Dec. 17, 1929. W. A. LOTH 1,739,600

APPARATUS FOR PRODUCING VARIATIONS OF PRESSURE

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Fig. 1

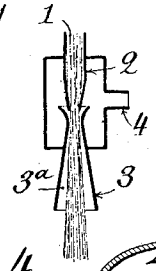


Fig. 2

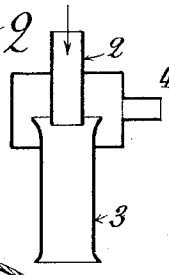


Fig. 3

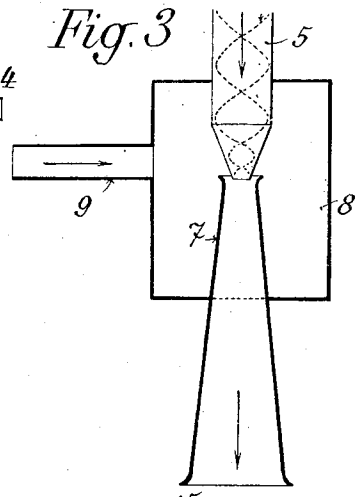


Fig. 4

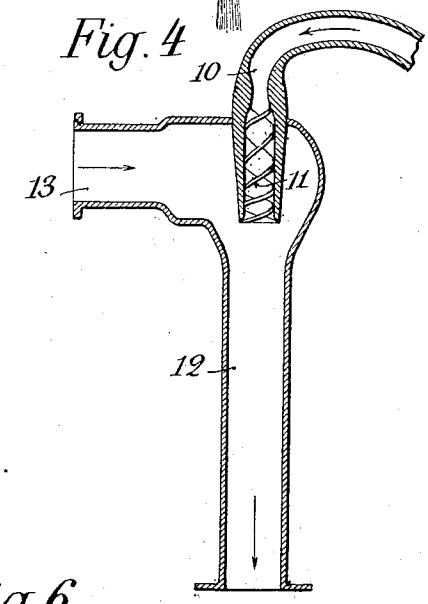


Fig. 5

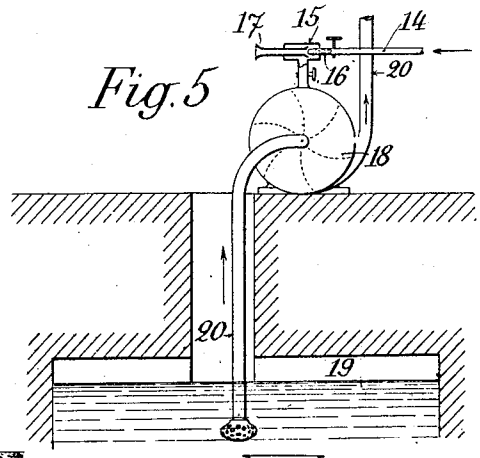


Fig. 6

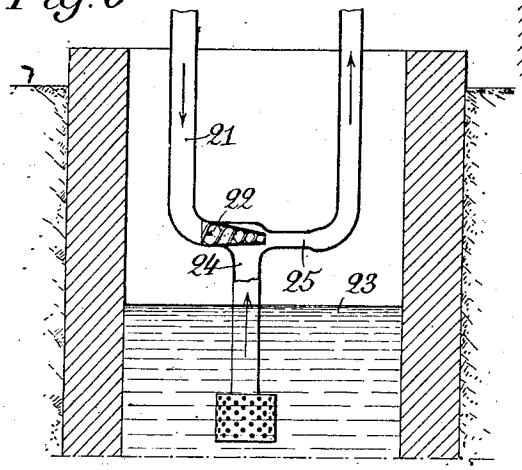
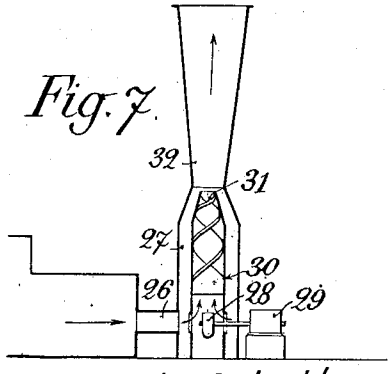


Fig. 7



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Fig. 8

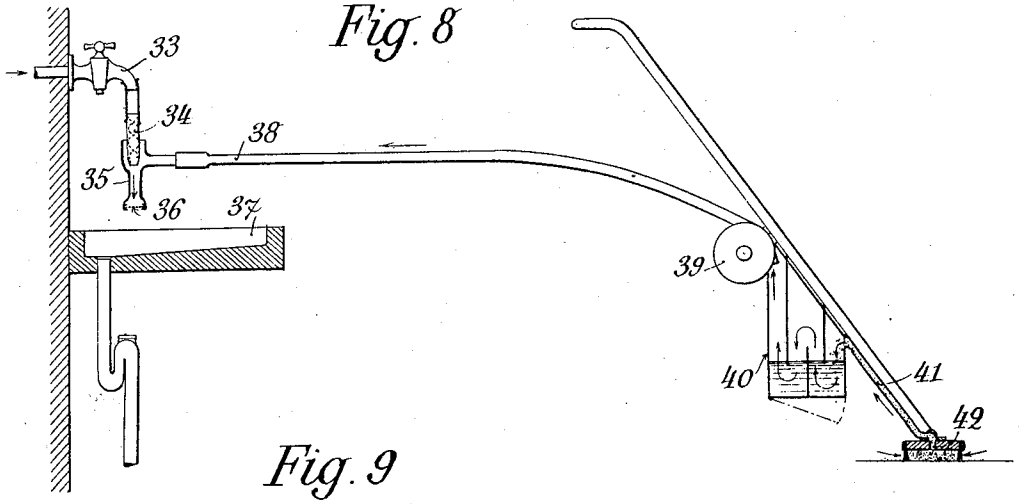


Fig. 9

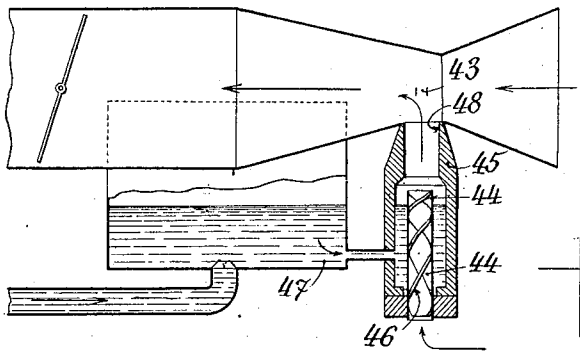


Fig. 10

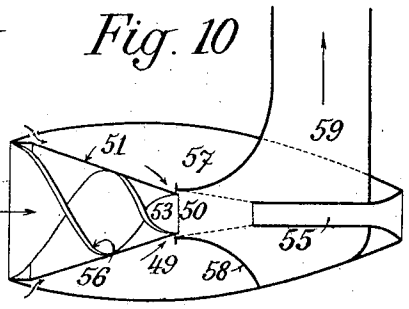


Fig. 11

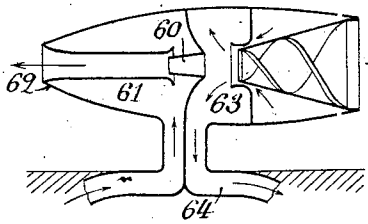
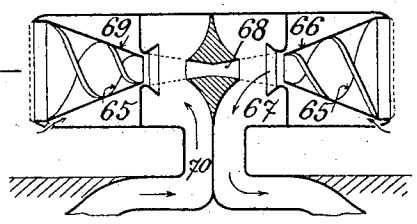


Fig. 12



W. A. Loth INVENTOR

By: Marks & Clark Attys.

Patented Dec. 17, 1929 1,739,600

UNITED STATES PATENT OFFICE

WILLIAM ARTHUR LOTH, OF PARIS, FRANCE

APPARATUS FOR PRODUCING VARIATIONS OF PRESSURE

Application filed July 6, 1927, Serial No. 203,863, and in France July 9, 1926.

In order to produce a variation of pressure either positive or negative in a fluid, the operation may be performed on the dynamic principle by means of a pump, a turbine or like apparatus, or on the static principle.

In the latter case, if a variation of negative pressure is to be obtained, an apparatus of the combined convergent and divergent type is employed.

The present invention relates to an apparatus which acts on the static principle, i. e. without moving mechanical parts, to produce a variation of pressure either positive or negative by the motion of a fluid, such motion being produced by the compression or the impact of said fluid, or by its suction.

In the appended drawings:

Figs . 1 and 2 relate to known devices, and, Figs. 3 to 12 to various applications of the apparatus constructed according to the invention.

Fig. 1 shows a combined converging and diverging device.

Fig. 2 shows a device comprising cylindrical nozzles.

Fig. 3 shows a vacuum-producing device.

Fig. 4 shows an apparatus for entraining a fluid.

Fig. 5 relates to a device for priming pumps.

Fig. 6 shows an apparatus for elevating water.

Fig. 7 shows a draught apparatus.

Fig. 8 indicates a vacuum cleaning device.

Fig. 9 shows an apparatus for the supply of internal combustion engines.

Fig. 10 relates to a device for the additional air supply of engines.

Figs. 11 and 12 relate to the ventilation of vehicles.

In Fig. 1 which represents a known apparatus adapted to produce pressure variations by means of a moving fluid, it is observed that the fluid 1 is discharged from the convergent element 2 and enters the divergent element 3 at a rather small angle, so that at the least variation of flow of the fluid stream 1, the pressure-producing fluid will no longer flow exactly upon the walls of the diverging element 3, upon which it exactly flows only for a determined rate, and the vacuum in the conduit 4 will not be very high, in spite of the output of the entraining fluid 1. Furthermore, due to the inactive space 3^a formed in the divergent element there is a continual risk of unpriming, and this occurs in practical operation, since the stream of fluid 1 is never exactly or constantly centered upon the axis of the diverging element 3.

It is thus evident that if it were feasible to considerably increase the discharge angle of the fluid stream 1 when issuing from the convergent element, the said stream would be more closely applied upon the walls of the divergent element, and this will take place within greater limits for the variation of the rate of flow of the said fluid, and this will eliminate the inactive space 3^a in the divergent element, so that for a given expenditure there will be obtained a better vacuum in the conduit 4 and all unpriming action will be prevented, since it becomes impossible for the fluid to pass through the inactive space 3^a and thus to enter the chamber, or the conduit 4, in which the vacuum is produced.

It will be further noted that if instead of withdrawing the fluid in the conduit 4 by the suction fluid 1 along the walls of the divergent element 3, the fluid could be withdrawn by and within the fluid 1, the resulting vacuum would be better, since the contact between the molecules of the fluid 1 and the walls of the diverging element will be closer, and will be obtained almost instantly, thus offering applications which could not hitherto be made, since the fluid 1 will act not only at its outer surface but at the same time throughout its whole mass. It is further noted that the loss of pressure will be thus reduced.

Furthermore, the discharge angle of the liquid stream of the withdrawing fluid 1, after passing through the convergent element, will allow the diverging element to be brought nearer the converging element, whereby the loss of kinetic energy will be still further reduced.

In all of the known apparatus in which as shown in Fig. 1, a vacuum is produced on the

static principle, the withdrawing fluid has a uniform or variable straight motion, and the same is true for the fluid withdrawn.

The principle of the apparatus according to the invention, consists in imparting to the pressure-changing fluid, for the purposes above indicated, instead of a straight motion as hitherto employed, a suitable rotary motion, and the same conditions may prevail for the withdrawn fluid.

It is shown by experience that by substituting a pressure-changing fluid having a rotary motion for a fluid having a straight motion will permit the obtainment, for the same power, of a vacuum having ten times the value, and even more in some cases.

For the purpose indicated, I mount in the conduit containing the pressure-changing fluid a helical surface or an element or elements of the propeller type, either coaxially with the tubes employed for said fluid, or extending from the wall of said tubes, and such helical surfaces or elements may have a constant or variable pitch; the pitch may vary progressively or otherwise, and may be increasing or decreasing in the proper direction, or may be subject to positively controlled or automatic changes, in all cases without departing from the principle of the invention but by solely modifying the forms of construction.

I may further combine the principle of the rotary motion of the pressure-changing fluid with the known suction effect due to the combination of a convergent and a divergent element.

In particular, the combination of a convergent element and a cylindrical element, the former being provided with a helical device, is advantageous, and chiefly for its large output, whereby I obtain pressure variations which are 20–25 times as great as in apparatus in which helical devices are not employed, such as in the known combinations of a converging element with a divergent or a cylindrical element employing a fluid with straight motion.

It is evident that my said apparatus for producing positive or negative pressures may be employed with various fluids and at various temperatures, and for instance I may heat or cool the fluids in rotation, for different purposes.

The rotation of the pressure-changing fluid may be effected by dynamic means instead of by static means, i. e. the rotation instead of being produced by devices of the helical type or helical surfaces which are solid and stationary and serve to rotate the said fluid, may be produced by known devices consisting in moving blades or conduits which are placed at the centre of the admission tube, and the fluid is supplied in straight motion to such devices and issues therefrom in a rotary motion, thus effecting variations of pressure.

The apparatus shown in Fig. 3 is of the type of suction devices, and therein the pressure changing fluid which is usually water or air under pressure which is delivered to the convergent element 5 provided with a helical member 6, and then into the diverging element 7. Due to its rotation, the said fluid withdraws the other fluid contained in the chamber 8 which is connected by the conduit 9 with the chamber in which the vacuum is to be produced.

Fig. 4 shows a device which may be utilized with apparatus for evaporation, concentration or vacuum drying, with cooling plants employing steam, with air ejectors with or without intermediate condensation, with ejectors for priming or emptying, or for the rapid production of a vacuum in certain chambers such as turbine-condensers. The steam is supplied through the conduit 10 to the helical device 11 and is then discharged therefrom, drawing with it into the conduit 12 the fluid which is to be withdrawn and which is supplied by the conduit 13

The device shown in Fig. 5 serves for the priming of centrifugal pumps and siphons, and centrifugal pumps may thus be rapidly and effectively started, with a smaller consumption of steam than in the known ejectors and a greater elevation of water. The fluid is injected under pressure into the conduit 14, attains the suction device 15 and passes through the helical device 16 by which it is rotated. The fluid issues through the conduit 17. As soon as the mixture of liquid and fluid leaves the apparatus, the apparatus is stopped and the centrifugal pump 18 which is now primed will elevate the liquid from the vessel 19 through the conduit 20.

The apparatus shown in Fig. 6, serves to elevate water from wells or pits, tanks or the like, to fill or empty tanks, to elevate or transfer liquids, or the like. The fluid under pressure is supplied by the conduit 21 to the helical element 22, and is rotated by the latter. Due to this rotation, the suitable liquid is withdrawn and is circulated from the tank 23 through the pipe 24 to the pipe 25 in which it is circulated.

Due to the great efficacy of my said apparatus, in virtue of the rotation above specified, it may be utilized in cases in which the usual suction devices, operating by the straight motion of the fluid, will not suffice, for instance in cases in which it is necessary to furnish a vacuum exceeding 30 mm. of water, with the same expenditure of power, or in the cases in which it is required to obtain a vacuum at least equal to this amount, by the use of a less power of ventilation. By the use of my said method and apparatus I obtain an economy of power with a greater efficiency, and can thus provide for all such cases of utilization.

The fluids which are for instance gases in the case of chimneys, are supplied by the pipe 26 (Fig. 7) and circulate in the pipe 27, but a part of said gases, by means of the blower 28 driven by the motor 29 for example, may be drawn into the conduit 30 containing the helical element 31 which rotates the said fluids as above specified. When issuing from the conduit 30, the fluid (such as gases) are in rotation and thus produce a great suction of the gases or like fluids admitted at 32 through the conduit 27. From this point, the mixed fluids are discharged through the conduit 32.

Fig. 8 shows a dust suction apparatus which is operated by a stream of water which flows through the cock 33 to the helical device 34 by which the water is rotated; the water is thence circulated into the conduit 35 and proceeds into the device for breaking up the jet 26 and into the sink, for example, thus producing a vacuum in the pipe 38 which is partially wound upon the drum 39, and hence in the dust box 40 which may be provided with baffles or contain an antiseptic liquid, and also in the conduit 41 and at the suction orifices 42 which are disposed for instance among the bristles of a brush.

In the major part of the apparatus employed to effect the intimate mixing of a comburent and a combustible, such as air and petrol, it is observed that at slow speeds, due to the difference in inertia and density between air and petrol, there will be a lack of petrol, whilst at high speeds there will be an excess of petrol.

This defect is obviated in the device shown in Fig. 9. A vacuum or suction 43 which is proportional to the speed of the engine is caused to act upon the air nozzle 44 of the sprayer 45. In the said nozzle is disposed the helical surface 46. The air which is drawn into the nozzle 44 serves to withdraw the petrol 47 by the effect of vacuum or suction.

At slow speeds of the engine, the air which is drawn through the nozzle 41 by the vacuum 43 will itself produce a vacuum by which the petrol 47 is withdrawn; but due to the rotation of this air produced by the helical surface 46, this vacuum becomes incomparably stronger than the vacuum produced by the known means employing straight motion. When the engine speed increases, the helical surface 46 due to the fact that it rotates the air in the nozzle 44 and outwardly of the same will cause a loss of pressure which varies in the same direction as the engine speed. This loss of pressure which increases with the engine speed will finally cause a variation in the ratio between the air and the petrol in the mixture.

However, this loss of pressure is such that while it will offer at all engine speeds the requisite amount of petrol and air, it will automatically vary the composition of the mixture by changing the ratio between the petrol and the air in such manner that the value of this ratio will vary inversely with the value of the force of suction of the engine, according to a progression which is under control as well as the speed of this latter. This action is finally manifested by a diminution according to a law (which is under control) of the richness of the mixture according to the increase in the engine speed.

The combination of the two actions, i. e. the diminution of the ratio between fuel and air and the diminution which is at each instant proportional to the increase in volume of the fuel and air mixture supplied which is itself proportional to the increase in the engine speed, will provide for an automatic correction and will increase the fuel feed at slow speeds of the engine, and will further prevent the excessive feed of fuel at high speeds, as a final result, the apparatus thus affords a better increase of speed and an increased efficiency, and I also obtain an incomparably better and finer atomizing than in any of the known devices, while providing a more homogeneous mixture and effecting a saving of fuel.

In the above-mentioned constructions, the relative sizes, of the several parts may be varied at will, and for instance the diameter of the air nozzle 44 may be equal to the internal diameter 48 of the sprayer 45, or may be smaller than the latter.

The helical surface 46 may be movable about a vertical axis intersecting the axis of the nozzle 44; said surface may be turned through an angle of 360 degrees or it may be turned through more than 360 degrees about its axis, and this motion may be suitably braked.

In Fig. 10, I utilize the rotation of the fluid, as above indicated, in order to compress another fluid, for instance air which is supplied to a carburetter, by utilizing the vacuum or suction produced at 49, and the air thus drawn forward will be added to the air passing through the cross section 50, of minimum surface, of the convergent cone 51.

The rotation of the fluid produced in the convergent member 51 by the helical element 56, permits to compress the air which passes through the maximum cross section of the convergent cone 51, without any reflection which produces counter-pressure, as usually happens in a convergent cone in which the molecules of air strike the wall of the cone and are reflected towards the centre, thus producing a region of whirling motion. Due to the forced rotation of the fluid, the centrifugal force maintains the impinging molecules in contact with the wall, and further, the central region itself becomes compressed upon the layer which is already applied upon the walls (Fig. 10), thus uniting in a portion 53 which is strongly compressed in the minimum cross section of the con-

vergent cone in which the expansion takes place at 54.

In Fig. 10, a tube 55 is placed in the centre of expansion of the cone of air, and it serves to regulate and to annul the air whirls which may be produced at the centre of the cone.

The air which is delivered to the helical device 56, for instance under pressure will be rotated by said device; it passes through the minimum section 50 and draws in the fluid through the annular space between the neck 50 of the converging element 51 and the neck 57 of the divergent element 58, circulating thence through the conduit 59 and into the carburetter, its straight motion being facilitated by its own movement of expansion due to its rotation.

Fig. 11 shows a device which is applicable to a system of aeration, with the use of compression and suction, or either of these alone. It will serve chiefly for the aeration of vehicles moving in a single direction, or for the aeration of motor vehicles, aeroplane bodies or the like.

This takes place by delivering air into the vehicle or by removing the air by suction, or by these two actions which are employed alternately, successively or simultaneously, and herein the air is displaced as above stated. I may operate the apparatus by compression or suction (Fig. 11). A small part of the rotating air is sent into the central cone 60, thus producing a vacuum or suction in the chamber 1 which is connected with the interior of the vehicle, this vacuum being facilitated by the fact of the suction due to the action of the outer air upon the suitably shaped surface 62. This rotating air produces a compression in the chamber 63 and the conduit 64 which are connected with the interior of the vehicle. Instead of this double action of suction and delivery of air in the vehicle at different points due to the rotation of the air, the operation may be limited to a single action of suction or compression, thus delivering air to the interior of the vehicle or withdrawing the air from the vehicle. Such apparatus may be movable upon a supporting base, with directing vanes, so as to be applicable to vehicles moving in all directions.

Fig. 12 shows an example of a suction and compression apparatus which may be utilized upon railway vehicles or upon vehicles proceeding successively in different directions, and which need not be movable about a vertical axle. According to the figure, the air which is rotated by proceeding along the helical element 65 disposed in the cone 66 is partially delivered to the pipe 67 and thence to the vehicle. Another portion flows in the conduit 68 and thence into the divergent element 69 and resumes its rotation due to the action of the helical element 65, thus withdrawing air from the conduit 70. If the vehicle travels in the other direction, the suction and compression will have the contrary direction but their value will remain the same.

My said apparatus is obviously applicable for other purposes, and those above specified are given solely by way of example. In particular, the apparatus may be mounted upon the top of ordinary chimneys to increase the draught.

Finally, it should be remarked that the whole or a part of the helical element may be movable about an axis which coincides for instance with the axis or axes of the tubes whether convergent, divergent or cylindrical. Due to this freedom of motion of said helical element I may vary the speed of rotation of the fluid passing through the said helical element. In this manner, by changing the speed of rotation by braking or like means, I may find other uses for the apparatus.

I may further utilize helical surfaces which are subject to deformation under the variable pressure of the fluid, thus offering an automatic device in which the pitch is variable and is exactly adapted for each pressure. This deformation or variation in pitch might also be effected at will by suitable means.

Having thus described my apparatus, what I claim as new therein, and my invention, is:

1. In an apparatus for producing variations in the pressure of fluids, the combination of a convergent nozzle adapted to be connected to a source of fluid under pressure, a nozzle of any kind placed behind the said convergent nozzle, and having a very large inlet opening relatively to the outlet opening of the said convergent nozzle and a suction chamber containing the said nozzles, the said convergent nozzle being for the purpose specified provided with means adapted to cause the fluid passing through the same to make a rotary motion about its axis, substantially as described.

2. In an apparatus for producing variations in the pressure of fluids, the combination of a convergent nozzle adapted to be connected to a source of fluid under pressure, helical ribs provided in the said convergent nozzle, a nozzle of any kind placed behind the said convergent nozzle and having a very large inlet opening relatively to the outlet opening of the said convergent nozzle and a suction chamber containing the said nozzles, the said ribs extending as far as the outlet opening of the said convergent nozzle.

In testimony whereof I have hereunto affixed my signature.

WILLIAM ARTHUR LOTH.