Sept. 28, 1948. I. I. PINKEL 2,450,016

HIGH VOLTAGE FOAM BREAKER

Filed Oct. 12, 1944 3 Sheets-Sheet 1

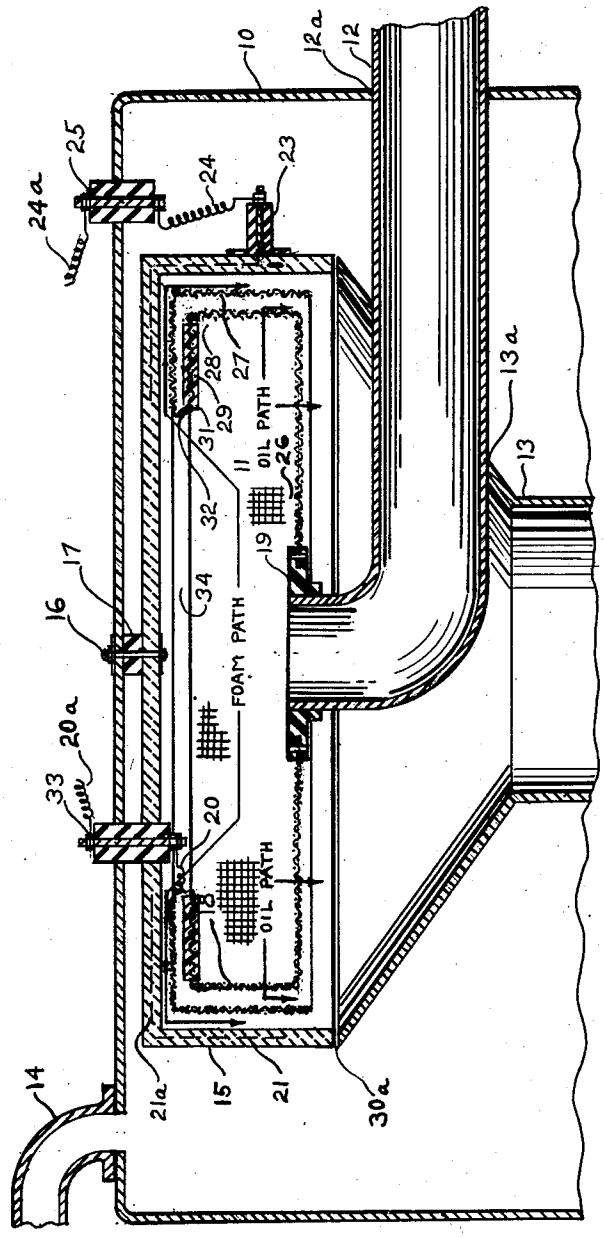


FIG 1

Inventor

I IRVING PINKEL

By W. Glenn Jones

Attorney

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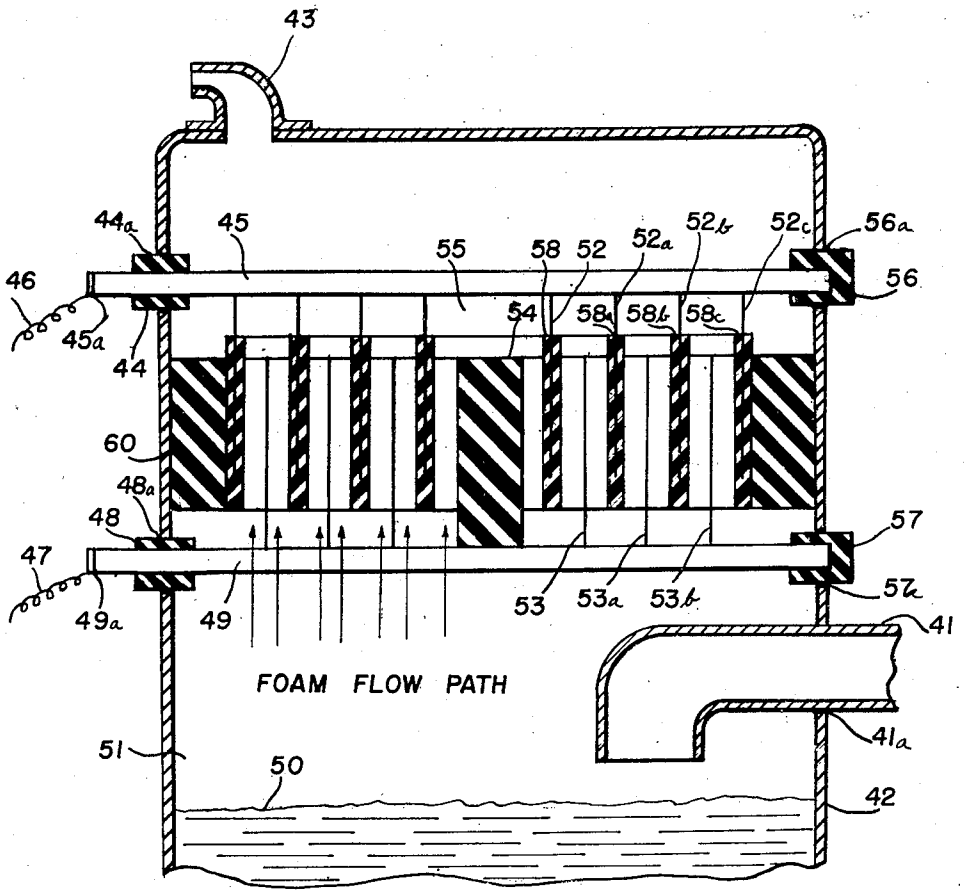


FIG. 2

Inventor

I. IRVING PINKEL

By W. Glenn Jones

Attorney

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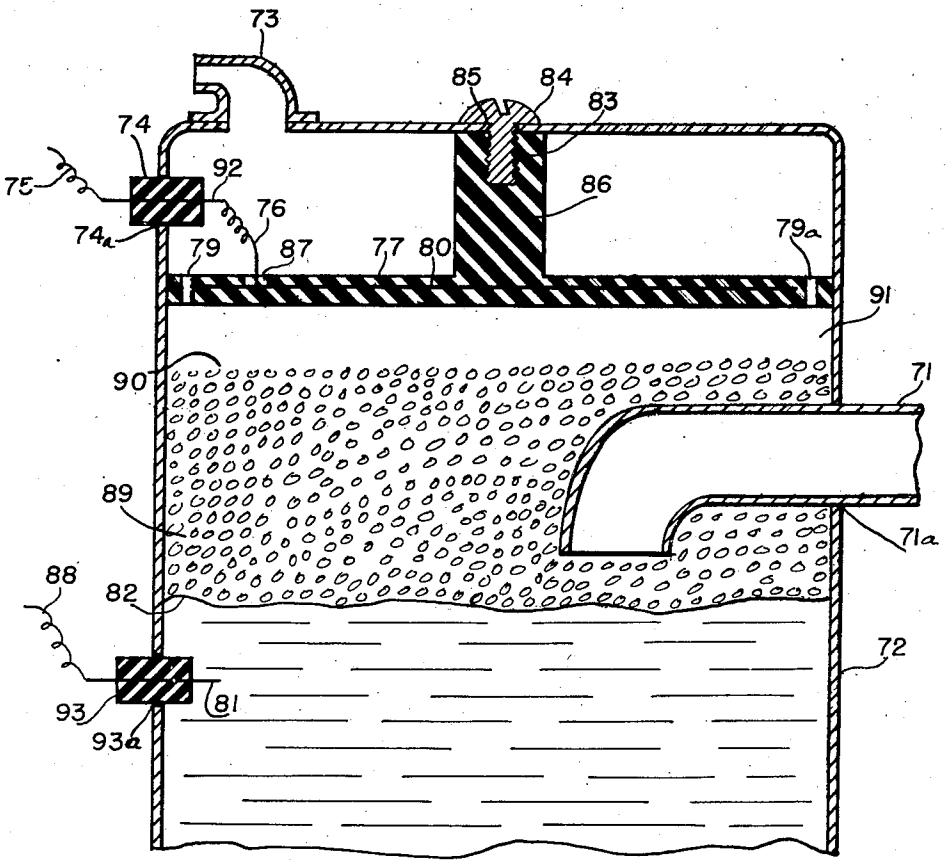


FIG. 3

Inventor
I. IRVING PINKEL

By W. Glenn Jones
Attorney

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HIGH-VOLTAGE FOAM BREAKER

Isadore Irving Pinkel, Cleveland, Ohio

Application October 12, 1944, Serial No. 558,445

4 Claims. (Cl. 204—302)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to apparatus for clearing foam from liquids and, in particular, to apparatus employing an electrical field within which foam from oil or the like is directed to pass so that gas entrained therein, as bubbles, is caused to be released therefrom by reason of the creation of a brush discharge. In many processes involving the handling or distribution of various types of liquids, foaming usually takes place due to air or other gases present becoming entrained therein thus affecting the efficiency of the systems. Where a distillation process is involved, foaming of the distillate not only lowers the distillation efficiency but very often results in a carryover of the charge-stock into the distillate receiver.

The invention as defined and claimed herein is shown in combination with an aircraft engine oil system of the dry-sump type, in which the oil supply is carried in an oil tank and circulated to and from the engine by pumps. The foam, which is invariably produced in the oil tank by reason of the gases from the crank case mixing with and circulating together with the oil pumped from the engine, reduces the efficiency of the oil circulating pressure pump and otherwise greatly disturbs operation of the lubricating system. The reduction in the pressure pump efficiency caused by the oil tank foam becomes more and more acute with altitude of flight and may impose a maximum flight altitude appreciably below that for which the aircraft is designed. For this reason and also due to the fact that a considerable amount of oil is lost to the atmosphere when oil foam fills to overflowing the tank and engine crankcase, the cruising range of the aircraft may be materially reduced, so that the problem of oil foam formation in aircraft oil systems is of vital importance.

One object of this invention is to provide a foam breaker which is positive in operation and conducive to a rapid flow and processing of the liquid and foam passing therethrough.

Another object of this invention is to provide a foam breaker which requires very little effort to operate, is readily adapted to various applications, is simple in construction and light in weight.

These as well as the various other novel features and advantages of this invention will become apparent from a reading of the specification and accompanying drawings of which:

Fig. 1 is a cross-sectional view of the foam breaker and oil tank within which it is secured;

Fig. 2 is a cross-sectional view of an alternate form of the foam breaker incorporating a multiplicity of foam breaking electrodes; and

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Fig. 3 is a cross-sectional view of the modified form of the foam breaker and oil tank in which it is secured, for use with foams that are conductors of electricity.

With reference to Fig. 1, there is disclosed an oil tank 10, having firmly secured therein but electrically insulated therefrom an oil-foam breaker, indicated generally by numeral 11, oil inlet pipe 12, funnel 13 through which oil passes in flowing from the oil-foam breaker 11 to the lower part of the tank 10, and exhaust member 14 for venting the released gases from the tank. The oil inlet pipe 12, for delivering oil to the breaker 11, passes through suitably sealed openings 12a and 13a in the sides of tank 10 and funnel 13 respectively.

The oil-foam breaker 11 comprises a cup 15 made from a suitable dielectric material, such as plastic or the like, secured to but electrically insulated from the tank 10 by means of fasteners 16 and insulation spacers 17 respectively, and a cylindrical shaped double walled screen 18 secured to but electrically insulated from oil inlet pipe 12 by means of ring 19 so that it projects up into the cup 15, allowing sufficient space between the outer walls thereof and the inner walls and top of the cup 15 to permit the free passage of oil foam therethrough. Imbedded in the side wall of cup 15 is a cylindrical helix of wire or metallic tape 21 and in the base a spiral coil 21a of similar material connected electrically in series relationship to the coil 21. The continuity of the electrical circuit is provided by means of a suitably insulated binding post 23 joined to coil 21 and to an external lead wire 24a through inner connecting wire 24 and suitably insulated binding post 25. The lead wire 24a provides one point at which connection with an outside source of high potential electrical energy is to be made.

A metallic screen 18, also formed in the shape of a cylindrical cup, consists of a base 26 having a central opening therein for accommodating the securing ring 19, outer and inner vertically extending concentric cylindrical walls 27 and 28, inner wall 28 being formed integrally with the base 26, annular portions 29 and 31 secured at their edges to walls 27 and 28 respectively and short vertically extending cylindrical wall 32 secured to the inner edges of annular members 29 and 31 respectively. Screen openings in the annular member 31 are tightly sealed with a plastic or like material so as to prevent the passage of liquid therethrough. To one end of binding post 33 is connected a lead wire 20a and to the other an inner connecting wire 20 joined to screen 18, thus providing the second point at which connection with an outside source of high potential elec-

trical energy is to be made. The circular opening 34, of sufficient size, is provided at the top of screen 18 for permitting the foam, during the processing operation, to pass readily therethrough so that it may distribute itself evenly in a thin layer on the upper surface of the annular screen portion 29 and the outer surface of cylindrical screen wall 27.

The operation of the device is carried out essentially in the following manner:

The two lead wires 20a and 24a are connected to a source of high potential electrical energy to impress an electrical charge on each of the cup-shaped members 15 and 18, the space existing between the inner surfaces of member 15 and outer wall 27 and top 29 of member 18 being sufficient to prevent formation of an electrical arc and also to provide a sufficient clearance for the oil foam passing therethrough so that its progress is not impeded. Carrying foam which may be entrained therein, oil enters through the pipe 12 and is discharged upon the surface of the ring 19 and the screen surface 26. The oil which is free of foam will drain through the openings in the screen surface 26 and side walls 28, as indicated by the arrows in Fig. 1, and proceed down into the funnel 13 from which it is delivered to the bottom of tank 10. The foam remaining, however, does not pass through the screen but is forced upwards through the circular opening 34 to be dispersed in a uniformly thin mass within the electrostatic field between the cup 15 and screen 18. For the best efficiency this electrostatic field comprising the space between the surface of the inner screen 27 and the adjacent surface of cup member 15 as well as that between outer screen surface 29 and the adjacent inner surface of cup 15, is of a sufficient magnitude to produce a brush discharge in the foam passage. The material from which the cup 15 is made is of a sufficient dielectric strength to maintain electrostatic field stability so that electrical arcing across the passages is prevented.

An appreciable portion of the oil recovered when the foam is broken pours through the openings in screen 29 and down into the inside of the double wall of screen member 18, striking the sealed surface 28 from which it is deflected down into funnel 13 through the opening existing between side wall screens 27 and 28. The remainder of the foam continues on its path down through the electrostatic field formed between outer screen wall 27 and the adjacent inner wall of cup 15 within which gases entrained therein are released. The oil, free of foam, passes downwardly into the funnel 13 and finally to the bottom of tank 10. The sealed screen surface 31 not only provides drainage for the recovered oil but prevents the oncoming foam from making contact therewith and being wetted thereby, the effect of which would be to increase the oil film thickness thus rendering it more difficult to break the foam. The possibility of reformation of foam in the oil after it has passed through the breaker is reduced to a minimum by reason of the inwardly converging walls of funnel 13 which direct the oil from the breaker to the main oil tank 10 in an undisturbed even flow. Gases released from the foam pass through opening 30a into the tank 10 from which they are exhausted to the atmosphere through the vent 14.

Fig. 2 shows an alternate form of the foam breaker incorporating a multiplicity of foam breaking electrodes. Oil tank 42 has secured therein, but electrically insulated therefrom, an oil-foam breaker indicated generally by numeral 55, oil inlet pipe 41, and gas vent 43. The oil inlet pipe passes through suitably sealed openings 41a in oil tank 42.

The oil-foam breaker 55 contains a central electrode 54 and cylindrical shell electrodes 52, 52a, 52b, 52c, 53, 53a and 53b substantially coaxial with electrode 54. Each of the cylindrical shell electrodes 53, 53a and 53b is located between two cylindrical shell electrodes of the set 52, 52a, 52b and 52c, and are substantially equally spaced therefrom to form annular flow passages of nearly uniform width. Cylindrical shell electrodes 53, 53a, 53b, and solid cylindrical electrode 54 are supported by and securely fastened to metallic rod 49 in a manner to establish electrical contact between metallic rod 49 and said cylindrical electrodes. The second set of cylindrical shell electrodes 52, 52a, 52b and 52c are suspended from and securely fastened to metallic rod 45 in a manner to establish electrical contact between said metallic rod and said cylindrical shell electrodes. Each electrode of the second set 52, 52a, 52b and 52c, is fitted with a cover of dielectric material 58, 58a, 58b and 58c respectively in the region of the annular foam flow passage which provides a uniform thickness of electrical insulation around the electrode on both the inside and outside surfaces and across one end thereof. Metallic rod 49 is supported by insulator sleeves 48 and 57 extending through sealed openings 48a and 57a respectively in oil tank 42. Metallic rod 45 is supported at its ends by insulator sleeves 44 and 56 extending through sealed openings 44a and 56a respectively in oil tank 42. Lead wire 46 is connected to end of metallic rod 45 at 45a, and lead wire 47 is connected to end of metallic rod 49 at 49a. Lead wires 46 and 47 are the two points to which are connected the terminals of a source of high difference of electrical potential energy. Spacer 60, made of dielectric material, is cemented to the inside wall of oil tank 42 and occupies the tank space between the outside surface of electrode insulator 58c and the inside wall of said oil tank.

The operation of the device is carried out as follows:

The two lead wires 46 and 47 are connected to a source of high potential electrical energy to establish a strong electrical field across the annular foam flow passages between the electrodes of the set 53, 53a, 53b and 54, and the electrodes of the set 52, 52a, 52b and 52c. Oil-bearing foam flows into oil tank 42 through inlet pipe 41 and accumulates above the oil level 50 in oil tank space 51. At the level of the foam breaker 55 the accumulated foam must flow into the foam flow passages where the foam is broken in the electric field. The efficiency of the foam breaker is increased if the electric field in the foam flow passages is strong enough to produce a brush discharge. The oil that is recovered from the foam channels down through the foam layer in the oil tank to the oil level 50. The gas released from the foam is vented from the tank through gas vent 43. Although the electrodes 52, 52a, 52b, 52c, 53, 53a, 53b and 54 are shown as cylindrical coaxial elements, it is obvious that flat plate electrodes or electrodes of other shapes may also be used.

For breaking foams that are conductors of electricity the arrangement of the electrodes shown in Fig. 3 is effective. With reference to Fig. 3 there is shown in oil tank 72 in which is mounted

and insulated electrically from said tank an insulated electrode 80 positioned above the oil level 82, an exposed electrode 81 immersed in the tank oil, an oil inlet pipe 71, and a tank gas vent 73. The oil inlet pipe passes through a suitably sealed opening 71a in the wall of oil tank 72.

The foam breaker comprises the exposed electrode 81 extending through insulator sleeve 93 into the tank oil, and the insulated electrode 80 mounted above the oil level 82 in oil tank 72. Electrode 80 is embedded in a disk of suitable dielectric material 77 which is supported from the top of oil tank 72 by screw 84 extending through opening 85 in top of tank 72 into threaded hole 83 in boss 86 which is integral with disk 77. Disk 77 extends over the entire cross-section of oil tank 72 so that foam cannot flow by the perimeter of said electrode and enter into the tank space above said electrode. Connecting wire 76 makes electrical contact with wire 92 and metallic plate 80 through hole 87 in disk 77. Insulator sleeve 74 is mounted in opening 74a of the side wall of oil tank 72 in a manner to be leakproof, and insulates wire 92 from electrical contact with oil tank 72. Lead wire 75 is electrically connected to wire 92 and lead wire 88 is electrically connected to electrode 81. Electrode 81 is insulated from oil tank 72 by means of insulator sleeve 93. Lead wires 75 and 88 are the two points to which are attached the terminals of a source of high difference of potential electrical energy. Holes 79 and 79a extend through dielectric material 77 to provide a passage for gases released from the foam to flow to the oil tank vent line 73.

The manner of operation of this modified device is as follows:

Oil-bearing foam enters oil tank 72 through oil inlet pipe 71. The foam floats on top of the oil level 82 where it accumulates in the foam space 89. By virtue of the electrical conductivity of the oil and oil foam, due to the presence of moisture plus soluble metallic salt or acids, the foam has the same electrical potential as that which is impressed on electrode 81. As foam level 90 approaches electrode 80 the intensity of the electric field in the intervening space 91 increases up to the point where the foam breaking at foam level 90 proceeds at the same rate foam is introduced into tank 72, at which time no further rise in the foam level occurs. The gas released from the foam passes through openings 79 and 79a and passes out through gas vent 73. The oil recovered from the foam channels down through foam layer 89 to the oil level 82.

It will be understood that the above description and accompanying drawings comprehend only the general and preferred embodiment of the invention and that various changes in construction, proportion and arrangement of the parts may be made within the scope of the appended claims without sacrificing any of the advantages of the invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. An apparatus for releasing gases entrained as foams in liquids, said apparatus comprising: a tank; a pair of electrodes having their surfaces uniformly spaced apart and mounted within and electrically insulated from said tank and from each other to form a foam flow passage therebetween; an insulating covering on one of said electrodes over all of the surface of said electrode in contact with the atmosphere of the foam flow passage; a porous member within said tank and adjacent said electrodes; an electrical conductor connected to each of said electrodes and adapted to be connected to a source of high potential electrical energy; an inlet conduit adjacent said porous member positioned to direct foam carrying liquid to said member to permit the portion of the incoming liquid which is free of foam to pass through said member and the remaining foam to flow into said passage; and means for directing all of the foam free liquid into the bottom of said tank.

2. In an apparatus for releasing gases entrained as foams in liquids, the combination comprising: a tank, a pair of electrodes mounted within said tank and having their surfaces uniformly spaced apart to form a foam flow passage therebetween; a porous member within said tank and adjacent said electrodes; an electrical conductor connected to each of said electrodes and adapted to be connected to a source of high potential electrical energy for impressing a large difference of potential across said electrodes; an inlet conduit adjacent said porous member positioned to direct foam carrying liquid to said member to permit the portion of the incoming liquid which is free of foam to pass through said member and the remaining foam to flow into said passage wherein the gas entrained therein will be released; and means for receiving said portion of the liquid and the liquid from which gases entrained therein have been released.

3. In an apparatus for releasing gases entrained in liquids as foam, the combination comprising: a pair of extended surface electrodes each having a portion thereof uniformly spaced apart from the other to form a foam flow passage therebetween, another portion of one of said electrodes being porous to permit the drainage therethrough of that part of the liquid initially free from foam; a separate electrical conductor connected to each of said electrodes adapted to be connected to a source of high potential electrical energy; an inlet conduit adjacent the porous portion positioned to direct foam carrying liquid to said porous portion; and means for receiving said liquid initially free from foam and the liquid from which gases entrained therein have been released.

4. The combination according to claim 3 wherein said electrodes are cylindrical in shape one being placed concentrically within the other.

I. IRVING PINKEL.

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