March 2, 1937. R. F. SIMONIN 2,072,281

MIXING AND ATOMIZING APPARATUS FOR HYDROCARBONS AND OTHER FLUID MATERIALS

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Fig.1.

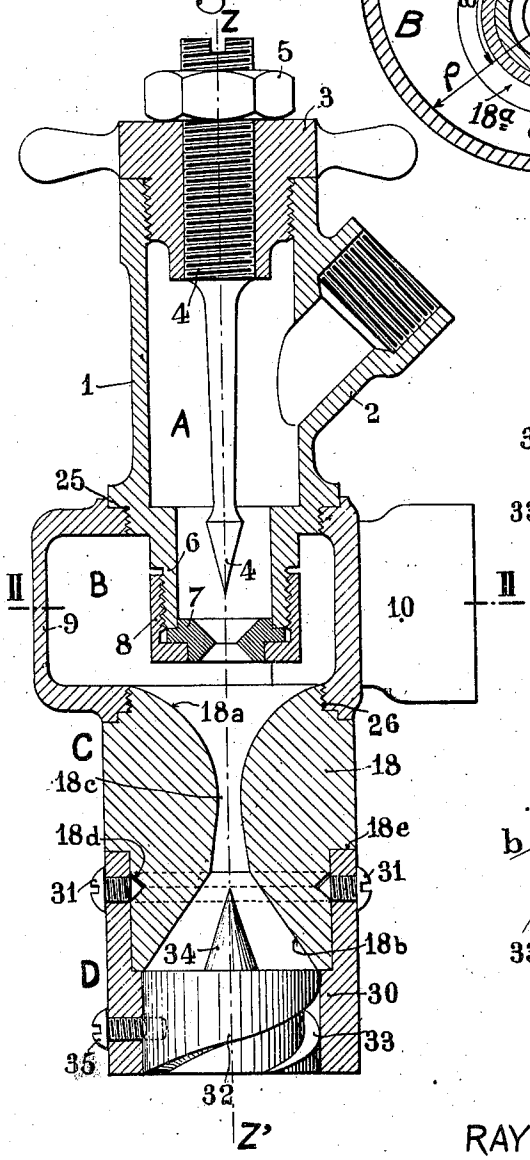

Fig.2.

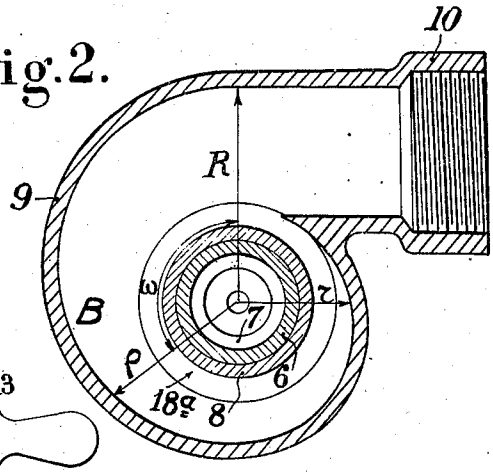

Fig.3.

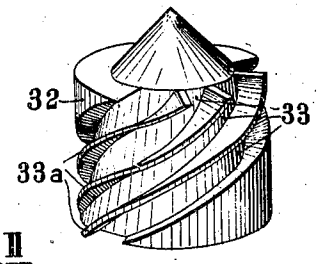

Fig.4.

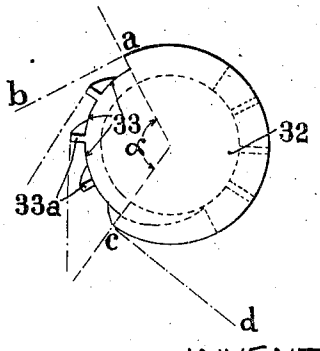

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Fig.5.

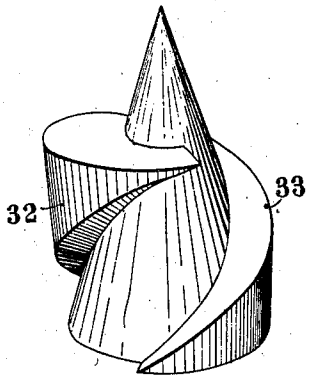

Fig.6.

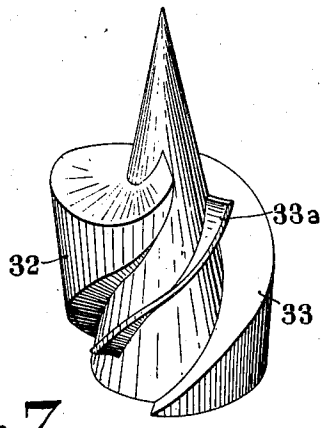

Fig.7.

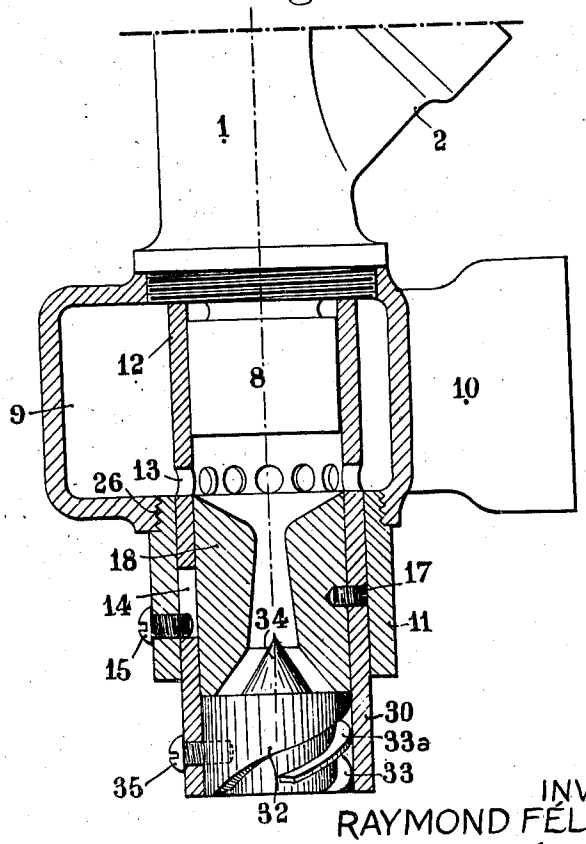

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Fig. 8

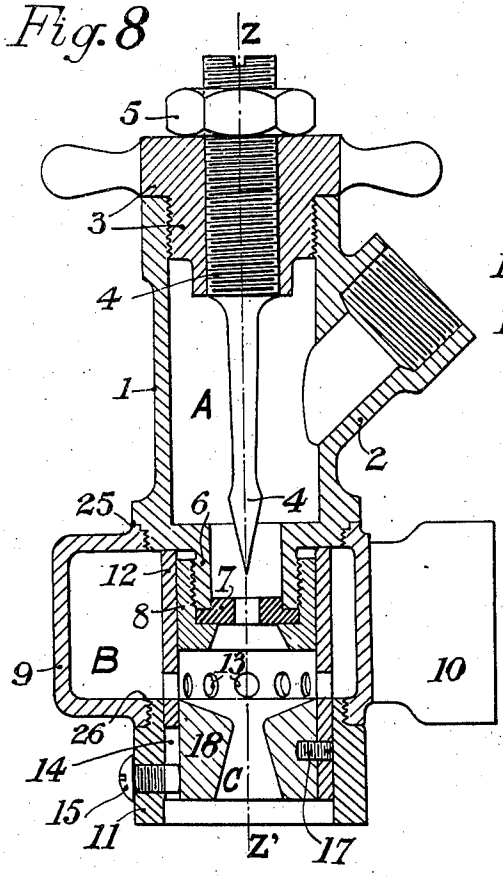


Fig. 9

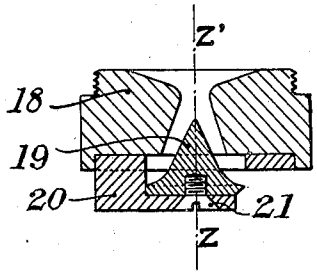
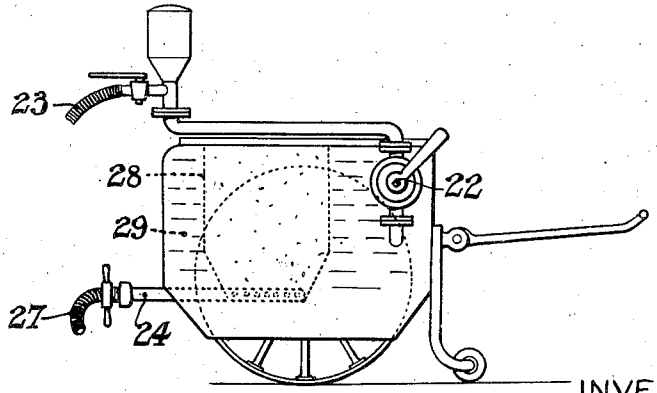


Fig. 10



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Patented Mar. 2, 1937

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UNITED STATES PATENT OFFICE

2,072,281

MIXING AND ATOMIZING APPARATUS FOR HYDROCARBONS AND OTHER FLUID MATERIALS

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Application September 23, 1936, Serial No. 102,136
In France October 17, 1935

10 Claims. (Cl. 299—114)

This invention relates to a mixing and atomizing apparatus for hydrocarbons and other fluid materials, which can be used, in particular, for mixing and spreading on roadways more or less complex hydrocarbonaceous liquids, eventually laden with fillers in suspension.

This apparatus is characterized by the combination of a connecting branch adapted to be connected to an inlet pipe supplying liquid under pressure and terminating in a washer having a calibrated hole, a chamber surrounding the outlet end of said connecting branch and having itself a connecting branch directed tangentially and adapted to be connected to an inlet pipe supplying another fluid material, a nozzle having a Venturi passageway in alignment with the axis of said calibrated hole, and a device allowing to distribute, in the form of a thin sheet, the mixture issuing from said nozzle.

The fluid material tangentially entering said chamber, for instance a liquid, air laden with a filler in suspension, etc., may not be delivered under pressure therein because the jet of liquid under pressure, through the calibrated hole of the washer, forming a spraying nozzle, and the nozzle having a Venturi passageway, produces in this chamber a suction which is sufficient for drawing said fluid material therein, even if this fluid material comes from a tank open to the atmosphere and arranged at the level of said chamber.

The accompanying drawings, given by way of example only, illustrate some embodiments of the subject-matter of the invention.

Fig. 1 is a vertical section of a first form of construction.

Fig. 2 is a cross section thereof made along line II—II of Fig. 1.

Fig. 3 is a perspective view showing a modification of a core having a helical groove.

Fig. 4 is an underside plan view of said core.

Figs. 5 and 6 are perspective views of two other modifications of this core.

Figs. 7 and 8 are vertical sections of two other forms of construction.

Fig. 9 is a vertical section of a modification of the nozzle and of the distributing device.

Fig. 10 is an elevation of a carriage for liquids.

The apparatus illustrated in Figs. 1 and 2 comprises four distinct parts A, B, C, D.

The part A is composed of a hollow cylindrical body 1 in which leads a connecting branch 2 through which is sent the primary liquid under pressure. A wing nut 3, constituting a plug, is screwed in the body 1. A needle valve 4 is screwed in the plug 3 and is exactly centered in the cylinder 1. It can be secured in any required position by a lock nut 5.

The body 1 terminates in a connecting branch 6 having a diameter preferably smaller than that of the body 1, and the axis of which coincides with the axis Z'Z of the cylindrical body 1. A spraying nozzle washer 7 perforated with a cylindrical or slightly conical hole is secured to the body 1 by a spraying nozzle cap 8 secured on 6. This cap 8, made cylindrical, is in alignment with the axis Z'Z.

The part B of the apparatus is constituted by a chamber 9 the cross section of which is of spiral shape (Fig. 2); to this chamber is tangentially connected a connecting branch 10 which causes it to communicate with a tank containing the secondary fluid, under pressure or not.

In the example illustrated, for the profile of chamber 9 has been chosen a spiral such that the difference between its variable radius vector ρ and the radius r of a fixed circumference concentric with the axis ZZ' of the spraying nozzle is proportional to the angle ω formed by the radius vector with an axis of origin, i. e. a spiral having for equation:

$$\rho=\frac{R-r}{2\pi}(2\pi-\omega)+r$$

R being the greatest radius vector of this spiral.

This arrangement is adapted to facilitate the supply of the secondary fluid under the suction effect of the primary liquid in chamber 9.

This chamber is screwed at 25 on the body 1. It is provided, at its lower part, with a circular opening 26 centered on the axis Z'Z and screw-threaded for receiving the part C. This third part C consists in a nozzle 18 having a Venturi passageway and directly screwed in the opening 26. In this example, the inlet orifice of the nozzle 18 is in the shape of a portion of a torus 18a to the narrowest section 18c of the Venturi passageway. The outlet orifice has a conical and relatively widely flared shape 18b.

The fourth part D of the apparatus is composed of two bodies of revolution fitted one into the other; the outer body of revolution 30 consists in a connecting branch which is fitted with slight friction on the end of the nozzle 18 and is supported by screws 31, the points of which extend in a groove 18d, of angular section, provided about the nozzle. The setting of the device D can thus be modified at will.

Moreover, the pressure of the screws on the lower wall of the groove 18d ensures the contact

of the connecting branch 30 with a shoulder 18e of the nozzle, in order to obtain the necessary fluid-tightness. The inner body of revolution or core 32 is secured in the connecting branch 30 by screws 35. In this example, the contact surface of the bodies of revolution 30 and 32 is cylindrical and a helical groove 33 is provided in the periphery of the core 32.

Instead of this core having a simple groove, more or less wide, use can be made of bodies of revolution of different shape, for instance those illustrated in Figs. 3 to 6.

Figs. 3 and 4 illustrate a cylindrical core, the helical groove 33 of which is divided, by narrow threads 33a, into a plurality of passages of constant pitch, but having a depth which decreases from the inlet end to the outlet end. The entire groove occupies an opening forming an angle α smaller than 180° In Fig. 4, the dotted lines indicate the directions of the elementary jets when they issue from the grooves 33, these jets forming a sheet having at this place the shape of a portion of a hyperboloid comprised between the extreme generatrices *ab* and *cd*.

This sheet can come in contact with the ground according to a portion of an annular zone the radius of which will depend on the distance separating the device from the ground, and the angular opening of which will correspond to that of groove 33. If the apparatus is moved at a constant speed and parallel to the ground in the direction of the bisectrix of the arc of impact of the sheet, a substantially uniform distribution of the liquid spread on the ground will be obtained per unit of area as long as the supply pressure will not be changed.

As shown in Figs. 5 and 6, the core 33 has a frustum-like shape slightly converging downwardly, so that once inserted in a connecting branch of corresponding shape, the pressure exerted by the liquid on the top of the core will press the periphery of the latter against the inner wall of the connecting branch, thus ensuring the fluid-tightness of the joint and allowing as well the core to be secured without the use of screws or similar members.

As shown in Fig. 5, the core is provided with a groove 33 without subdivision, whilst the core illustrated in Fig. 6 is subdivided on a portion of its length by a thread 33a. It is to be understood that the number of intermediate threads can vary without the desired effect being appreciably modified.

In these various examples, the obliquity of the grooves relatively to the axis of the core is constant or varies to a slight extent; but the dispersion of the liquid in the shape of a hyperboloid sheet would also be obtained if the grooves had different shapes and inclinations in the first portion of their length, provided their outlet portions are, on a suitable length, all directed with one and the same obliquity as in the examples illustrated. For instance, each groove can have a V-shape or a sinuous shape, for the purpose of completing the stirring and emulsion of the various liquids when more or less complex mixtures are to be spread on the ground.

In the above examples, the core 32 carries a conical projection 34 entering the outlet orifice of the nozzle 18 for facilitating the flow of the liquid towards the groove 33.

The apparatus illustrated in Fig. 7 differs from the preceding one by the fact that it comprises a cylindrical slide valve 12 secured to the nozzle 18 by a screw 17; this slide valve is perforated, on its periphery, with holes 13 and can slide with slight friction, on the one hand, on the cap 8 terminating the inlet connecting branch 1 and, on the other hand, in a socket 11 screwed in the opening 26 of the bottom of chamber 9.

The stroke of this slide valve is limited by a screw 15 passing through socket 11 and extending in a groove 14. In this example, the distributing device D is constituted by an extension 30 of the slide valve and by the core 32 secured in this extension by a screw 35. It moves therefore with the slide valve and with the nozzle. In the position of rest or lower position, the holes 13 are withdrawn within the socket 11. If the primary liquid under pressure is caused to enter the body 1, the needle valve 4 being lifted, this liquid passes through the spraying nozzle, enters the nozzle 18, thence passes through groove 33 and issues in an atomized condition in the form of a sheet. Within the slide valve 12, between the spraying nozzle and the nozzle 18, a partial vacuum is created so that the atmospheric pressure lifts the unit constituted by the slide valve, nozzle 18 and core 32, whereby the holes 13 open in chamber 9 and that the secondary fluid is sucked through the latter and through the connecting branch 10. This fluid then mixes with the primary liquid in the nozzle 18, and, from this moment, it is their mixture which is atomized and projected in the shape of a sheet.

Fig. 8 shows only the parts A, B, C of an apparatus to which can be secured a suitable distributing device, for instance that shown in Fig. 9. This apparatus comprises a slide valve 12 similar to that just described, but shorter. Its nozzle 18 having a Venturi passageway, presents an inner profile different from that of the nozzle 18 of Figs. 1 and 7.

Fig. 9 illustrates a distributing device which can be used instead of the distributing device 30, 32 described above. It consists in a member 19 secured, by a screw 21, on a support 20 secured in its turn to the nozzle 18; this member has the shape of an approximately conical body of revolution, the point of which extends in the outlet orifice of the nozzle, and the base of which has a concave profile allowing to spread out the jet issuing from the nozzle in the form of a bell-shaped sheet.

The vehicle shown in Fig. 10 comprises a hydrocarbon vat moved by hand, in which is arranged a vessel 28 containing a filler and surrounded by the primary liquid 29 (hot tar for instance).

A pump 22 sends the primary liquid under pressure in a flexible pipe 23 leading to the connecting branch 2 of the mixing apparatus. A tube 24 opens at the bottom of the filler vessel and communicates with the connecting branch 10 of this apparatus by means of a fluid-tight flexible pipe 27.

It suffices to pump for obtaining the desired result.

Use can be made of the dispersing device composed of the connecting branch 30 and core 32 independently of the mixing device composed of the spraying nozzle 7, vacuum chamber 9 and nozzle 18, by securing it for instance directly to the outlet of a conduit supplying any liquid under pressure.

Although it is preferable to provide the groove 33 in the surface of the core 32 and to leave the inner wall of connecting branch 30 smooth or plain, equivalent results might be obtained by forming the groove in the connecting branch and by leaving the surface of the core plain, or by

forming suitably associated grooves in these two members.

I claim:

1. In a mixing and atomizing apparatus for hydrocarbons and other fluid materials, the combination of a hollow body, a connecting branch for the admission of a driving fluid on said hollow body and opening in the same, a washer, having a calibrated hole, on this hollow body, for the issue of said driving fluid, an annular hollow body adapted to surround said washer, a connecting branch for the admission of a driven fluid on this annular hollow body and arranged to open tangentially in the latter, a nozzle having a Venturi passageway on this annular hollow body and in alignment with the axis of said hollow washer, and means on this nozzle allowing to distribute, in the form of a thin sheet, the mixture of driving and driven fluids issuing from said nozzle.

2. A mixing and atomizing apparatus as claimed in claim 1, in which said washer having a calibrated hole is removably secured on the corresponding hollow body, adapted to receive the driving fluid.

3. A mixing and atomizing apparatus as claimed in claim 1, in which said annular hollow body, surrounding said washer, encloses a chamber having a spiral shape, said inlet connecting branch of this chamber being directed tangentially to the wall at the place where its radius of curvature is maximum.

4. A mixing and atomizing apparatus as claimed in claim 1, in which the inlet orifice of the nozzle having a Venturi passageway is in the shape of a portion of a torus up to the narrowest section of said passageway.

5. A mixing and atomizing apparatus as claimed in claim 1, in which said means, provided on said nozzle and allowing to distribute, in the form of a thin sheet, the mixture issuing from said nozzle, is constituted by two bodies of revolution fitted one into the other, one of these bodies of revolution having in its surface in contact with the other body, a groove terminating according to an oblique direction relatively to the axis of these two bodies of revolution and arranged for opening on a portion of a circumference smaller than 180°.

6. A mixing and atomizing apparatus as claimed in claim 1, in which said means, provided on said nozzle and allowing to distribute, in the form of a thin sheet, the mixture issuing from said nozzle, is constituted by two bodies of revolution fitted one into the other, one of these bodies having in its surface in contact with the other body a groove longitudinally divided by at least one thread which extends at least on a portion of the length of said groove.

7. A mixing and atomizing apparatus as claimed in claim 1, in which said means, provided on said nozzle and allowing to distribute, in the form of a thin sheet, the mixture issuing from said nozzle, is constituted by two bodies of revolution fitted one into the other, one of these bodies having a groove in its surface in contact with the other body, the contact surfaces of these two revolution bodies being cylindrical, and said bodies being removably connected one to the other.

8. A mixing and atomizing apparatus as claimed in claim 1, in which the means allowing to distribute, in the form of a thin sheet the mixture issuing from said nozzle, are arranged on the latter so that they can be set at will about the axis of this nozzle.

9. A mixing and atomizing apparatus as claimed in claim 1, in which the means allowing to distribute, in the form of a thin sheet, the mixture issuing from the said nozzle, are in the shape of a frustum converging towards the outlet.

10. A mixing and atomizing apparatus as claimed in claim 1, in which said nozzle having a calibrated hole is arranged in a cylindrical outlet connecting branch of said hollow body adapted to receive the driving fluid, a cylindrical slide valve rigid with said nozzle having a Venturi passageway, perforated on its periphery and arranged for longitudinally sliding on said outlet connecting branch and in an axial outlet orifice of said annular hollow body, the perforations of said slide valve being so arranged as to open or cut off the passageway between the chamber of said annular hollow body and the said nozzle according to the position of said slide valve.

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