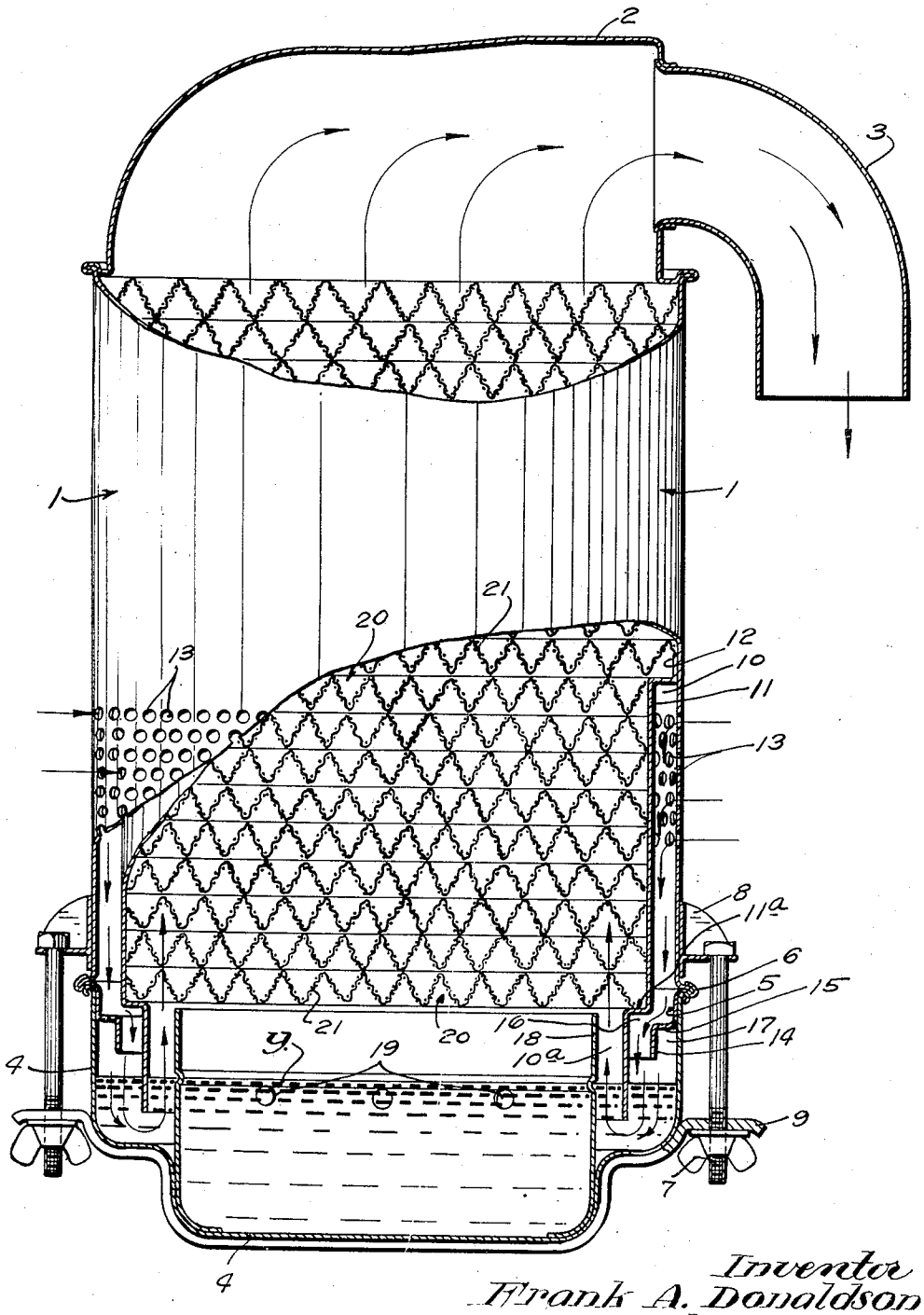
Oct. 22, 1940. F. A. DONALDSON 2,219,176

BACKFIRE OIL TRAP

Filed March 22, 1939



Inventor
Frank A. Donaldson
By his Attorneys
Merchant & Merchant

Patented Oct. 22, 1940

2,219,176

UNITED STATES PATENT OFFICE

2,219,176

BACKFIRE OIL TRAP

Frank A. Donaldson, St. Paul, Minn.

Application March 22, 1939, Serial No. 263,504

5 Claims. (Cl. 183—15)

My present invention relates to improvements in air cleaners for use in connection with the intakes of internal combustion engines and more particularly to that type of engine intake air cleaner embodying a body of fluid, usually oil.

More specifically stated, the invention relates to the novel manner of forming in air cleaners of this character means for trapping within the body of the cleaner oil directed backwardly through the cleaner under instantaneous back pressure surges resulting from engine backfire.

It is well recognized in the air cleaner art that in air cleaners of the type referred to, and in which a body of fluid is employed as a dust collecting medium, there is a tendency, under occasional backfire conditions of the engine through its intake, to blow oil from the oil reservoir of the cleaner outwardly through the intake conduit or passage of the air cleaner. Of course, if such backwardly directed oil is permitted to be discharged from the cleaner through its intake not only is the efficiency of the cleaner immediately impaired, but also considerable damage can be done by the discharged oil to machinery, buildings or the like on which the discharged oil may be deposited.

An important object of the present invention is the provision of an oil trapping arrangement incorporated entirely within the body of the cleaner. In accordance with the preferred arrangement herein illustrated, the oil trapping arrangement is built into the body of the cleaner at only a very slight additional cost and with practically no sacrifice of capacity as compared to similar cleaners of the same external dimensions.

Another important object of the invention is the provision, in an air cleaner of the type incorporating a fluid reservoir and an annular air inlet leading downwardly into the fluid reservoir, of a simple, inexpensive and highly efficient means for arresting, within the body of the cleaner, such oil as may be displaced from the oil well and directed backwardly through the cleaner under instantaneous back pressure surges, resulting from engine backfire, during the brief duration of such back pressure surges.

The above and other highly important objects of the invention will be made apparent from the following specification, claims and drawing.

In the accompanying drawing like characters indicate like parts.

Referring to the drawing:

The single figure thereof is a view in side elevation with some parts shown in section and some parts broken away, of an air cleaner incorporating a preferred embodiment of the invention.

The air cleaner illustrated includes a cylindrical casing shell 1, which shell is closed at its top by a head 2 extending from which is an air outlet conduit 3 that is adapted to be connected to the intake of an internal combustion engine in the conventional manner. The bottom of the cylindrical casing shell 1 is normally closed by a cup-like oil reservoir 4 that is normally filled with oil Y to the level indicated. This oil reservoir 4 is preferably telescopically applied to the lower end portion 5 of the cylindrical casing 1 and is normally removably held in position tightly pressed against stop means preferably in the nature of an annular bead 6 of the cylindrical shell 1 through the medium of clamping bolts 7 and anchoring brackets 8 and 9, the former of which are anchored to the casing shell 1, and the latter of which are suitably anchored to the oil reservoir 4.

For the purpose of providing an annular air inlet passage 10 leading downwardly into the oil well from atmosphere there is provided within the shell 1 a depending inner skirt 11. This skirt 11 is of smaller diameter than the shell 1 except at its upper end portion where it is turned outwardly and anchored at 12 to the shell 1, thereby closing the top of the annular air intake passage to the interior chamber of the cleaner.

The lower end portion of the skirt 11, while concentrically disposed with respect to the large upper portion thereof, is of reduced diameter, the large diameter upper section and smaller diameter lower section being connected by a radially or laterally extended annular portion 11*a*. Preferably and as illustrated, the smaller diameter lower section of the skirt 11 extends from a point somewhat above the normal static level of the oil *y* to a point below the normal static level of the oil well.

The upper end portion of the annular air intake passage 10 communicates with atmosphere through a plurality of perforations 13 on the shell 1.

The lower end portion 5 of the shell 1, which constitutes the outer wall of the annular intake passage 10 below the annular bead 6, is of substantially the same diameter as the main shell section 1 above the bead 6 for a material extent axially, but is reduced materially in diameter at its lower end portion 14. The reduced diameter portion 14 is connected to the large diameter upper portion of the shell section 5 by a laterally or

radially extended portion 15 that is axially spaced from the radial section 11a of the skirt 11, so as to form with the said portion 11a an angular substantially radially disposed intake section 16 intermediate the different diameter upper and lower sections of the intake passage 11.

As will be evident from the drawing, the oil reservoir 4 is telescopically applied over the larger diameter portion of the shell section 5 and forms with the reduced diameter portion 14 and radial portion 15 of the shell section 5 an inverted annular channel 17 overlying the fluid y immediately radially outwardly of the reduced diameter end of the intake passage 11. This inverted annular channel 17, as will hereinafter be seen, serves as an oil trap under instantaneous backfire conditions.

Mounted on the bottom of the oil reservoir 4 concentrically of the axis thereof, is an inner oil cup-forming annular flange 18 which is preferably provided with a plurality of oil metering openings 19. This cup-forming flange 18 terminates with its upper edge preferably above the static fuel level in the reservoir and in approximately the same plane as the radial skirt portion 11a.

The inner oil cup flange 18, being of smaller diameter than and being concentrically disposed with respect to the reduced diameter lower portion of the skirt 11, forms with said skirt 11 a reversely directed continuation 10a of the annular air intake passage 11 that opens into an expansion chamber 20 that is packed with a pervious filtering medium preferably in the nature of stacked corrugated wire screen elements 21. The lower screen element 21 is seated on the ledge formed by the radial portion 11a of the skirt 11.

Operation

Under normal operating conditions in connection with an internal combustion engine, for example, the interior of the cleaner will be subjected to varying degrees of partial vacuum or sub-atmospheric pressure by virtue of the intake strokes of the engine pistons and the resultant predominant vacuum condition existing, under operating conditions, in the intake manifold of the engine to which manifold it may be assumed that the outlet conduit 3 is connected. As a result of this predominant sub-atmospheric pressure, air under atmospheric pressure will rush into the inlet passage 11 through the inlet perforations 13 and will pass downwardly through the tortuous annular inlet passage 11 and impinge against such oil as in the underlying portion of the oil well.

This downwardly directed air will, of course, reverse its direction of travel and pass upwardly into the expansion chamber 20 over the upper edge of the cup-forming flange through the upwardly directed portion 10a of the intake passage 10. Under continuous operating conditions, most of the oil radially outward of the cup-forming flange 18 will be displaced and carried with the incoming air into the expansion chamber where it will be intercepted by the screen elements and permitted to flow downwardly toward the oil well.

This downward flow of oil will collect above the oil cup and build up a head of oil over the oil cup 19 which will constantly tend to overflow the edges of the cup and pass downwardly through the upwardly directed portion 10a of the intake passage, but the velocity of air moving through the intake passage will prevent such downward return of oil under such operating conditions and will pick up such oil as tends to overflow the cup and carry the same back into the upper interior portion of the expansion chamber only to be condensed on the screen elements and be returned to the oil head above the oil cup 19.

Under conditions of backfire which cause the predominate sub-atmospheric condition in the engine's intake to raise momentarily to a positive or plus atmospheric pressure, air will be directed downwardly through the expansion chamber 20 and such downwardly directed air, when it strikes the body of oil within the portion 10a of the intake passage, will tend to blow all the oil radially outwardly of the cup flange 18 upwardly into and through the intake passage 10, and, of course, if in the absence of a suitable oil trap this is just what would happen. However, in the present structure a large part of this oil will be momentarily trapped within the inverted annular channel 17, and such oil as is blown into the lower end of the annular passage 10 above the lower end of the shell portion 14 will, due to the abrupt outward turn in the intake passage 10 between wall portions 11a and 15, be deflected and thrown against the outer shell or casing 1. The oil thus thrown against and spread over a wall of the passage will have its velocity sufficiently retarded by surface friction to keep it from reaching the perforations 13 during the very brief period of the back-fire surge.

From the above it will be evident that the offset in the lower end portion 5 of the shell 1 serves two important functions, to wit: (a) to provide an oil trap reservoir, and (b) to provide one wall of a tortuous passage which causes such oil as may be blown into the intake to be distributed over the wall surfaces thereof to thereby retard its velocity and prevent its reaching the final point of outlet during the brief period of the back pressure surge. Tests of this cleaner under backfire conditions both with and without the portions 14 and 17 of the outer wall of the inlet passage conclusively prove the merits of this device as an oil trap. For example, when this arrangement is incorporated, even under quite severe backfire conditions, little if any oil is discharged from the perforations 13; whereas, in the absence of this arrangement last described under similar backfire conditions oil is discharged from the perforations 13 at very high velocity. As previously indicated, such backfiring of oil to atmosphere results in immediately lowered efficiency of the cleaner due to the lowering of the fuel level in the well reservoir, and is further serious in that the discharged oil is apt to result in serious damage or at least the dirting of any object with which it comes in contact. A still further serious result of backfiring of oil through the inlet of the cleaner is that the oiling up of the surface of the primary intake passage or perforations results in the rapid collection of dirt in these passages which rapidly increases the restriction of the device and thereby reduces the efficiency of the engine to which it is connected.

From a manufacturing point of view the fact that the lower section 5 of the shell 1 is primarily formed as a separate unit and the manner in which it is anchored or attached to the shell section 1 is very important. In the first place, it is cheaper to form the lower section 5 of the shell as a separate unit than it would be to form a similar contour directly on the end of the main shell section 1, and even after this was done, it would require an operation to form a suitable annular bead to act as a stop for the oil reservoir

4. According to the present scheme, the lower end of the shell section 1 and the adjacent upper end portion of the lower section 5 thereof are each provided with out-turned flanges which are joined by rolling one of these flanges around the other thereof.

What I claim is:

1. In an air cleaner, a cylindrical shell made up of a main upper section and a relatively short lower section, said upper and lower shell sections being provided at their point of jointure with out-turned annular flanges one of which is rolled over the other thereof to secure the two together, the said lower shell section immediately below said flanges being of approximately the same diameter as the said upper section but being of reduced diameter at its lower portion, a cup-like oil receptacle telescopically applied over the larger diameter upper portion of the lower shell section to the limit permitted by the joined annular flanges of the sections, an annular skirt flange concentrically disposed within the interior of the shell and being of less diameter than said shell so as to provide therebetween and said shell an annular air intake passage, said skirt extending downwardly from the intermediate portion of the shell to the vicinity of the normal static oil level therein, means closing off communication between the top of said annular air intake passage and the interior of the shell, and air inlet opening through the upper shell section.

2. The structure defined in claim 1 in which the said skirt which forms the inner wall of the annular air intake passage is shaped to approximately correspond to the contour of the reduced diameter portion of the lower shell section.

3. In an air cleaner, a cylindrical shell having a reduced diameter lower end portion and a radially outwardly projecting stop means located near the bottom of the shell but above the reduced diameter portion thereof, a cup-like oil receptacle telescopically fit over the largest diameter portion of the cylindrical shell below said stop means to the limit permitted by engagement of the top of the oil receptacle with the said stop means, a cylindrical skirt concentrically disposed within the shell section and extending into the oil receptacle, said skirt being spaced from the sides of the shell to form therewith an annular intake passage terminating in the oil receptacle at a point below the reduced diameter lower end of said shell, the reduced diameter lower end portion of the shell section being spaced from the adjacent wall portions of the oil receptacle to form therewith, and within the oil receptacle, a downwardly opening oil trapping channel radially outwardly of the discharge end portion of the annular intake passage.

4. In an air cleaner, a cylindrical shell having a reduced diameter lower end portion, a cup-like oil receptacle telescopically engaging the lower end portion of the cylindrical shell above said reduced diameter portion, a cylindrical skirt concentrically disposed within the shell section and extending into the oil receptacle, said skirt being spaced from the sides of the shell to form therewith an annular air intake passage terminating in the oil receptacle at a point below the reduced diameter lower end of said shell, the reduced diameter lower end portion of the shell section being spaced from the adjacent wall portions of the oil receptacle to form therewith, and within the oil receptacle, a downwardly opening oil trapping channel radially outwardly of the discharge end portion of the annular air intake passage.

5. The structure defined in claim 4 in which the said skirt, which forms the inner wall of the annular air intake passage, is shaped to approximately correspond to the contour of the reduced diameter lower end portion of said shell.

FRANK A. DONALDSON.