United States Patent

[11] 3,628,893

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[33] **Italy**
[31] **7182A/67; 6884A/68**
Continuation of application Ser. No. 747,300, July 24, 1968. This application May 4, 1970, Ser. No. 31,877

[54] **LIQUID AND AIR MIXING GEAR PUMP**
6 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **417/310,** 418/15
[51] **Int. Cl.** **F04b 49/11,** F04c 15/02
[50] **Field of Search** 418/15; 417/310

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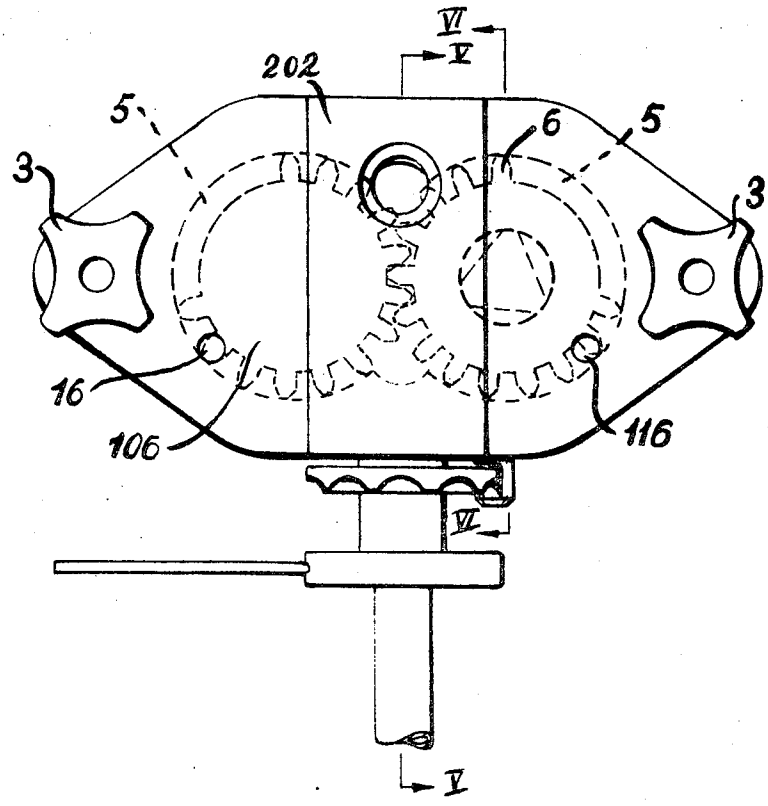
ABSTRACT: This invention relates to a two-gear pump for the formation of liquid and air emulsions, comprising a liquid intake at the point in which the gears begin to come out of mesh; a liquid and air mixture delivery port at the point in which said gears come into mesh, and an air intake port opening into the path of the crown of teeth of each gear outside their meshing point.



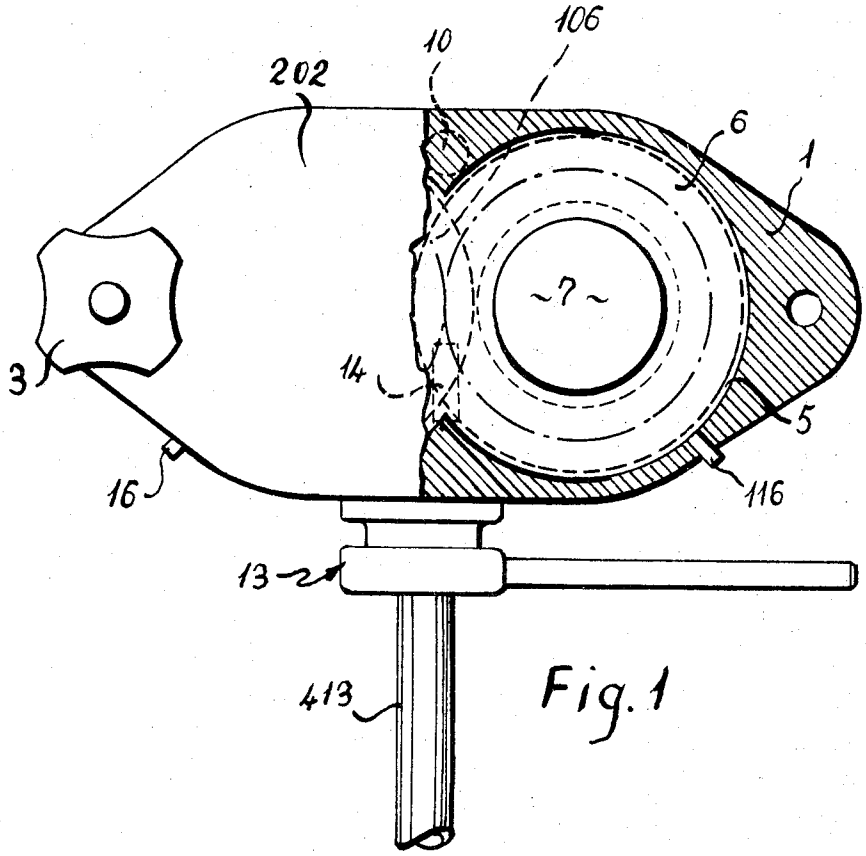


Fig. 1

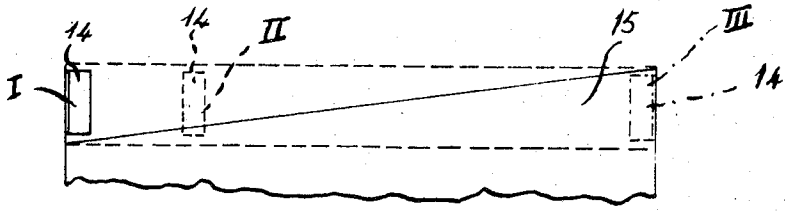


Fig. 3

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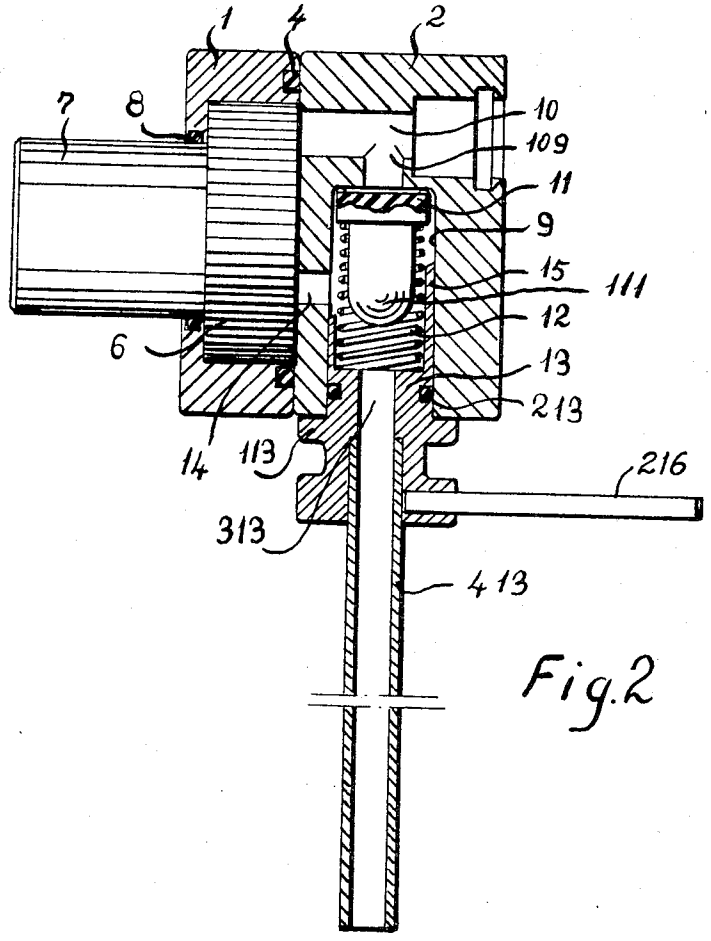

Fig. 2

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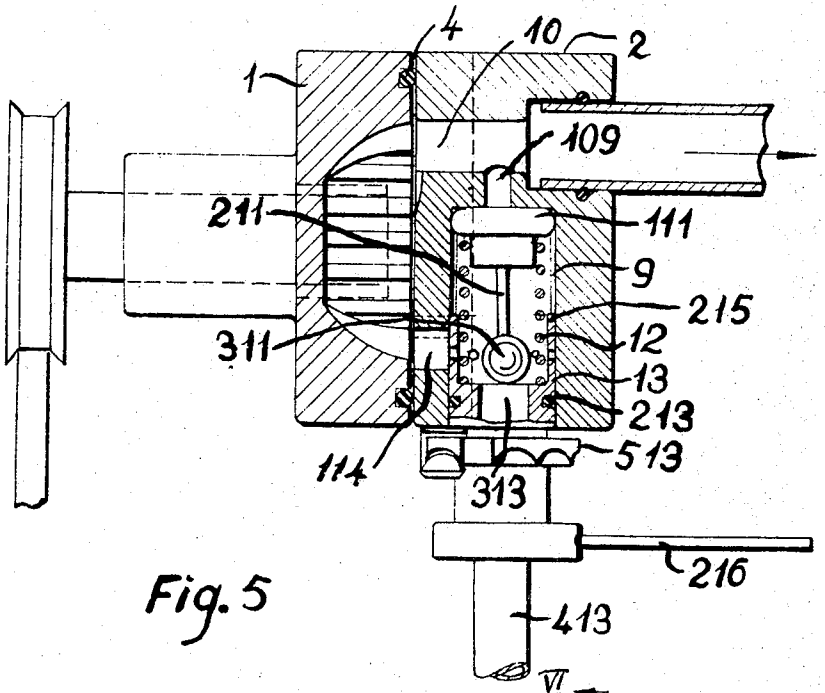

Fig. 5

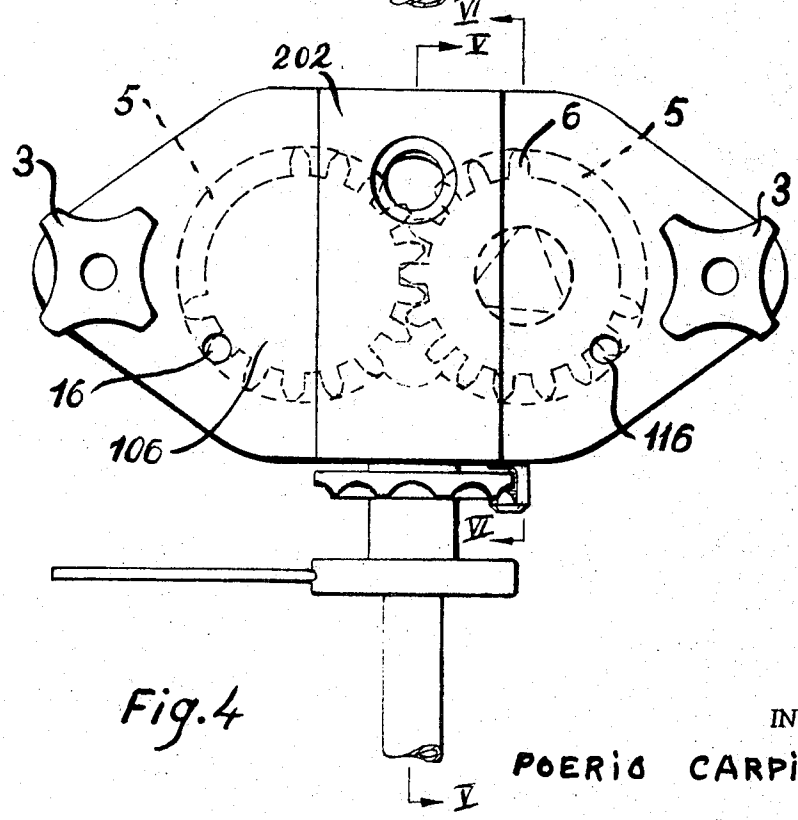

Fig. 4

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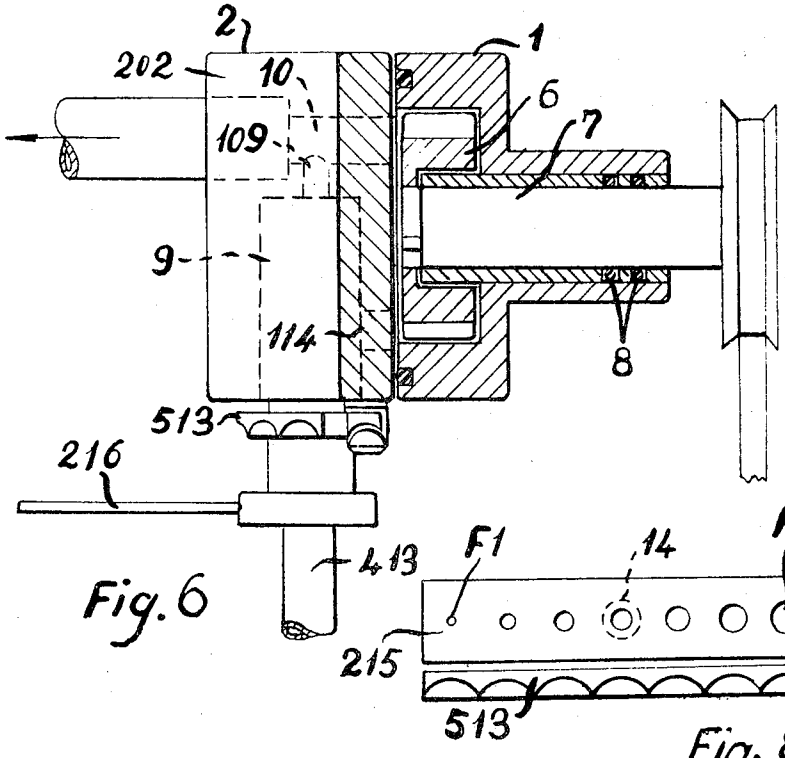

Fig. 6

Fig. 8

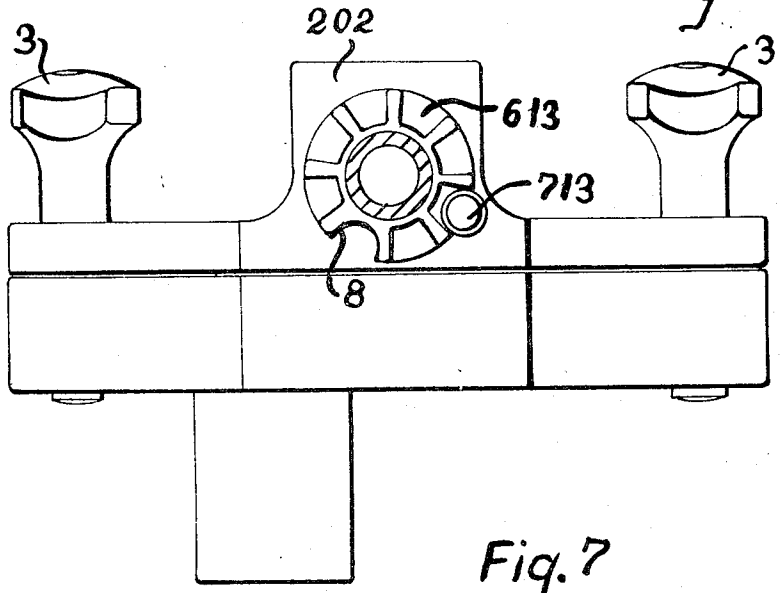

Fig. 7

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LIQUID AND AIR MIXING GEAR PUMP

This is a continuation of application Ser. No. 747,300 filed July 24, 1968, now abandoned.

This invention relates to a two-gear pump for the feeding and mixing of liquid and air for the formation of liquid and air emulsions by which the volume of air in the mix may be adjusted according to the requirements.

More particularly, the invention has for its object a two-gear pump of the aforementioned type, provided with adjustable means for the continuous or the stepwise adjustment of the reciprocal ratios of the liquid and gaseous phases of the liquid-air emulsion being produced by the pump in a given volume of emulsion delivered by the pump.

The above and other objects and advantages of the invention will be apparent from the following specification, made with reference to the accompanying drawings, in which:

FIG. 1 shows in front view, with parts in vertical section, a first embodiment of a gear pump according to the invention, adapted to form and deliver a mix of liquid and gas–usually air–and provided with means for the continuous adjustment of the air ratio in the mix.

FIG. 2 is a vertical section of the pump of FIG. 1.

FIG. 3 shows diagrammatically the development in a plane of the adjusting member of the pump of FIGS. 1 and 2.

FIG. 4 is a front view of a second embodiment of pump according to the invention.

FIG. 5 is a vertical section of the pump of FIG. 4, on line V–V of FIG. 4.

FIG. 6 is a vertical section of the same pump, on line VI–VI of FIG. 4.

FIG. 7 is a bottom plan of the pump shown in FIG. 4.

FIG. 8 shows diagrammatically the development in a plane of the section adjusting member of the pump of FIGS. 4 to 7.

With reference to FIGS. 1 and 2 of the drawings, the gear pump shown comprises a hollow casing section 1, tightly closed by a cover 2 fastened to the casing 1 by means of suitable bolts 3. A suitable O-ring 4 housed inside a groove formed into the peripheral edge of the casing 1 assures a fluidtight seal between casing 1 and cover 2.

Inside casing 1 two cylindrical chambers 5 are formed, crossing each other along the pump central vertical plane. Inside said chambers 5 a pair of gears 6, 106 in mesh with one another are housed.

The gear 6 is keyed onto shaft 7, projecting outwardly of casing 1 through a suitable bore. An O-ring 8 is mounted in a groove inside said bore, so as to provide for a tight seal between shaft 7 and the bore walls.

Cover 2 is formed at its middle area with a boxlike extension 202, in which a cylindrical chamber 9 is bored. Chamber 9 communicates at one end through port 109 with the pump delivery duct 10. The other end of chamber 9 is closed by means of the cylindrical plug 13. The plug 13 is provided with a circumferential groove housing an O-ring 213, for a tight seal with the wall of chamber 9. The plug 13 is provided with an axial through bore 313, opening at one end inside of chamber 9, while at its opposite end is connected to one end of the liquid mix suction pipe 413. The plug 13 is provided at its end projecting inside of chamber 9 with a hollow cylindrical sleeve or collar 15, having a substantially helical profile, facing the liquid suction port 14, as best shown in FIG. 3. A double-acting valve 11 is slidably mounted inside chamber 9, and is constantly urged upwardly, against port 109, by a spring 12 abutting against the bottom of plug 13.

Plug 13 is furthermore provided with an external abutment flange 113, and with a radially projecting operating lever 216.

Two air inlet ports 16, 116 formed in the pump casing, are communicating each with the suction side of the gears 6, 106.

The operation of the just-described pump is as follows: when the gears 6, 106 rotate, the pump sucks the liquid from pipe 413 through the port 14, and mix it with the air sucked through the ports 16 and 116, the amount of air sucked by the gears being proportional to the amount of liquid filling the space between the gears. As a consequence, by reducing the amount of liquid, an air-richer emulsion will be automatically produced, and vice versa.

This is accomplished according to the invention by angularly adjusting the sleeve or collar 15 with respect to the port 14, by simply rotating the plug 13. In this manner, as best shown in FIG. 3, it is possible to continuously pass from one position (position I) of port 14 and collar 15 in which port 14 is fully uncovered, to a position in which port 15 is fully covered (position III) through intermediate air/liquid adjustment positions in which the gear pump will suck amounts of liquid which are proportional to the uncovered area of slot 14, the remaining of the volume (that is a volume which is proportional to the covered portion of port 14) being provided by the air sucked by the gears 6, 106 through the apertures 16, 116.

The air and liquid phases sucked by the pump are thereafter emulsified in a conventional manner by the gears, and are thereafter pumped through the delivery port 10.

The valve 11 is a bypass valve, which permits to the emulsified mixture to be returned from the delivery 10 to the pump suction side, any time the pressure at the delivery side goes up over a predetermined value. As shown, valve 11 is provided with a lower extension 111, for closing the port 313 whenever valve 11 opens, so as to avoid that the bypassed emulsion be returned through duct 413 to the liquid mix tank.

In FIGS. 4 to 8 a second embodiment of the gear pump according to the invention is shown, for the stepwise adjustment of the air-liquid ratios. The pump shown in the said figures is substantially the same as the pump previously described. The main difference resides in the fact that the plug 13 is provided with a cylindrical collar or sleeve 215 which, as best shown in FIG. 8, is provided with a set of calibrated ports F1...F7, of increasing diameter. By putting one of the said ports into alignment with the suction port 14 of the gear pump inlet, the desired air-liquid ratio is obtained. For the exact alignment of the ports F1...F7 with the port 14, The plug 13 has an external flange 513, provided with a number of notches 613 corresponding to the number of calibrated ports F1...F7, and coacting with abutment member 713.

As best shown in FIG. 5, the bypass valve in the embodiment as shown comprises a valve body 111, for the closure of port 109. A stem 211 of flexible material extends downwardly from the lower side of said valve 111., bearing at its free end a ball valve 311. The valve 311 is normally held at a certain distance from port 313. Whenever valve 111 opens, valve 311 is lowered onto port 313, thus closing said port and avoiding any return of liquid down pipe 413 into the mix tank.

The operation of the pump shown in FIGS. 4 to 8 is the same as the operation of the pump of the previous embodiment, with the only difference that the adjustment is stepwise.

Although the gear pump described and shown was mainly devised for use on soft ice cream-making machines and expresso whipped cream-making machines, it will be understood that same may be usefully employed whenever a liquid and gas emulsion is desired.

Having thus described my invention, what I claim is:

1. A mixing pump having an output which is an admixture of an incompressible and a compressible fluid successively supplied in a closely controlled proportion comprising

a casing having separate inlets for said fluids and at an outlet for said admixture,

intermeshing rotor means in said casing having at least one recess of predetermined volumetric capacity to receive said fluids, said inlets and outlet being connected to said rotors,

said incompressible fluid being received in said recess at a point where said rotors move out of mesh

said compressible fluid being received in said recess at a point between said inlet and said outlet and being mixed with said incompressible fluid during passage to said outlet, and

means for controlling the volume of flow of said incompressible fluid to said rotors whereby the proportion of the admixture components is closely controlled, said means comprising a chamber connecting said incompressible fluid inlet with said rotors, and valve means for said chamber for controlling the flow of said fluid to said rotors,

said chamber having a port leading to said outlet and said valve means comprising a double-acting valve controlling the flow to said rotors and back flow from said outlet.

2. A mixing pump having an output which is an admixture of an incompressible and a compressible fluid successively supplied in a closely controlled proportion comprising

a casing having separate inlets for said fluids and an outlet for said admixture,

intermeshing rotor means in said casing have at least one recess of predetermined volumetric capacity to receive said fluids, said inlets and outlet being connected to said rotors,

said incompressible fluid being received in said recess at a point where said rotors move out of mesh

said compressible fluid being received in said recess at a point between said inlet and said outlet and being mixed with said incompressible fluid during passage to said outlet, and

means for controlling the volume of flow of said incompressible fluid to said rotors whereby the proportion of the admixture components is closely controlled, said means comprising a chamber connecting said incompressible fluid inlet with said rotors, and valve means for said chamber for controlling the flow of said fluid to said rotors,

said chamber having a port connected with said outlet, a sleeve within said chamber, a second valve member normally closing said last named port, and resilient means seated on said sleeve and urging said second valve member towards the closed position.

3. A liquid and air mixing gear pump comprising a pump casing,

a pair of intermeshing gears rotatably mounted inside said casing,

a liquid intake duct ending with a port at a point in which said gears begin to come out of mesh;

means comprising an adjustable shutter for varying the free flow passage area of said liquid intake port,

a liquid and air mixture delivery port at the point in which said gears come into mesh, and

an air intake port opening in the path of the crown of the teeth of each gear between said liquid intake and said liquid and air mixture delivery port.

4. A pump according to claim 3 in which said shutter is provided with a number of calibrated ports individually movable into the area of said liquid intake port.

5. A pump according to claim 3 further comprising a bypass valve connecting the said delivery port with said liquid intake port.

6. A mixing gear pump having an output which is an admixture of a liquid and air successively supplied in a closely controlled proportion, comprising

a pump casing,

a pair of intermeshing gears rotatably mounted in said casing,

a liquid intake duct ending with a port at a point in which said gears begin to move out of mesh,

means for varying the free flow passage area of said liquid intake duct,

a liquid and air mixture delivery port at the position where the said gears move into mesh,

and for each gear an air intake port disposed to supply air to the teeth of the gear at a position between said liquid intake and said liquid and air mixture delivery port.

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