Oct. 16, 1951 S. A. HAYES 2,571,871

PROPORTIONER

Filed Nov. 18, 1947 2 SHEETS—SHEET 1

FIG. 3.

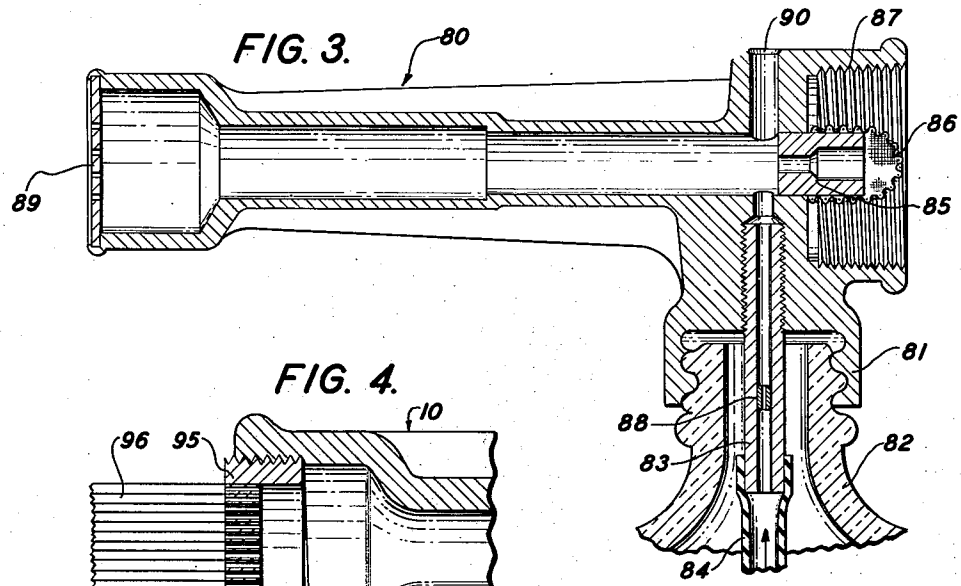


FIG. 4.

FIG. 1.

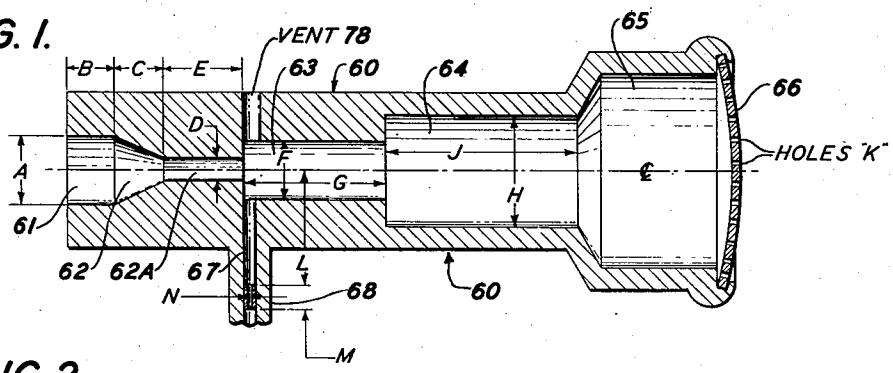
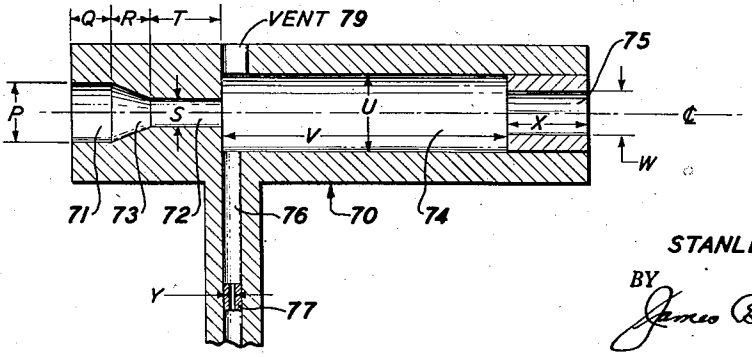


FIG. 2.



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PROPORTIONER

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FIG. 5.

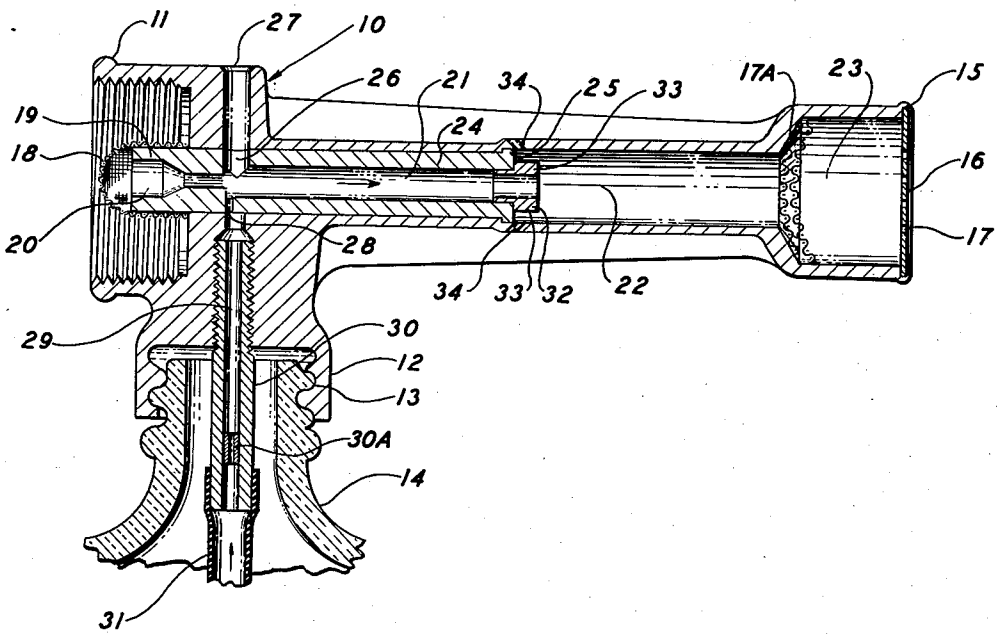
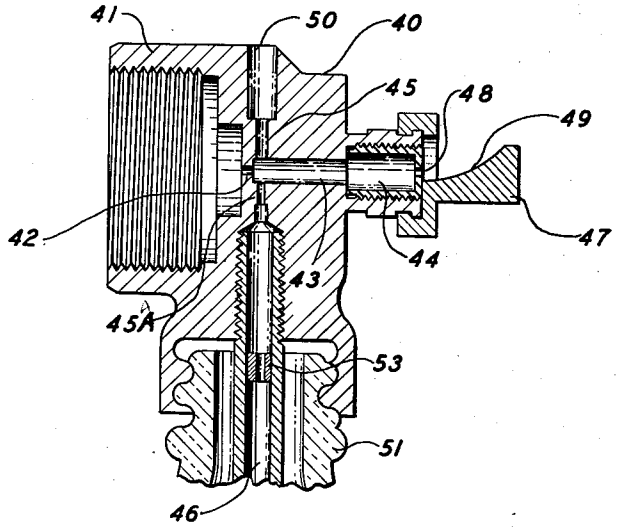


FIG. 6.



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2,571,871

PROPORTIONER

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Application November 18, 1947, Serial No. 786,762

15 Claims. (Cl. 103—262)

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This invention relates to eductors for sucking a first liquid into a carrier stream of another liquid. It provides novel means for balancing such eductors, i. e., for assuring that the proportion of the first liquid sucked into the carrier stream of the second liquid will be substantially constant despite variations of the pressure of the entering carrier stream. It also provides means for reducing the proportion to a low value without making the suction leg for the first liquid so small that it is easily clogged and hence impractical.

In one aspect, the invention provides an improved gun or spraying device for mixing together water and a detergent solution and thereafter aerating it and projecting it as a foamy stream. Such a device is particularly adapted for washing transportation equipment, etc., and when equipped with a brush, is a highly effective dish washer. In another modification, the apparatus of the invention is useful as fire fighting apparatus which mixes a wetting agent with a water stream in correct proportion and ejects the resulting mixture as a spray which, because of its improved wetting properties, is superior in extinguishing burning, etc. In still another form, the apparatus is a spray device for proportioning and projecting liquid fertilizers, germicides, fungicides, insecticides, etc.

It has been proposed heretofore to construct eductor type proportioners. In such apparatus a carrier liquid under pressure passes through a restricted throat which opens into an expansion chamber, usually disposed coaxially with the throat. A leg for sucking in a second liquid enters the eductor from the side. Suction created in the expansion chamber forces the second liquid to enter the main carrier stream, where it is commingled. Certain types of eductors (for example, that described and claimed in U. S. Patent 2,381,589, granted to me August 7, 1945) may be "balanced," i. e. so constructed that the ratio of liquid volume entering through the leg to the liquid volume entering through the throat remains substantially constant even though the pressure of the liquid entering the throat is varied over a substantial range. Such eductors, while satisfactory in operation, are difficult to manufacture because of

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the precision required in control of the several dimensions.

As a result of my investigations, I have discovered that an eductor of one type which is unbalanced by reason of improper proportioning of the several elements, may be balanced by the insertion of a choke in the apparatus toward its discharge end. The type of eductor which may be balanced by this means is one having a cylindrical throat which opens abruptly into a coaxial cylindrical expansion chamber of larger cross section, with a suction leg or conduit entering the expansion chamber from the side adjacent the junction of throat and chamber. In the majority of instances, such eductors are not balanced, i. e. the proportion of liquid passing into the eductor respectively through throat and side leg, varies with the pressure at the throat. In consequence, such eductors have little application in operations in which the proportion must remain substantially constant even though the pressure of the carrier stream entering the throat varies, as is the case with most water mains, etc.

In accordance with my invention, eductors of the foregoing type may be brought to balance by introduction of a choke (i. e. a restricted passage) in the discharge end beyond the expansion chamber. The choke may take the form of a conduit of smaller cross section than the chamber disposed coaxially adjacent its discharge end, or it may take the form of a second coaxial expansion chamber larger than the first and closed at its end by a screen, perforated disk or the like, which offers appropriate resistance to the discharging stream.

The choke, in addition to balancing the eductor, increases the proportion of carrier liquid to side leg liquid. Thus by varying the degree of choke the eductor may be designed to suck a constant proportion ranging from 3 to 1 to 30 to 1 over a wide range of carrier stream inlet pressures, say 20 to 100 pounds per square inch.

If increase in the proportion over about 60 to 1 is desired, I have discovered that this may be accomplished, without disturbing the "balance" of the eductor, by inserting an additional choke in the side leg. This second choke conveniently takes the form of a bushing which is press-fitted into the side leg. The bushing has

a small orifice. Should the insertion of this choke bring about unbalance in the eductor, the balance may be restored by moving the bushing longitudinally along the side leg, i. e. by varying the distance between the choke and the entrance of the side leg into the expansion chamber.

These and other aspects of my invention will be more thoroughly understood in the light of the following detailed description and the drawings in which:

Fig. 1 is a diagrammatic longitudinal section of an eductor of the invention in which balance is achieved by choking the discharge with a perforated plate on the exit of a second expansion chamber;

Fig. 2 is a diagrammatic longitudinal section of an eductor of the invention in which balance is achieved by placing a choke conduit on the exit of the first expansion chamber;

Fig. 3 is a longitudinal section through a form of the apparatus of the invention particularly adapted for the distribution of concentrated liquid fertilizers, germicides, insecticides, etc., and as a fire nozzle;

Fig. 4 is a fragmentary section of the discharge end of the eductor equipped with a perforated brush plate for use in dish washing, etc.;

Fig. 5 is a sectional elevation of a car washer constructed in accordance with my invention; and

Fig. 6 is a schematic diagram of an eductor particularly adapted for the dispersal of fungicides, germicides and insecticides, etc.

Referring to Fig. 1, the eductor illustrated comprises a body **60**, having a cylindrical inlet section **61** for the entrance of a carrier liquid, say water, under pressure. The inlet opens into a coaxial tapered or frusto conical section **62** which is joined to a coaxial cylindrical throat section **62A** of smaller diameter than the inlet. I have found that the tapered section ahead of the throat is desirable in that it tends to assure more accurate balancing of the eductor over a wider pressure range by reducing turbulence.

The throat opens abruptly into a first expansion chamber **63**, which is cylindrical in shape and with its rear wall adjacent the throat perpendicular to the axis of throat and chamber. The first expansion chamber in turn opens abruptly into a second coaxial cylindrical expansion chamber **64** of larger bore, and this in turn opens into a flared coaxial nozzle section **65**, the discharge end of which is closed by a perforated plate **66** having a plurality of holes K. The plate acts as a choke.

The eductor of Fig. 1 has a side leg or conduit **67** which extends at right angles to the first expansion chamber and enters it immediately adjacent its rear wall. This side leg, through which liquid is sucked into the carrier stream, has a bushing or choke **68** employed to further increase the proportion of carrier stream to side-leg stream while maintaining undisturbed the balance attained by choking the discharge of the eductor with the plate **66**. Preferably the choke **68** is a press-fit bushing having a small control orifice, the size of which is determined by the degree to which the proportion of carrier stream to side leg stream is to be increased, i. e. the smaller the orifice, the greater the proportion. By sliding the bushing along the side leg, a position of balance may be obtained in each case.

On Fig. 1, certain dimensions of the eductor are indicated by the letters A to N inclusive, and in the following Table I, numerical values of these

dimensions are given for a number of actual cases in which eductors of the invention were tested and found to be in balance at the proportions stated over a wide pressure range.

TABLE I

Eductors of Fig. 1 balanced to suck constant proportions of water into water carrier stream over pressure range of 20 to 100 pounds per square inch at inlet

Eductor No.	Ratio	Dimensions, Inches						
		A	B	C	D	E	F	
1	122-1	.172	.094	.187	.140	.156	.281	
2	80-1	.156	.094	.187	.125	.156	.250	
3	50-1	.136	.094	.187	.109	.156	.219	
4	88-1	.116	.094	.187	.094	.156	.187	
		G	H	J	K[1]	L	M	N
1	122-1	2.109	.391	1.109	73	1.0	.125	.0225
2	80-1	1.875	.391	1.094	65	1.0	.125	.021
3	50-1	1.640	.328	1.328	57	1.0	.25	.026
4	88-1	1.407	.281	1.563	49	1.0	.125	.024

[1] Number of holes of 0.042" diameter in choke plate.

In all cases the eductors of Table I were originally unbalanced, and balance was obtained by adjusting the number of holes K in the choke plate. After balance was thus achieved, the proportion of carrier liquid to side leg liquid was further increased by inserting the additional choke in the side leg.

Not all of the dimensions of the eductor are critical. However, I have found that balance is more readily obtained with the choke plate if the following relationships are approximately maintained. Thus the diameter F of the first expansion chamber should be twice the diameter D of the throat; the diameter H of the second expansion chamber should be three times the throat diameter D; and the length G of the first expansion chamber should be fifteen times the throat diameter D. Although it is not essential, the length J of the second expansion chamber preferably is about twelve times the throat diameter. Expressed mathematically

$$F=2D \qquad G=15D$$
$$H=3D \qquad J=\propto 12D$$

The apparatus of Fig. 2 is generally similar to that of Fig. 1, save that a different means is employed to choke the discharge and bring the eductor into balance. Thus the eductor of Fig. 2 comprises a body **70** with a cylindrical inlet bore **71** which reduces to a cylindrical throat **72** through an intermediate tapered section **73**, all coaxial. The throat opens into the rear wall of a concentric cylindrical expansion chamber **74**, the discharge of which is choked by a restricted coaxial cylindrical conduit **75** which is employed for balancing purposes.

As in the case of the apparatus of Fig. 1, the eductor of Fig. 2 has a side leg **76** which enters the expansion chamber immediately adjacent its rear wall, the suction leg being provided with a choke bushing **77** having a restricted orifice.

By varying the diameter or the length of the choke **75**, the eductor may be brought to balance. Thereafter the desired proportion of carrier liquid to side leg liquid is obtained by varying the length or cross section of the orifice in the choke bushing and the bushing is moved to a proper position in the side leg for balance.

Fig. 2 bears letters P to Y inclusive to identify certain dimensions and the following Table II gives a numerical example of these dimensions for one eductor which is balanced over a wide pressure range.

TABLE II

Eductor of Fig. 2 balanced to suck one volume through side leg for each 75 volumes passing through throat over pressure ranges of 20 to 100 pounds per square inch at inlet

[Dimensions, Inches.]

P	Q	R	S	T	U	V	W	X	Y
.156	.094	.187	.125	.156	.187	1.313	.375	.166	.021

In the case of the apparatus of Fig. 2, the diameter of the expansion chamber is approximately 1½ times the diameter of the throat and its length is about ten times the diameter of the throat. These dimensions are not critical, but furnish a good guide in the design of the balanced eductor of the invention employing a choke at the discharge end of the expansion chamber for balancing purposes.

In the eductor of Fig. 1 there is a large vent 78 opposite the side leg and there is a similar large vent 79 in the apparatus of Fig. 2. These vents are large enough to cut off the suction on the side legs entirely when they are open and thus furnish a ready control means. When the vent is closed with the thumb or finger the eductor pulls in the proper proportion of liquid through the side leg. When it is open, only the carrier stream is projected from the discharge end of the eductor.

The eductor of Fig. 3 is in general like that of Fig. 1, except in certain details. It is designed for quantity production, the eductor body proper being a die casting 80, which contains the expansion chambers and an integrally formed threaded bottle cap 81 adapted to screw on a bottle 82 of concentrated insecticide solution or the like into which the side leg projects. The side leg is a brass tube 83 threaded into the casting with a rubber tube 84 extending into the solution (not shown) in the bottle. The inlet and throat of the eductor are bored in a brass insert 85 fastened into the rear of the eductor, and a thimble 86 of brass screen or the like is placed over the inlet to prevent clogging of the throat. The rear of the eductor body carries a female threaded member 87 for attachment to a garden hose or the like.

The side leg contains a choke bushing 88 as in the case of the apparatus of Fig. 1 and the discharge of the eductor is choked by a perforated plate 89, the holes of which are of such size and number as to exert the proper balancing effect.

The apparatus of Fig. 3 is simple to use. Each one is designed to suck a fixed proportion (say 1 to 100) through the side leg over a wide pressure range of the entering carrier stream. A fertilizer solution which should be diluted, say 100 to 1, is placed in the bottle. Water is forced through the eductor as a carrier stream. The proper proportion of fertilizer solution is sucked into and commingled with the carrier stream and discharged as a spray whenever the vent 90 of the eductor is closed with the thumb.

Referring to Fig. 5, the apparatus comprises a nozzle body 10 having a large female threaded portion 11 at the rear for attachment to a garden hose (not shown). The nozzle body is provided

with a bottom flange 12 having an internal thread 13 which may be screwed onto a bottle 14 containing a detergent solution in concentrated form.

Conveniently the nozzle body is a die casting provided with a front flange 15 which is rolled or peened over a retaining ring 15A which holds in a screen or disperser plate 16 provided with a plurality of fine holes 17. At least one additional fine screen 17A is placed within the eductor behind the first screen to aid in dispersion of the stream and mixing with air. The size of bubble produced is regulated by the number and mesh of these screens.

A moderately fine screen 18 in the form of a thimble is slipped over the rear end of a portion 19 having a bore 20 coaxial with the nozzle body and constructed in the fashion of the previously described examples. This bore opens abruptly into a first elongated cylindrical passage or chamber 21 which is coaxial with the throat. The passage 21 in turn opens into a second coaxial cylindrical passage 22 which is somewhat greater in diameter but shorter than the first cylindrical passage. The second cylindrical passage flares out into a short wide third cylindrical passage 23 which is closed by the front screen or disperser. Thus the bore or throat 20 and the cylindrical passages 21, 22, 23 form a conduit through the nozzle.

It is convenient to form the throat portion and the first chamber 21 in a cylindrical insert 24 which has a flange 25 at its front end that fits a shoulder formed at the rear end of the second chamber. This insert is slid into the nozzle body and is provided with a side bore 26 which matches a transverse hole 27 that passes out of the top of the nozzle. The insert is also provided with another transverse passage 28 which is of smaller diameter than the upper passage 26. The lower passage communicates with a transverse hole 29 into which is threaded a pipe 30 which projects into the bottle. This pipe contains a choke bushing 30A. A rubber tube 31 is fastened to the end of the pipe and drops down to the bottom of the bottle into contact with the detergent solution (not shown). The bores 26, 27 form a continuous passage or vent to atmosphere from the rear of the first passage or chamber 21. The small bore 28, the pipe 30, and the tube 31 form a continuous suction leg up which the detergent solution is aspirated by a stream of water forced through the throat.

To "balance" the proportioner, i. e. to assure that it will suck constant proportions over a wide pressure range, the apparatus is provided with a choke conduit 32. This is concentric with the main passage through the eductor and is a tube provided with a flange portion 33 which bears against the front end of the insert 24 and projects slightly into the second chamber 22, leaving an annular space 33 around it. Into this annular space a plurality of suction ports or vents 34, 35, open. These latter communicate with the atmosphere and slope backward from the second chamber. These holes can be perpendicular to the chamber if desired. Liquid issuing from the choke conduit into the second chamber creates a suction in the second chamber, with the result that air is sucked in through the ports.

The operation of the car washer of Fig. 5 is as follows: The nozzle body is screwed onto the end of a garden hose; the bottle is filled with concentrated detergent solution and then the water is turned on. A stream of aerated water

will issue from the end of the nozzle. The bore 27 is then closed with the thumb. This bore is large enough so that when it is open there is insufficient suction on the lower leg of the eductor to draw up the detergent. However, when the bore 27 is closed with the thumb, suction is applied to the lower leg and the detergent solution is sucked up through the passageway and through the small orifice 28 into the water stream. Here it mixes with the water and is carried out of the nozzle. However, as the stream comes out into the second chamber 22, air sucked in through the ports 34, 35 is mixed with the water-detergent mixture under the influence of the screen 17A, causing the mixture to foam and froth, with the result that a foamy detergent stream is projected out of the nozzle against the automobile or whatever is to be washed. As long as the thumb is kept over the bore 27, detergent will be aspirated and the froth will be produced. However, when the thumb is removed the detergent flow ceases immediately and a stream of aerated rinse water issues from the nozzle. The vent 27 also acts as a vacuum breaker to prevent suck back of detergent etc. through the throat to the main.

The choke conduit 32 is so proportioned that the proportioner is "balanced," i. e. so that it will suck a predetermined proportion of the detergent solution into the water stream even though the pressure on the entering water stream may vary over a wide range, say from 20 to 80 pounds per square inch.

As soon as the car has been thoroughly wet with the detergent foam, which because of its frothy character tends to cling to the surface it strikes, the surface is gone over with a fabric mat or the like and then the car surface is rinsed with the aerated water stream from the nozzle, but without suction on the detergent.

The apparatus of the invention permits an automobile to be washed in a matter of minutes and is convenient for home use with any one of a number of synthetic detergent solutions now on the market. It is rugged, has no moving parts and is inexpensive to manufacture.

By varying the length or diameter of the chokes and by controlling the size of the air inlet ports in the second chamber, the apparatus may be designed to suck any desired proportion, say from 1 to 100 to 1 to 250. These ratios are about optimum for most detergent solutions.

The apparatus of Fig. 3 is also useful in fire fighting. It has been established that water containing certain wetting agents is more effective for this purpose, and a number of such agents are available for such use.

In fire fighting, the equipment is used in substantially the same way as in spraying fertilizer solution, except that a wetting agent is substituted for the fertilizer. In some cases, the equipment should be adjusted so that it will suck a different proportion through the side leg, say 1 to 160 instead of 1 to 100 in the case of a fertilizer. This result can be obtained by increasing the choke in the side leg.

The apparatus of Fig. 6 is a simple but highly effective structure adapted for the mixing and dispersal of germicides, weed killers, etc. It comprises a cylindrical body 40 having a female threaded connection 41 at its rear for attachment to a hose. The apparatus is provided with a concentric cylindrical throat 42 which opens abruptly into a first coaxial cylindrical chamber 43 which in turn opens into a second coaxial cylindrical chamber 44. The chamber 43 is of larger cross section than the throat and the chamber 44 is of still larger cross section. At the rear of the first chamber there is a transverse bore 45 which opens upward to atmosphere. Immediately below it is a smaller bore 45A which communicates with a pipe 46 threaded into the bottom of the body. This pipe contains a choke bushing 53. A disperser member 47 is fastened onto the second chamber from the front. There is a constricted bore 48 at the front of the apparatus which acts as a choke conduit and this bore throws a jet against a curved disperser surface 49.

In operation, the apparatus is threaded on the end of a garden hose; the pipe 46 by means of a tubular extension (not shown) is connected to a body of liquid contained in a bottle 51 to be sucked into the water stream and then the water is turned on. As long as the thumb is kept clear of the top 50 of the upper bore or vent, there is insufficient suction on the eductor to draw liquid up through the bottom leg, so that merely a stream of aerated water issued from the apparatus. However, when the thumb is placed over the vent, suction is created immediately on the lower leg and the liquid, say a concentrated solution of germicide, insecticide, or weed killer, is drawn into the eductor and mixed with the water in a predetermined proportion.

The apparatus of Fig. 5 may be used as a dish-washing device in the form in which it is shown, or it may be equipped with a brush as indicated in Fig. 4. Such a brush comprises a perforated plate 95 fastened into the discharge end of the eductor 10, with bristles 96 projecting from the front. The brush may be used to rub the dishes, thus aiding the washing action of the foamy detergent stream which the eductor discharges.

I claim:

1. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a cylindrical expansion chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a first choke conduit of smaller cross section than the expansion chamber disposed on the outlet side thereof, a suction conduit for the first liquid opening into the side of the expansion chamber near the end thereof that communicates with the throat and a second choke conduit slidably disposed within said suction conduit and movable substantially the length thereof.

2. Apparatus according to claim 1 in which the first choke conduit is disposed immediately adjacent the outlet of the expansion chamber.

3. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a cylindrical expansion chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a choke conduit of smaller diameter than the chamber disposed beyond the expansion chamber, and connected therewith, a first suction conduit for the first liquid opening into the side of the expansion chamber near the end thereof that communicates with the throat and downstream from the throat, and a second suction conduit vented to atmosphere and opening into the chamber sepa-

rately from said first suction conduit, and of such size as to destroy suction on the first suction conduit when open.

4. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a cylindrical expansion chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber extending in the same direction as the expansion chamber and the throat and of larger cross section than the expansion chamber, and with the latter communicating with an end thereof, a choke of smaller open cross section than the expansion chamber disposed at the outlet of the second chamber, a suction conduit for the first liquid opening into the side of the expansion chamber near the end thereof that communicates with the throat, and a choke of restricted open cross section disposed in the suction conduit.

5. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber extending in the same direction as the first chamber and the throat and of larger cross section than the first chamber, and with the latter communicating with an end thereof, the second chamber being open at the opposite end, a choke conduit of smaller diameter than the first chamber disposed between the first and second chamber, a first suction conduit for the first liquid opening into the side of the first chamber near the end thereof that communicates with the throat, and a second suction conduit vented to atmosphere and opening into the second chamber adjacent the choke conduit and sloping outward and backward.

6. In an eductor for sucking a first liquid into a carrier stream of a second liquid the combination which comprises a first chamber, a throat of smaller cross section than the chamber opening abruptly into the chamber, a suction leg opening into the side of the first chamber, a second chamber disposed at the end of the first chamber opposite the throat and of larger cross section than the first chamber with the first chamber opening abruptly into it, and a suction conduit for gas opening into the second chamber adjacent the junction of the first and second chambers.

7. In an eductor for sucking a first liquid into a carriage stream of a second liquid the combination which comprises a first chamber, a throat of smaller cross section and in line with the first chamber opening into the end of the chamber a suction leg opening into the side of the first chamber, a second chamber disposed at the end of the first chamber opposite the throat and of larger cross section than the first chamber with the first chamber opening abruptly into it, and a plurality of vents for gas opening into the second chamber adjacent the junction of the first and second chambers and sloping outward and backward.

8. An eductor for mixing a detergent solution with a stream of carrier liquid and causing the resulting mixture to foam, comprising an elongated first chamber, a throat of smaller cross section than the chamber in line with and opening abruptly into the chamber, an elongated second chamber extending in the same direction as the throat and the first chamber and with the first chamber opening abruptly into an end thereof, a suction leg for the detergent solution entering the side of the first chamber adjacent the throat, a vent for sucking in gas entering the second chamber adjacent the first chamber, and a choke plate disposed on the outlet of the second chamber.

9. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber of greater cross section than the first chamber extending from the first chamber, a choke in said second chamber spaced from the end of the first chamber and comprising a plurality of parallel passages parallel to the axis of the first and second chambers, and a suction conduit for the first liquid opening into the side of the first chamber near the end thereof that communicates with the throat.

10. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber extending in the same direction as the first chamber and the throat and of larger cross section than the first chamber, and with the latter communicating with an end thereof, the second chamber being open at the opposite end, a choke conduit of smaller diameter than the first chamber disposed between the first and second chamber, a first suction conduit for the first liquid opening into the side of the first chamber near the end thereof that communicates with the throat, an atmospheric vent opening into the first chamber adjacent the first suction conduit, and a second suction conduit vented to atmosphere and opening into the second chamber adjacent the choke conduit and sloping outward and backward.

11. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber extending in the same direction as the first chamber and the throat and of larger cross section than the first chamber, and with the latter communicating with an end thereof, the second chamber being open at the opposite end, a choke conduit of smaller diameter than the first chamber disposed between the first and second chamber, a first suction conduit for the first liquid opening into the side of the first chamber near the end thereof that communicates with the throat, a second choke conduit disposed in said first suction conduit, and a second suction conduit vented to atmosphere and opening into the second chamber adjacent the choke conduit and sloping outward and backward.

12. In an eductor for sucking a first liquid

into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber extending in the same direction as the first chamber and the throat and of larger cross section than the first chamber, and with the latter communicating with an end thereof, the second chamber being open at the opposite end, a choke conduit of smaller diameter than the first chamber disposed between the first and second chamber, a first suction conduit for the first liquid opening into the side of the first chamber near the end thereof that communicates with the throat, and a second choke conduit slidably disposed in said first suction conduit.

13. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber extending in the same direction as the first chamber and the throat, the second chamber being of larger diameter and smaller length than the first chamber and communicating with the end of the first chamber, a third chamber extending in the same direction as the first and second chambers and the throat, the third chamber being of larger diameter and smaller length than the second chamber and connecting with an end of the second chamber, the other end of the third chamber being open, a choke conduit of smaller diameter than the first chamber disposed between the first and second chambers, a perforated plate mounted across said open end of the third chamber, a first suction conduit for the first liquid opening into the side of the first chamber near the end thereof that communicates with the throat and a second suction conduit vented to atmosphere and opening into the second chamber adjacent the choke conduit and sloping outward and backward.

14. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending in the direction of the throat axis with the throat opening into an end thereof abruptly, a second chamber extending in the same direction as the first chamber and the throat, the second chamber being of larger diameter and smaller length than the first chamber and communicating with the end of the first chamber, a third chamber extending in the same direction as the first and second chambers and the throat, the third chamber being of larger diameter and smaller length than the second chamber and connecting with an end of the second chamber, the other end of the third chamber being open, a choke conduit of smaller diameter than the first chamber disposed between the first and second chambers, a perforated plate mounted across said open end of the third chamber, a wire screen disposed across the opening between the second and third chambers, a first suction conduit for the first liquid opening into the side of the first chamber near the end thereof that communicates with the throat and a second suction conduit adjacent the choke conduit and sloping outward and backward.

15. In an eductor for sucking a first liquid into a carrier stream of another liquid, the combination which comprises a restricted throat through which the carrier stream is introduced, a first chamber of greater cross section than the throat extending coaxially from the throat, a second chamber of greater cross section and lesser length than the second chamber extending coaxially from the second chamber, a third chamber of greater cross section and lesser length than the second chamber extending coaxially from the second chamber, the third chamber being open at its end opposite the second chamber, a first choke conduit of smaller diameter than the first chamber disposed between the first and second chambers, a first suction conduit for the first liquid opening into the side of the first chamber adjacent the throat, a second suction conduit vented to atmosphere opening into the first chamber adjacent the throat, a second choke conduit disposed in said first suction conduit, a third suction conduit vented to atmosphere and opening into the second chamber adjacent the first choke conduit and sloping outwardly toward the throat, and a perforated plate disposed across the open end of said third conduit.

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