unfiltered oil space of the filter container.

In order to prevent unfiltered particles coming into contact with the piston part, means, which conveniently consists of a supplementary strainer or filter element, is provided, which, as will be explained hereinafter, exercises no restriction on the full pressure of the unfiltered oil acting upon the piston.

One constructional form of the invention, applied to an oil filter, will now be described, by way of example, with reference to the accompanying drawings, whereon:

Figure 1 is a rear elevation of the filter;

Figure 2 is a section on the line A—A in Figure 1;

Figure 3 is a plan section of the filter head on the line B—B in Figure 1; and

Figure 4 is a vertical section of the filter head on the line C—C in Figure 3.

Referring to the drawings:

The oil filter comprises a head 1 having an inlet 2 for unfiltered oil, an outlet 3 for filtered oil, a subsidiary outlet 4 for unfiltered oil, a housing for the control valve and a container 5, which encloses the annular filter element 6. In the present construction, the container is detachably attached in known manner to the head by means of a centre bolt 7 which extends through the head and the filter element and screws at its bottom end into a boss 8 projecting upwards from the base of the container. Unfiltered oil entering the container from the inlet first fills the annular space in the container around the filter element 6 and then flows inwardly through the latter and upwardly through an outlet passage 3A surrounding the centre bolt to the outlet 3 from the filter head.

In this particular construction, the head is formed with a lateral flat face 9 which is designed to form a joint with a corresponding flat face on the engine or machine in association with which the filter is used and to which it is attached.

Toward the top of the head and between the flat face 9 of the head and the outlet passage 3A in the head, the latter is formed with a control valve housing which comprises a bore 13 of large diameter at its left hand end, a bore 14 of somewhat smaller diameter at its right hand end and an intermediate bore 15 of still smaller diameter connecting the two bores, all these bores being coaxial. The left hand bore 13 (hereinafter called "the valve head cylinder") is threaded to receive the screwed shank 16 of a closure plug 17, which is formed with a central hole 18 and an external annular groove 19 connected to the hole by means of a number of radial ports 20. The right hand bore 14 (hereinafter called "the piston cylinder") is counterbored at its outer end and threaded to receive the screwed shank 21 of another closure plug 22 which is formed with a central hole 23 and has a wide external annular groove 24 which is wider than and communicates with, a narrower annular inner groove 25. The inner groove is connected by radial ports 26 to the central hole 23 and the circumferential shoulder formed at the junction of the two grooves forms a seat for an annular strainer 27 consisting of a fine gauze screen.

The control valve member comprises a spindle 28 provided at its left hand end with a hardened valve head 29 which is arranged in the valve head cylinder 13 and is recessed to provide a sharp dirt-cutting edge 30 adapted to form an oil-tight seal with the hardened and ground face 16A of the shank of the left hand closure plug 17. The edge 30 surrounding the mouth of the central hole 18 in the plug constitutes a valve and the face 16A forms a valve seat with which the edge forms liquid tight engagement. The spindle is slidably guided in the intermediate portion 15 of the control valve member housing, being a substantially oil-tight fit therein. The opposite end of the valve member spindle, within the piston cylinder 14, is reduced in diameter forming a shoulder and fitted with a piston 31 which is slidable in the cylinder and is held in place on the spindle against the shoulder by a C-ring 32 fitted in a groove in the end of the part of the spindle of reduced diameter. This piston is of the same diameter as the dirt cutting edge 30 on the valve head 29 and it is fitted externally with flexible sealing rings 33 of rubber, synthetic rubber or other material impervious to oil.

A valve spring 34 housed in the central hole 23 in the right hand closure plug 22 reacts between the base of the hole and the right hand face of the piston 31 and thus acts to force the control valve member to the left, so that the valve head 30 will be thrust into oil-tight engagement with the hardened and ground face 16A of the left hand closure plug 17.

The inlet port 2 for unfiltered oil passes through the flat face on the head 1 and receives its supply from an oil circulating pump (not shown). This port also communicates with the annular space surrounding the filter element 6 in the container via the vertical port 2A.

The outlet port 3 for filtered oil also passes through the flat face on the head 1 and is connected within the head to the interior of the filter element via the outlet passage 3A surrounding the centre bolt 7. This outlet port is also connected by means of a passage in the engine or machine bed to the bearings to be lubricated.

In the flat face is also formed a subsidiary outlet port 4 which is connected within the head 1 to the valve head cylinder to the right of the valve seat 16A and which leads to a sump or other container for a purpose which will be described hereinafter.

A sloping passage 35 runs from the bottom face 1A of the head to that part of the said counterbored end of the control valve housing which surrounds the said external groove 24 in the right hand closure plug 22, and thus provides communication between the annular inlet space in the container surrounding the filter element 6, the central hole 23 in the plug 22 and the right hand end of the valve member piston 31, to which the pressure of the oil at the inlet 2 is thereby applied.

A second sloping passage 36 connects that part of the valve head cylinder 13 which surrounds the annular groove 19 in the left hand closure plug 17 to the inlet port 2 thus providing communication between the inlet system, the central hole 18 in the plug 17 and the left hand side of the valve head 29, to which the pressure of the inlet oil is thereby applied.

A third sloping passage 37 connects the central oil outlet passage 3A in the head to the piston cylinder 14 at that side of the piston 31 opposite the connection to the passage 35. The end of the passage 37 which opens into the cylinder is so positioned that it is to the left of, and never closed by, the piston 31.

A spring-loaded balance, or by-pass, valve 38 is also provided in the head 1 and is adapted, when forced off its seat, to provide communication between the annular inlet space in the container 5 surrounding the filter element 6 and the outlet passage 3A in the head surrounding the centre bolt 7. In the event of the filter element becoming clogged, and the pressure difference between the inlet side and the outlet side rising above a predetermined value, the balance valve 38 is forced off its seat and allows unfiltered oil to pass from the container into the outlet passage 3A and thence out of the head outlet 3 to the bearings or other place of use of the oil.

A fourth passage 100 the outlet end of which is counterbored and threaded is provided for a pressure gauge connection which, however, forms no part of the present invention.

As previously mentioned the filter is mounted on a machine or engine with its flat face 9 sealed against a similar face on the machine or engine. The inlet 2 is connected to the outlet from the oil circulating pump and the filtered oil outlet 3

is connected by suitable passages or conduits to the bearings or other places of use. The outlet 4 is connected to the engine sump or the supply container.

When the oil circulating pump commences to operate, oil is circulated through the inlet 2 and pressure is built up in the inlet passages on the inlet side of the filter element 6. If the oil is cold and viscous, the amount of oil that can pass through the filter element is limited and, consequently, the pressure of the oil increases and the conventional pump relief valve (not shown) may open. Whether or not this occurs, the pressure of the unfiltered oil in the inlet port 2 in the head, the sloping passage 36, the central hole 18 in the left hand closure plug 17 and under the valve head 29 similarly increases. Simultaneously, the pressure of the unfiltered oil in the sloping passage 35, the central hole 23 in the right hand closure plug 22 and the right hand end of the piston cylinder 14 on the right of the piston 31 also increases. Since the head of the piston 31 is of the same diameter as the valve seating edge 30 the thrusts of the unfiltered oil pressure acting upon the opposite ends of the control valve member are in equilibrium, the valve head is consequently held in contact with its seat only by the control valve spring 34.

When the oil passes through the filter element, however, the pressure of the filtered oil in the interior of the element, in the outlet passage 3A in the head surrounding the centre bolt 7, in the third sloping passage 37 and in the piston cylinder 14 on the left of the piston 31 also builds up and, when as a result of back pressure built up from the bearings it reaches a predetermined value, it forces the piston 31 with the control valve members 28 and 29 to the right against the thrust of the control valve spring 34. The valve head 29 is thus moved away from its seat and allows unfiltered oil to pass via the valve head cylinder 13 and the subsidiary outlet port 4 in the head into the sump or other container.

Conversely, when the pressure of the oil in the main outlet 3 falls below the predetermined figure, the valve spring 34 thrusts the valve head 29 into contact with its seat and closes the subsidiary discharge outlet 4.

Since unfiltered oil is thus controlled by the valve head 29 the latter necessarily operates in unfiltered oil. Since, however, the valve head is not of the piston type and is formed with a dirt-cutting edge 30, the likelihood of the movement of the control valve member being hampered by suspended particles is negligible.

Further, since the pressure in the valve head cylinder 13 is equal to the pressure (generally atmospheric) of the oil in the sump or other container while the pressure of the oil in the piston cylinder 14 on the right of the spindle guide 15 is the outlet pressure, there is no possibility of particles in the unfiltered oil in the valve head cylinder becoming wedged in the guide because any oil leakage through the guide will be filtered oil under pressure and will take place in the direction towards the valve head cylinder 13 and the sump or other container and will effectively prevent the entry of particles into the guide. Any leakage from the bore 14 to the valve head cylinder 13 will be slight and, therefore, there will be substantially no flow of oil through the passage 37. When the passage 37 and the bore 14 are filled with filtered oil merely the change in filtered oil pressure at the outlet 3 will be transmitted to the underside of the piston head 31.

Since, as has previously been explained, it is necessary to balance the thrust of the unfiltered oil from the inlet side of the filter acting upon the valve head 29 by an equal thrust upon the right hand end of the piston 31, it is necessary to cause oil at the inlet pressure which is normally unfiltered to act upon the right hand end of the piston. Such oil, however, passes through the fine strainer 27 mounted upon the right hand closure plug 22 before reaching the piston. Since there is no passageway past the piston this oil is static and exerts its static pressure upon the piston. Consequently, the restricted area of the strainer does not restrict the full and free application of the oil inlet pressure to the piston just as though the oil were unstrained.

I claim:

1. A filter comprising in combination a head having an inlet for unfiltered oil adapted to be connected to a source of oil under pressure, a main outlet for filtered oil adapted to be connected to a place of use of the oil, and a subsidiary outlet for unfiltered oil adapted to be connected to a receptacle, a filter container, means for detachably connecting said filter container to said head, a tubular filter element mounted in said filter container of such size that an annular space is formed in said filter container between the latter and said filter element, a port in said head connecting said inlet with said annular space, a passage formed in said head connecting the interior of said filter element with said main outlet, a chamber in said head in communication with said subsidiary outlet, a second passage providing communication between said chamber and said inlet, a valve seat surrounding the outlet end of said passage, a second chamber in said head, a cylinder in said head having one end communicating with said second chamber, a third passage connecting the opposite end of said cylinder with said main outlet, a fourth passage providing communication between said second chamber and said annular space, and a control valve assembly slidably arranged in said head and adapted to allow unfiltered oil to flow to said receptacle through said subsidiary outlet when the pressure of filtered oil in said main outlet exceeds a predetermined value, said assembly comprising a valve head having a dirt cutting edge normally seated against said valve seat in said first chamber, a piston part slidable in said cylinder between said third passage and the end of said cylinder which communicates with said second chamber, means operatively connecting said valve head and said piston part, said piston part being acted upon on one side by the pressure of the filtered oil at the main outlet and on the other side by the pressure of the unfiltered oil in said second chamber which exerts a thrust equal and opposite to the thrust on said valve head, and a control spring acting on said piston part to bias said valve head toward said valve seat.

2. A filter as claimed in claim 1 wherein the outlet from said second passage into said first chamber is formed by a hollow closure member mounted in said head in said chamber and has formed on one face thereof said valve seat.

3. A filter as claimed in claim 1 wherein said means connecting said valve head and said piston part comprises a spindle slidable in a bore between said first chamber and said cylinder.

4. A filter as claimed in claim 1 including auxiliary filter means interposed between said fourth passage and said piston part for preventing par-

ticles in the unfiltered oil from coming into contact with said piston part.

5. A filter as claimed in claim 1 including a hollow closure member mounted in said head in said second chamber and having a peripheral groove formed in its outer surface in communication with the outlet from said fourth passage, a port in said closure member providing communication between said groove and said second chamber, and a strainer fitted in said groove to prevent particles in the unfiltered oil from entering said second chamber.

6. A filter as claimed in claim 1 wherein said main and subsidiary outlets and said inlet open out into a lateral flat face formed on said head and which is adapted to form a joint with a corresponding flat face on a device upon which the filter is used.

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