Nov. 8, 1966 W. B. NOTZKE 3,283,728

EJECTOR

Filed June 12, 1964

Fig. 1

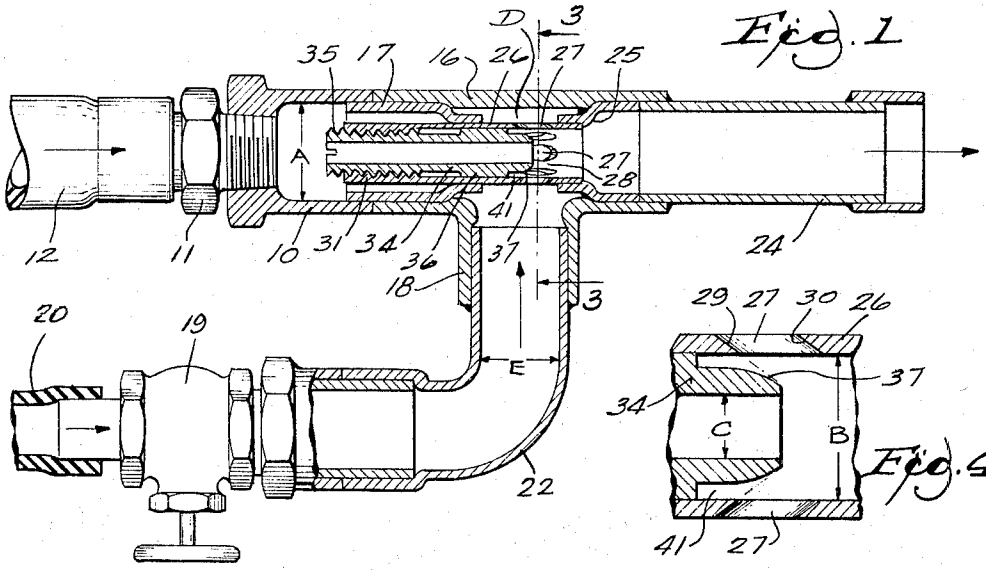


Fig. 4

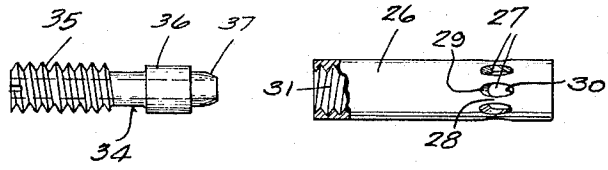


Fig. 2

Fig. 5

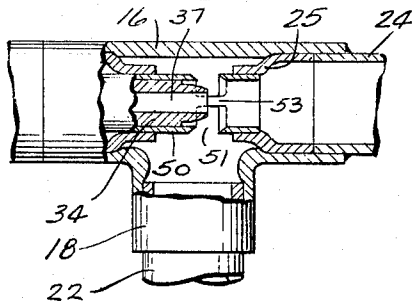
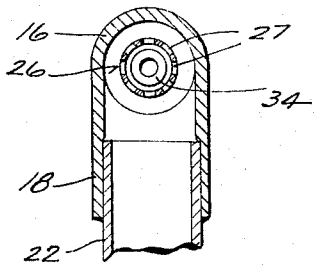


Fig. 3



INVENTOR.
WILHELM B. NOTZKE
BY
Miles Hennigan
ATTORNEY

United States Patent Office

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EJECTOR

Wilhelm B. Notzke 2227a N. 47th St., Milwaukee, Wis.

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This invention relates to ejectors of the type acting on fluid to be drawn from a container, by aspiration by a jet of fluid flowing past openings to a chamber into which the ejection fluid is drawn.

Automotive repair shops, garages, service stations and the like are usually equipped with air compressors which easily maintain pressures up to 90 pounds per square inch. Such shops, etc. frequently have work requiring the use of a high degree of vacuum, but a vacuum pump capable of producing adequate vacuum is expensive and substantial time is required to draw such vacuum. The testing of power brakes, pneumatic motors for windshield wipers and washers and the like require vacuum of a high order but such work cannot support a scale of charges justifying the purchase of vacuum pumps to reach an adequate vacuum in a practical length of time. The present device permits the attainment in seconds of vacuum of 22 inch gage with 90 pounds per square inch of air pressure, which is very commonly available.

In such shops and stations, it is also frequently desirable to draw liquid from containers such for example as to draw oil from an internal combustion engine rather than draining the oil from the engine. However, it is not economical to equip small shops, etc. with liquid pumps of suitable sizes for such work. The present device allows the withdrawal of liquids in a very short time by use of the air pressure commonly available. For example the following table shows the time per gallon used to remove one gallon of various liquids at 90 lbs. per square inch air pressure:

Liquid	Gallons	Seconds
Lubricating oil —30W, at room temperature	1	50
Water	1	10
Gasoline	1	8

Also, the underground gasoline storage tanks of automotive service stations as well as bulk storage tanks for other petroleum products are particularly susceptible to the collection of water therein on which the gasoline or oil floats. The useful storage capacity of a tank is thus decreased and there is possibility of delivery of water with gasoline to a tank of an automobile. When such water is present in the gasoline supply system of an automobile, it freezes in cold weather and motorists usually shun service stations where it is suspected that water is being delivered with the gasoline even though that is not the case. Hence it is desirable for a service station to be able to advertise that its storage tanks are periodically pumped out to assure freedom from water. The present device permits the pumping of water out of such tanks simply by inserting a hose through the tank filler pipe and using the air pressure available in the station.

Such shops and stations are also frequently required to use flammable liquid such as gasoline in cleaning parts and the like and fires cannot be entirely avoided. A gasoline fire is not extinguishable by a jet of water, but is actually spread thereby. However a fog or mist of water in air is effective both in smothering the flame and in cooling the combustible below its combustion point. The present device is effective in forming finely divided water particles in air by using water as the ejection fluid and air as the pressure fluid, and can throw such mist for considerable distances at the air pressure

commonly available in a service station. Thus the present device provides the equivalent of a fog nozzle which quickly extinguishes flames such as gasoline-cotton waste fires, at air pressures commonly available and with a hose simply dropped into an open tank as the source of the water.

Generally, the present device includes an inlet tube to be connected to a source of pressure fluid such as compressed air, and which provides an inlet to a pressure chamber. An intermediate tube connects the inlet tube with an outlet tube in which a mist of pressure fluid and fluid to be ejected, is formed in an outlet chamber. The intermediate tube has an opening for entry thereinto, of a fluid to be ejected and provides a chamber from which the ejection fluid is aspirated by a jet of the pressure fluid. Partitions extend across the inlet and outlet tubes at adjacent ends thereof and aid in defining the inlet chamber, the intermediate chamber and the outlet chamber.

The inlet, intermediate and outlet tubes are approximately of the same flow cross section area but a tubular connector extending centrally of the tubes and between and through the partitions divides the intermediate chamber into two chambers in which very different pressures prevail. The connector has a flow cross section area of no more than one-half the flow area of the inlet tube and has lateral openings in the portions thereof between the partitions. Such openings have end surfaces at oblique angles to the center line of the connector and the total area of the openings is at least one-half of the cross section area of intermediate tube side connection. A nozzle fills the connector between the inlet and intermediate chambers for jetting air past the connector openings and aspirating fluid to be ejected from the intermediate chamber. The nozzle has a flow cross section area of approximately one-half of the flow area of the connector and is reduced in size at the nozzle end to reduce eddys and the like in and around the openings of the connector. The end surface of the nozzle is tapered at the angle of the ends of the connector opening and the nozzle is adjustable to bring such taper into alignment with one of the end surfaces of the openings.

Referring to the drawings:

FIG. 1 is a longitudinal cross section through the present device, with a hose connection for the pressure fluid and a valve for the fluid to be ejected, both shown in elevation.

FIG. 2 is an "exploded" side elevation of the tubular connector and nozzle.

FIG. 3 is a cross section on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged fragmentary view of a portion of the device shown in FIG. 1; and

FIG. 5 is a partial logitudinal section of a modified tubular connector having a few enlarged openings rather than a larger number of small openings for aspiration thereinto of the ejection fluid.

Referring specifically to the drawing by reference numerals, **10** designates an inlet tube with a threaded end to receive a nipple **11** for a hose **12** by which a pressure fluid such as compressed air may be supplied at pressure up to 100 pounds per square inch. An intermediate tube **16** is joined to the outlet tube **24** as by a partition member **17** and is provided with a side connection **18** having a valve **19** for connecting a hose **20** to extend into a fluid to be drawn into the ejector and aspirated by the pressure fluid and discharged therefrom under pressure. The intermediate tube provides a chamber into which the fluid to be ejected is drawn and a chamber from which the ejection fluid is forced. An outlet tube **24** is joined with the intermediate tube **16** and has a partition **25** which aids in defining an intermediate chamber. The flow cross section areas of the inlet chamber, the intermediate cham-

ber and the side connection thereto and the outlet chamber are approximately the same size but the intermediate chamber is largerly occupied by a connector tube and a nozzle therein.

A tubular connector 26 extends through and is mounted in the partitions 17, 25 to coact with the partitions and the intermediate tube in defining an annular aspiration chamber into which is drawn the fluid to be ejected. Lateral openings 27 are formed in the connector between the partitions, with lands 28 between the openings. In FIG. 2 the openings are shown as a considerable number of elongated holes made by drilling in a fixture holding the drill at a given angle, while FIG. 5 shows only two large openings. However in either case, the ends 29 and 30 of the openings are at the same angles to the center line of the connector and such angle is between 35 and 45° to the center line. An internal thread 31 is provided for adjustment of another part within the connector 26. The cross sectional area of the connector 26 is no more than one-half of the area of the cross section flow area of the inlet tube. The openings 27 total at least as much area as the cross section area of the side connection 18.

A nozzle 34 is formed with a thread 25 to fit adjustably into the connector 26 and has a collar 36 supporting the nozzle centrally within the connector. At its discharge end the nozzle is tapered as is shown at 37 to the same angle as the ends 29 and 30 of the connector lateral openings. Otherwise the nozzle discharge end is shaped to provide space 41 from the internal surface of the connector 26 adjacent to the nozzle discharge end. Such space reduces the formation of eddys and other disturbances in the fluid within the annular aspiration chamber, as the fluid is drawn into the connector by the jet of pressure fluid passing therethrough. The flow cross section area of the nozzle is approximately one-half the cross section flow area of the connector so that the fluid to be ejected is presented as a relatively thin annular body around a jet of the pressure fluid.

Referring specifically to FIG. 5, the parts generally are described above, but the connector tube is changed and will now be described. Instead of providing many holes 27 with lands 28 between each two holes, the connector tube 50 is formed with most of the connector cut away to provide only two openings 51 with only two lands 53 joining the rear and forward parts of the connector. The rear and forward edges of the openings 52 are bevelled to the same angle as the hole surfaces 29 and 30 in the preceding figures and the nozzle 37 is adjusted relative to the holes 52 as was previously described. A minimum resistance is now exerted against liquid flow into the connector 50 from the aspiration chamber, and less pressure is required to secure the same results as were previously obtained with 90 lbs. pressure.

In use, the nozzle is adjusted axially of the connector until its tapered surface 37 is aligned with the angular ends 29 of the connector openings. In that position, a vacuum of the order required in testing windshield wiper motors, power brakes and the like can be produced in seconds by use of air pressures of no more than 90 pounds per square inch. The same setting of the nozzle also produces the results mentioned above when the device is used for drawing a liquid from a container or for forming a "fog" of water and air and failure to produce such results is an indication that the nozzle is improperly placed and requires adjustment. The proportioning of the flow areas of the various parts are all related to the inlet chamber flow area and such proportions must be maintained if the best results are obtained with only adjustment of the nozzle as described. So long as the given proportions and adjustment are maintained, there is no need for special "streamlining" of the parts and all of the parts can be made from standard tubing sizes now available on the market.

The present invention provides an evacuating device, a liquid lifting device and a fog nozzle for use on gasoline fires or the like, and employs only air pressure commonly available in automobile service stations and in a relatively simple structure of which the parts are in given relation to one another. The cross section areas of the several parts are designated by letters in the drawings and the proportions of such areas to one another are as indicated in the table below:

TABLE I

Parts:	Cross section area
Inlet tube 10	A.
Connector 26	B equals more than one-half of A.
Nozzle 34	C approximately equals one-half of B.
Aspiration chamber	D larger than F.
Side tube 22	E less than A.
Connector hole total area	F=no more than ½ of A—at least ½ × E.

I claim:

1. An ejector comprising an inlet tube, an outlet tube, an intermediate tube joining said inlet and outlet tubes and having a side opening, partitions across said inlet and outlet tubes at adjacent ends thereof, a tubular connector mounted in and having lateral openings between said partitions, and a nozzle mounted in said connector for directing a jet of pressure fluid therethrough and aspirating ejection fluid through said outlet tube, said nozzle being adjustable axially of said connector for positioning the discharge end of said nozzle substantially in the plane of the ends of said connector openings nearest to said inlet tube.

2. An ejector comprising an inlet tube, an outlet tube, an intermediate tube joining said inlet and outlet tubes and having a side opening, partitions across said inlet and outlet tubes at adjacent ends thereof, a tubular connector mounted in and having lateral openings between said partitions and at an oblique angle with respect to the center line of said connector, and a nozzle mounted in said connector for directing a jet of pressure fluid therethrough and aspirating ejection fluid into said outlet tube, said nozzle having a tapered discharge end at the same angle as the oblique angle of said connector lateral openings and being adjustable axially of said connector for positioning the discharge end of said nozzle relative to said connector lateral openings.

3. An ejector comprising an inlet tube, an outlet tube, an intermediate tube joining said inlet and outlet tubes and having a side opening, partitions across said inlet and outlet tubes at adjacent ends thereof, a tubular connector mounted in and having lateral openings between said partitions, and a nozzle mounted in the connector for directing a jet of pressure fluid therethrough and aspirating ejection fluid into said outlet tube, said nozzle filling the cross sectional area of said connector except for providing space at the connector surfaces adjacent the discharge end of said nozzle.

4. An ejector comprising an inlet tube, an outlet tube, an intermediate tube joining said inlet and outlet tubes and having a side opening, partitions across said inlet and outlet tubes at adjacent ends thereof, a tubular connector mounted in and having lateral openings between said partitions, said lateral openings having a total flow area greater than the flow area of said side opening, and a nozzle mounted in the connector for directing a jet of pressure fluid therethrough and aspirating ejection fluid into said outlet tube.

5. An ejector comprising an inlet tube, an outlet tube, an intermediate tube joining said inlet and outlet tubes and having a side opening, partitions across said inlet and outlet tubes at adjacent ends thereof, a tubular connector mounted in and having a circumferential series of lateral openings located between said partitions and centered with respect to said side opening, said lateral openings having a total flow area greater than the flow area of said side opening, and a nozzle mounted in the connector

for directing a jet of pressure fluid therethrough and aspirating ejection fluid into said outlet tube.

6. An ejector comprising an inlet tube, an outlet tube, an intermediate tube joining said inlet and outlet tubes and having a side opening, partitions across said inlet and outlet tubes at adjacent ends thereof, a tubular connector mounted in and having lateral openings between said partitions, and a nozzle mounted in the connector for directing a jet of pressure fluid therethrough and aspirating ejection fluid into said outlet tube, said connector having a cross sectional area in the region of said

lateral openings less than the cross sectional area of said outlet tube.

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MARTIN P. SCHWADRON, *Primary Examiner.*

WARREN E. COLEMAN, *Examiner.*

HENRY F. RADUAZO *Assistant Examiner.*