

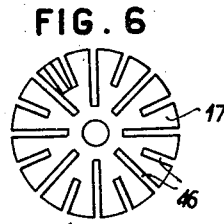
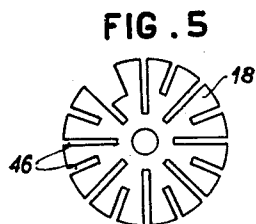
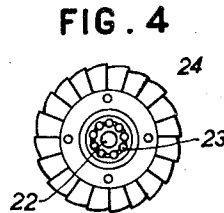
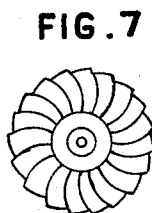
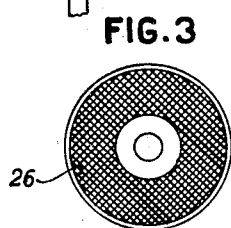
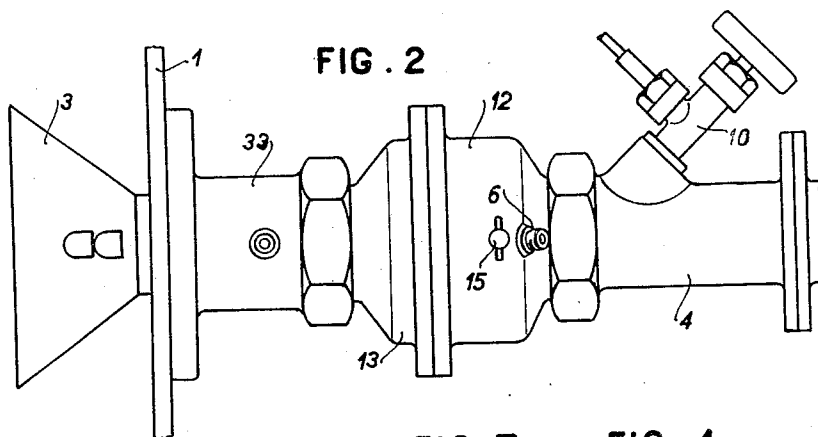
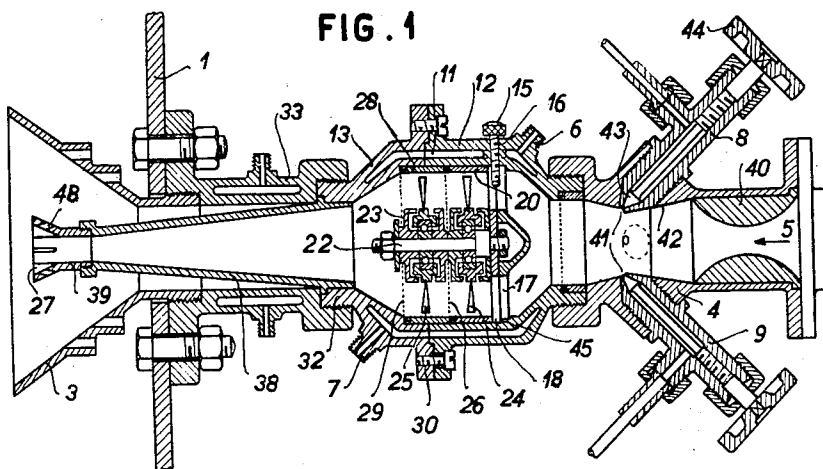
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METHOD FOR CARBURETING HEAVY LIQUID FUELS

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METHOD FOR CARBURETING HEAVY
LIQUID FUELS

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This invention relates to a method for carbureting liquid fuel, for example for the heating of boilers with naphtha and the like, in accordance with which the fuel is first sprayed preferably by means of compressed air, then supplied to a mechanically acting atomizer, and thence conducted to the point at which it is to be burned, and consists essentially in the fact that the chamber in which the fuel is mechanically atomized and simultaneously commixed with air is cooled.

The hitherto known and actually used heavy oil carbureting devices have not been capable of mixing heavy oil or naphtha with air so intimately that perfectly smokeless combustion is ensured. The main reason for this fact has been that the heavy oil is fed to the mechanical atomizing device, the purpose of which is primarily to mix the components of the heavy oil with air, partly in a liquid, but also partly in an already vaporized state. This is the case since the heavy oil must necessarily be heated before introduction into the carbureting device in order that it may acquire sufficiently thin liquid consistency as to permit of its atomization by means of compressed air. This preliminary heating, however, causes a large part of the components of the heavy oil, namely the more readily vaporizing components, to become converted into a vaporous or gaseous state. As in fractional distillation, these volatilized components are the first to pass into the mechanical atomizer, and traverse the same more rapidly than the liquid particles of the heavier components. These volatilized components are thus brought into less intimate contact with the simultaneously eddied air than the liquid particles of the heavier components, by impact against the moving parts and the walls of the carbureting device, and consequently pass into the flame for the greater part still in the form of vapor inadequately commixed with air.

The present invention aims at maintaining all the components of the heavy oil when heated according to the known practices, as stated, including the readily vaporized components, in a liquid state in the mechanical atomizer, since, as exhaustive tests have proved, it is only under this condition that such intensive commixture with air takes place that absolutely smokeless combustion results. This invention provides the only possibility yet known of carbureting all the components of heavy oil uniformly and completely, and of enveloping each of the minutest particles of the atomized liquid with air.

The essential feature of the invention is that

the fuel-air mixture while in the mechanical atomizing portion of the carbureting device is cooled, and that to such an extent that even the most readily vaporizing components of the oil are condensed back into liquid in the form of minute particles.

In this connection a particularly favorable effect is achieved by virtue of the further fact that the liquid particles produced in the described manner, that is to say by condensation, are smaller than those produced by mechanical atomization, so that a hitherto unequalled degree of homogenizing and atomization, with the simultaneous enveloping with air of each liquid particle produced by condensation, is achieved. The cooling can be effected by the action of cold applied from the outside, but preferably by utilization of the phenomenon of physics that vapor traversing a tube is condensed by the expansion occurring at a point at which the cross-sectional area of the tube is enlarged. For the utilization of this principle in the present instance it is important, in determining the dimensions of the carbureting device, that the cross-sectional enlargement be of such magnitude that even the most readily volatile components of the heavy oil are condensed to liquid particles in the form of extremely fine mist.

The invention can also be employed to equal advantage not only for heavy oils proper but also for liquid fuels of lower specific gravity, and more particularly for gasoline and mixtures thereof with benzol, spirits, naphtha, and the like, and permits of the attainment of a hitherto unequalled degree of perfection in the commixture of fuel and air.

A device for the carrying out of the method according to the present invention, and more particularly for the purpose of burning naphtha and heavy oils consists, in view of the above-described principles, of a part in which a mixture of sprayed fuel and air is produced, and of a further part, comprising the mechanical atomizer, in which the drop-shaped particles of heavy oil are very finely broken up and atomized, and in which the mixture is homogenized by means of fan wheels and filters.

A constructional example of a heavy oil carbureting device in accordance with the invention is shown in the accompanying drawing, in which:

Fig. 1 shows a carbureting device for heavy oil combustion, in longitudinal section.

Fig. 2 shows the same in elevation.

Fig. 3 shows a filter.

Fig. 4 shows an atomizing fan wheel.

Figs. 5 and 6 show the two parts of a regulating device for controlling the quantity of mixture.

Fig. 7 shows a modified form of fan wheel.

The part of the device serving for the production of a primary mixture of air and sprayed heavy oil consists for example of a tube 4 into the wall of which there are fitted the injecting nozzles 8 and 9 for the heavy oil, and into which compressed air enters in the direction of the arrow 5. To obtain the expansion of the mixture required in accordance with the invention, the inside of the tube 4 is conically enlarged from the nozzle orifices 41 onwards, in the direction of flow. For the purpose of the convenient regulation of the quantity of heavy oil injected into the tube 4, with a view to increasing or reducing the flame, the orifices 41 of the nozzles 8 and 9 are preferably of different cross-sectional areas. The regulation is effected in a known manner, for example by means of a needle 43 operated by rotation of the knob 44.

The cross-sectional area of the inlet in the tube 4, for the admission of compressed air, can be set for a particular size of flame or for a particular heating effect, by means of interchangeable bushings 40 the aperture of which is gradually enlarged to each side.

The mixture of fuel and air produced by the sweeping of the air intake with considerable speed past the jets of sprayed oil issuing from the orifices of the nozzles then passes into the mechanical atomizing device in which the fuel is reduced to an extremely fine mist, and in which the mixture is homogenized to the greatest possible extent. This device may be of any suitable or known construction and consists for example of the preferably two-part casing 12, 13 in which the fan wheels 24, 25 and the filters 26, 29 are arranged upon the shaft 22 disposed in the direction of flow. While the fan wheels are rotatable upon the fixed shaft, by means of the roller bearings 23, the filters 26, 29 are fitted in cylindrical bushes 20, 28, the outside diameter of which corresponds to the inside diameter of the casing 12, 13.

The shaft 22 is mounted at one end in the disc 18 which is pressed against the tapered part 45 of the casing and held in position by the pressure exerted upon the bushes 28, 20 on the tightening up together of the two halves 12 and 13 of the casing by means of the screws 30.

For the purpose of obtaining the expansion and consequent cooling of the mixture according to the invention, the portion 12 of the casing of the atomizer, at the end at which the mixture enters, is tapered, so that its cross-sectional area is greatly enlarged for a short portion of the path of flow.

The disc 18 and the disc 17, which is immediately adjacent thereto but rotatable in the casing, are each provided, as shown in Figs. 5 and 6, with radial slots 46, and these two discs constitute jointly a device for the regulation of the quantity of the fuel mixture passing to the atomizer. By means of the screw pin 16 passing through a slot in the casing and provided with a head 15, the disc 17 can be rotated to such an extent that the slots in the two discs can be caused to register completely or partly, that is to say that the slots in the one disc can be more or less completely covered by the intervening solid portions of the other disc.

The fuel mixture entering the casing 12, 13 under pressure causes the fan wheels 24, 25 to

rotate at very high speed, and preferably in opposite directions in consequence of suitable adjustment and setting of the blades. This arrangement has the effect of completely breaking up the liquid particles of the incoming mixture into a state of the finest mist, and at the same time of thoroughly intermixing and homogenizing the atomized fuel with air. This effect is still further increased by the provision of the filters 26, 29 which are arranged in alternating sequence with the fan wheels, and which divide up the mixture passing therethrough into a large number of fine threads. These filters can either consist in a known manner of wire gauze or can be made honeycomb-fashion of a number of closely juxtaposed channels for the passage of the mixture.

The described manner of mounting the shaft 22, the throttling discs 17, 18, the fan wheels 24, 25, and the filters 26, 29 permits of the convenient removal, as a single unit, of the whole of the internal mechanism of the atomizing device proper, after the slackening off of the flange connection between the two halves of the casing 12, 13.

In order to enable the cooling of the mixture by expansion on entering the atomizer casing to be intensified in case of need, or of enabling this cooling to be effected, if desired, without expansion of the mixture, the casing 12, 13 is jacketed, so that a cooling medium can be caused to circulate in the space between the double walls of this jacket.

Conversely, however, it can also become necessary, in cases of excessive cooling by expansion, which may even go below the freezing point of water so that the casing becomes coated with a layer of ice formed of the moisture condensed from the atmosphere, to pass a heated medium through the jacketing of the casing, with a view to maintaining the most favorable temperature for the atomizer.

Instead of arranging for both fan wheels to rotate, it is also possible to arrange for the wheel traversed last to be stationary. In this case this latter wheel is preferably constructed in the manner indicated in Fig. 7 with blades of maximum radial length, for the purpose of reducing the throttling resistance to a minimum.

For the attachment of the atomizer to the wall 1 of the combustion chamber there is preferably employed the tubular member 33 which can be double walled if necessary to permit of artificial cooling and to prevent excessive heating of the carbureting device casing by the heat conducted from the wall of the combustion chamber.

Exhaustive tests have shown that it is possible to obtain absolutely smokeless combustion of the fuel mixture with the aid of the method and carbureting device according to the present invention. The combustion is accordingly also effected with a degree of thermal efficiency which very considerably surpasses that of known heavy oil burners, since all the components of the liquid fuel are consumed leaving no residue. In the case of furnace heating both the boiler and the fire-box thus remain free, from solid, coked residue of combustion, but neither do fuel particles leave the flame in the liquid and non-combusted state, as is not infrequently the case with known burning devices, so that the combustion chamber is not fouled in any sense.

The increase in thermal efficiency obtainable by the use of the method and carbureting device according to the present invention over that ob-

tainable with known types of heavy oil burners is very considerable, and is of particular advantage in connection with the heating of marine engine boilers.

5 What I claim is:

10 1. The method of carbureting liquid fuel which consists in partially pre-vaporizing and spraying the fuel and mixing air therewith to form a primary mixture in which part of the fuel is in a vaporous state, mechanically breaking up the non-vaporized particles of fuel in the mixture, and at the same time cooling the vaporized portion of the fuel to condense the same and form minute liquid particles.

15 2. The method of carbureting liquid fuel which consists of partially pre-vaporizing and spraying the fuel and mixing air therewith to form a primary mixture in which part of the fuel is in a vaporous state, mechanically breaking up the non-vaporized particles in the mixture, and at the same time cooling the mixture to such a temperature that the most readily volatile constituents of the fuel are condensed and converted into minute liquid particles.

20 3. The method of carbureting liquid fuel which consists of partially pre-vaporizing and spraying the fuel and mixing air therewith to form a primary mixture in which part of the fuel is in a vaporous state, mechanically breaking up the non-vaporized particles in the mixture while expanding the mixture to cool the same and reduce its temperature to a point at which the vaporous contents will be condensed and form minute liquid particles.

30 4. The method of carbureting liquid fuel which consists of partially pre-vaporizing and spray-

ing the fuel and mixing air therewith to form a primary mixture in which part of the fuel is in a vaporous state, mechanically breaking up the non-vaporized particles in the mixture while expanding the mixture to reduce its temperature and controlling its reduced temperature whereby vaporous contents of the mixture will be condensed and formed into minute liquid particles which are then intermingled with the broken up non-vaporized particles.

5 5. The method of carbureting liquid fuel consisting of mixing air with sprayed partially pre-vaporized liquid fuel to form a primary mixture, cooling the mixture to condense vaporous portions thereof into minute particles, and breaking up larger particles of liquid fuel and mixing therewith the said minute particles and air.

10 6. The method of carbureting liquid fuel consisting of mixing air with sprayed partially pre-vaporized liquid fuel to form a primary mixture, changing the temperature of the mixture to a point at which substantially all of the vaporous portions thereof will be formed into minute liquid particles, and mechanically breaking up larger liquid particles and mixing the minute particles with the broken up particles and the air.

15 7. The method of carbureting liquid fuel consisting of mixing air with sprayed partially pre-vaporized liquid fuel to form a primary mixture, changing the mixture to reduce its temperature to a point at which vaporous contents thereof will be condensed and converted into minute liquid particles, and mechanically breaking up larger liquid particles and mixing therewith the minute particles and the air.

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