Feb. 4, 1941. G. M. WALTON 2,230,278

OIL SEPARATOR

Original Filed July 11, 1936 2 Sheets-Sheet 1

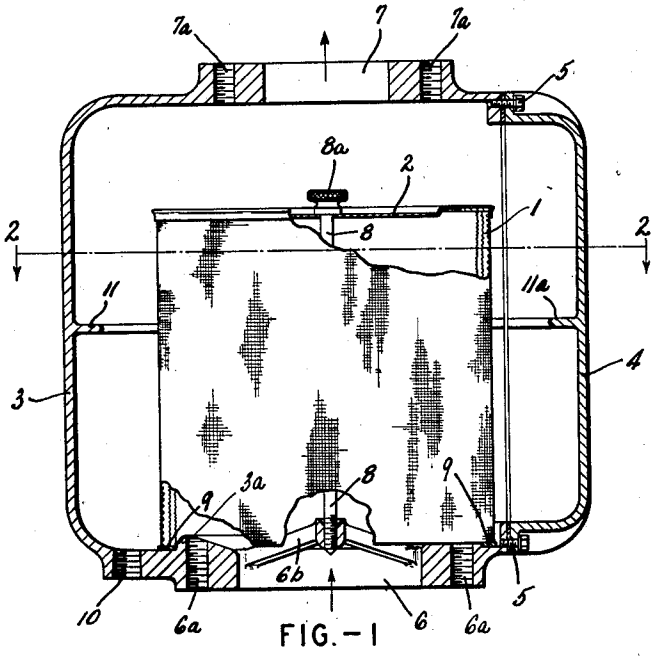

FIG.-1

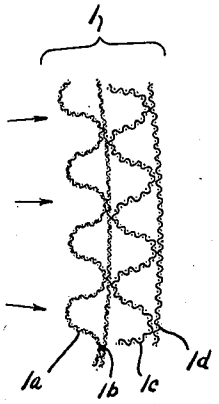

FIG.-3

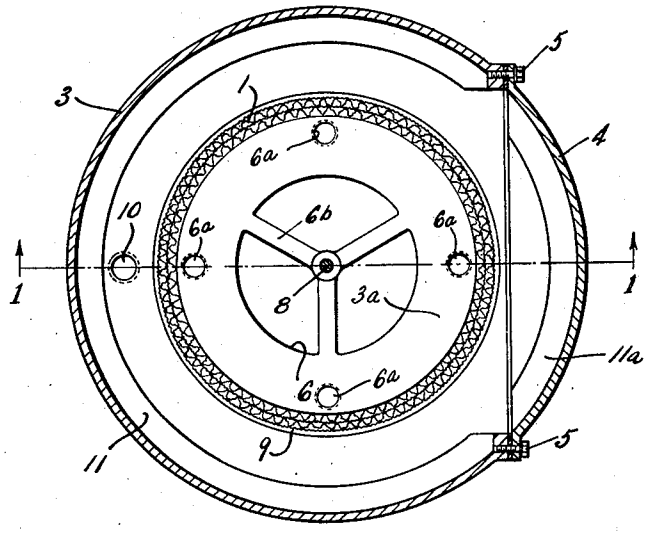

FIG.-2

INVENTOR
GEORGE M. WALTON
BY
Brockett, Hyde, Higley & Meyer
ATTORNEYS

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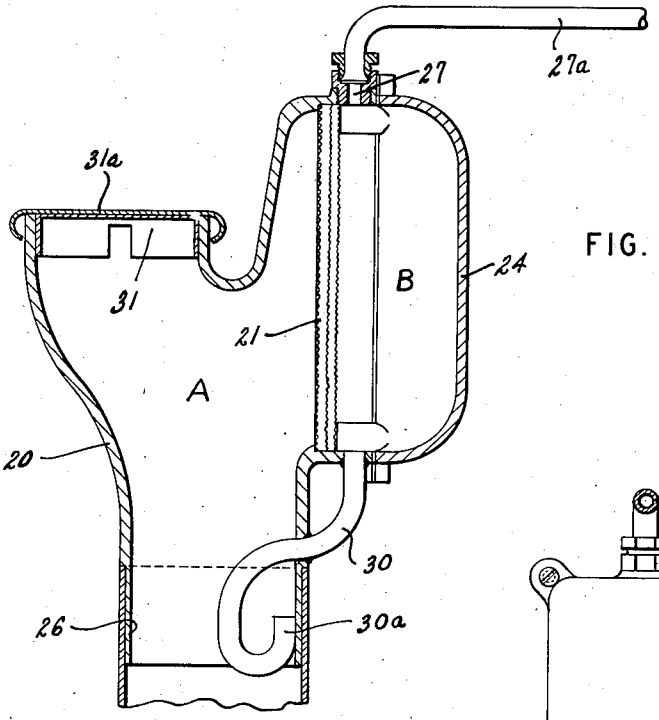

FIG. — 4

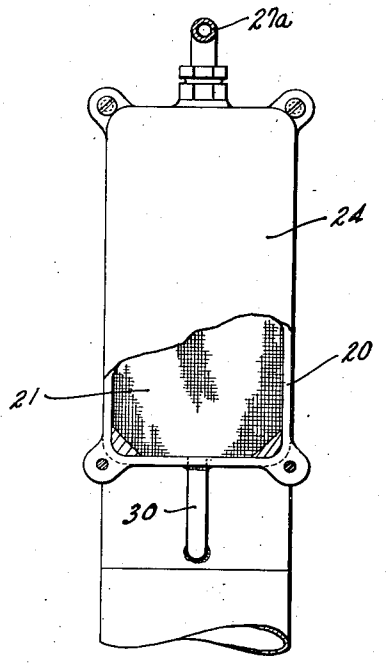

FIG. — 5

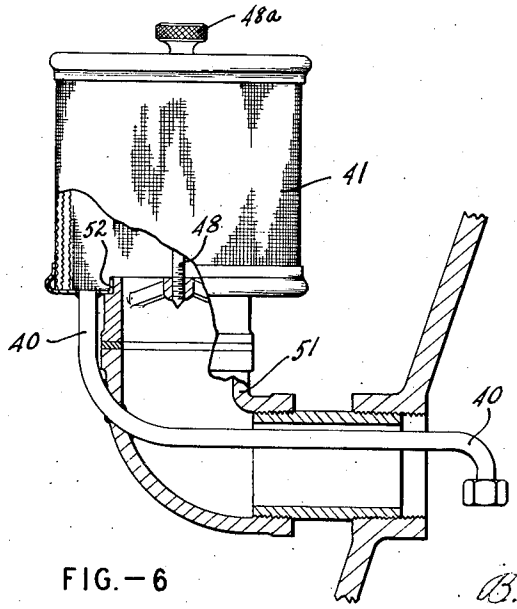

FIG. — 6

INVENTOR
GEORGE M. WALTON

BY
Bockett, Hyde, Higley & Meyer
ATTORNEYS

Patented Feb. 4, 1941 2,230,278

UNITED STATES PATENT OFFICE

2,230,278

OIL SEPARATOR

George M. Walton, Shaker Heights, Ohio, assignor to Air-Maze Corporation, Cleveland, Ohio, a corporation of Delaware

Application July 11, 1936, Serial No. 90,177
Renewed May 7, 1940

2 Claims. (Cl. 183—69)

This invention relates to means for separating minute or vaporous oil particles from a gaseous stream in which they are entrained. The invention particularly contemplates a device which may be connected to be effective between the crank case and the air inlet manifold of an internal combustion engine whereby the crank case interior may be maintained at a slight vacuum so that its vapors will not escape promiscuously, the crank case oil will be conserved yet will be prevented from entering the engine combustion chambers and producing a smoky exhaust. Such general arrangement is well known in the engine art particularly in the stationary, marine, and railway fields.

Requirements of a separator for the purpose, are that it handle the necessary volume of air with a very slight pressure drop, in the order of substantially less than an inch of water, and the general objects of this invention are to provide a simple rugged separator which shall successfully remove a maximum of entrained oil under these conditions.

More specifically an important object of the invention is to provide a separator wherein the primary separating function is accomplished by a metallic foraminous unit of simple design, and to this end the invention embraces a peculiar relation between elements of this unit as will appear.

Another object is to provide various housing arrangements for the separator element, suitable for various operating conditions, all allowing free accessibility to the unit with minimum disturbance to other parts of the device.

The exact nature of this invention together with further objects and advantages thereof will be apparent from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a typical sectional elevation of a large size, high capacity embodiment of the invention, parts being broken away to show details of construction; Fig. 2 is a typical transverse section through the same, as in the plane of line 2—2, Fig. 1, the plane of Fig. 1 being indicated by the line 1—1, Fig. 2; Fig. 3 is an enlarged detail in transverse section as in the plane of Fig. 2, showing construction of the foraminous unit; Fig. 4 is a typical sectional elevation of an embodiment of smaller capacity; Fig. 5 is an elevation of the same, with parts broken away to show details of construction; and Fig. 6 is an elevation of still another embodiment, parts being broken away to show details of construction.

With reference now to the drawings, and first to Figs. 1 to 3 thereof, 1 represents generally the foraminous unit, of cylindrical screen elements 1*a*, 1*b*, 1*c* and 1*d*, disposed on an upright axis, the top of the cylinder thus formed being closed as by a member 2. 3 is a housing for the unit, preferably of cast metal, of sufficient size to permit substantial space about and above the unit, having a lateral opening sufficient to permit removal of the unit therethrough, with a closure 4 for such opening, removably secured as by bolts 5. The housing has a bottom inlet opening 6 and a top outlet opening 7 with which the unit is preferably aligned, the housing being provided adjacent these openings with suitable means for the corresponding piping connections as conventionally indicated by the stud bolt holes 6*a* and 7*a*.

For the purpose of removably securing the foraminous unit properly positioned within the housing, a spider bracket 6*b* is disposed in the inlet opening 6 and a bolt 8 headed as at 8*a* extends rotatably through the closure 2, centrally through the unit to the shown threaded connection with the spider 6*b*. By this arrangement the lower extremity of the cylinder is caused to bear upon the bottom wall of the housing about a flange 3*a* surrounding the inlet opening 6, a gasket 9 being preferably employed between the cylinder and its wall.

The bottom wall of the housing may be provided with an outlet 10 located outside the unit 1 for drainage of the separated oil as through suitable connections back to the crank case served by the separator, the tendency of the separated oil being to collect on the outer face of the separator unit at the base of the latter, and the flange 3*a* preventing outflow of such oil through the inlet opening 6.

The housing is provided intermediate its ends with a flange 11 extending peripherally of the unit to prevent upward creepage of oil upon the inner faces of the housing walls. The closure 4 is preferably provided with a corresponding flange part 11*a* so that the flange is effectively endless.

The inlet opening 6 of the device having connection with an engine crank case, the outlet 7 having connection with the air inlet of the engine and a drainage connection being provided from the outlet 10 back to the crank case, it will be apparent that during the operation of the engine flow of crank case vapors will be had generally from the crank case through the separator and into the combustion chambers of the engine. The stream will enter the separator within the foraminous unit, flow radially outwardly through

its cylindrical screen elements, thence upwardly within the housing and therefrom through the separator outlet opening 7. In practice the permissible pressure drop at the separator is slight and according to my invention this pressure drop may be in the neighborhood of 0.8 of an inch of water. To accomplish this the parts of my foraminous elements are so proportioned and arranged that the return of flow therethrough is in the neighborhood of only 100 feet per minute although flow through inlet and outlet of the separator may be as high as 2,000 or 3,000 feet per minute.

In order to remove substantially all entrained oil under these conditions, the invention takes advantage of the cohesive property of the entrained particles, and to this end the screen elements of which the foraminous unit is composed, are of varying density so related that the succession of elements through which the stream flows, is one including a progression of decreasing density. In the example shown herein, two densities are employed, there being two elements of each density, and, these elements being of woven wire screen, the inner pair 1*a*, 1*b*, are of finer mesh than the outer pair 1*c*, 1*d*. Under the conditions described, I have successfully employed for the purpose rectangular mesh, 30 to the inch each way for the inner elements, and rectangular mesh, 18 to the inch each way for the outer elements, the wire of the screen being in the neighborhood of 0.01 of an inch diameter for each, slightly smaller for the finer screen and slightly larger for the coarser screen. As indicated in Fig. 3, the elements are arranged in pairs, one of each pair being smoothly cylindrical and having a complementary element crimped with longitudinally running deformations, the two elements of the pair being disposed immediately adjacent each other in overlying generally parallel relation, with the crimped one radially within the uncrimped one. In fact all of the elements are disposed in layer relation, each bearing against the next to permit flow of oil from one to the next, over the surfaces of the wires of the screening of which the elements are formed. Such arrangement also provides compactness and rigidity for the unit.

I have found a filter unit made of such elements so disposed, to be superior in operation to any others to my knowledge, and believe its manner of functioning to be as follows. The stream of vaporous oil laden air is first intercepted by the finer mesh screen element or elements which divide the main screen into very numerous minute ones. Most of the entrained oil particles deposit immediately upon the wires forming one or the other of these fine mesh screens, each particle cohering to the surface which it contacts. The mesh is so fine that entrained particles centrally disposed of one of these minute screens, are in passing through the screen caused to contact each other so that one large particle of oil may emerge from the first fine screen in place of an original number of fine particles. In such case the enlarged entrained particles will strike, and be retained by, the next screen.

The innermost screen 1*a* being crimped, although actually of the same fineness of the next screen 1*b* of its pair, is effectively a finer screen, owing to the oblique disposition of most of its parts with reference to the stream. Similarly, the intermediate crimped screen 1*c* is effectively coarser than the screen 1*b* and finer than the screen 1*d*, as well as forming a separator therebetween.

At any rate, the combined surface of the wires of the unit considered as a whole, soon becomes wetted in operation, the direction of the stream causing flow of this surface liquid in the direction radially outwardly of the unit. As flow is had of this liquid from one screen element to the next, as from the element 1*c* to the element 1*d*, the interstices of the screen element are effectively larger so that the gaseous flow has less effect upon the liquid upon the surface of the screen so that this liquid may flow downwardly of the screen under the action of gravity.

Thus, in general the liquid flow is formed from particles which have left the gaseous stream to form a surface skin which has movement radially outwardly of the unit and downwardly to the bottom of the unit. This liquid of course collects at the bottom of the housing where it drains off by way of the outlet 10. Should any liquid fly from the unit as by re-entrainment, it will be in the form of a large heavy particle adjacent the bottom of the unit, and will merely reimpinge itself upon the lower portion of the side wall of the housing up which it cannot creep beyond the flange 11.

In actual practice the air emerging from the housing is substantially entirely free from oil in any form.

With reference now to Figs. 4 and 5, an embodiment of much smaller capacity is shown, comprising a housing 20 within which is located a separator unit 21, vertically disposed and of flat form but of typical section similar to that already described, so that the hollow of the housing is divided into a pair of laterally adjacent compartments A and B. On one side of the separator the housing is provided with a bottom opening part 26 by which the housing may be mounted upon the neck of a pipe indicated through which oil may be supplied to the engine crank case. On the same side the housing has a top opening 31 provided with a removable closure 31*a*.

On the opposite side of the separator, the housing has a cover part 24 removable and of sufficient size to permit removal of the separator 21. Also on this side of the separator, the housing is provided at an elevated location with an outlet 27 from which a tube 27*a* may have connection with the inlet manifold of the engine.

For drainage of the separated oil from the compartment B back to the engine crank case, a tube 30 is connected as indicated, to lead from the bottom of the compartment B through the wall of the compartment A therebelow, and having a return bend 30*a* within the compartment A.

Running operation will be as follows. The engine will provide a suction through the pipe 27*a* maintaining the compartment B at a slight vacuum so that the crank case vapors will be drawn up through the opening 26 and separator unit 21. The separated oil will drain down through the tube 30, the part 30*a* of which comprises a U tube serving to permit oil to be returned in crank case direction through the tube but preventing upward flow therethrough in the direction of the evacuated vapors. The crank case may be filled with oil in the usual manner by removal of the closure 31*a*.

Fig. 6 illustrates still another application of the invention wherein a cylindrical separator unit 41 is employed generally similar to the unit illustrated in Figs. 1 to 3, and removably mount-

ed as by manipulation of the head 48a of the bolt 48. The separator unit is located at the end of piping 51 leading laterally from the engine crank case as indicated and including an elbow whereby the separator unit is vertically disposed. A flange 52 is provided within the base part of the unit to form an annular trough and prevent the separated oil from returning to the crank case by way of the piping 51. The tube 40 leads from this annular trough downwardly outside the piping 51, thence into the piping and into the crank case where it may have connection with a tube leading downwardly into the crank case oil. This arrangement functions as a breather for the crank case, permitting air flow in either direction but separating liquid particles from out-flowing air, such particles being returned to the crank case by way of the tube 40. Filling of the crank case is had by removal of the separator unit with the bolt 48.

What I claim is:

1. In a device for removing finely divided entrained oil particles from a gaseous stream, a screen separator unit, and means for causing said stream to pass therethrough, said unit comprising screens of different fineness disposed in vertical relation with the finest screen first engaging said stream and the successively engaged screens having progressively increasing effective screen openings for separating particles from said screen, there being vertically extending corrugations in at least part of said screens, said corrugations contacting contiguous screens from top to bottom to provide a screen path of travel for oil from the innermost screen to the outermost screen of said unit, and said screens and the meshes thereof being so constructed and arranged that a mist of oil is gathered into small globules on said first engaged screen, which globules are progressively coalesced into larger globules on successively engaged screens where the velocity through the screen openings is decreased sufficiently to permit the oil on the wires of the screen to travel downwardly thereon impelled by gravity.

2. A device as in claim 1 wherein said unit comprises parallel uncrimped screens and a vertically corrugated screen between them and in contact with each of them throughout the vertical length of said corrugations.

GEORGE M. WALTON.