LIQUIDS MIXING AND SELECTIVE DELIVERY SYSTEM

ABSTRACT: A liquids mixing and selective delivery eductor system. Pump-equipped conduit to force carrier liquid, e.g., water, from source to delivery nozzle structure. Conduit has an eductor inserted therein with its throat area connected by a check valve controlled suction passage to one or more sources of supplemental liquids, e.g., separate solution concentrates for washing, degreasing and jet-waxing. The eductor has associated therewith a special valve mechanism which can be selectively manipulated to allow one or more of the supplemental solutions to be mixed and delivered with the carrier liquid alone or together. The delivery nozzle has selective manual controls which will determine the types of deliveries, such as carrier liquid alone or the latter having a supplement admixed therewith as dictated by the setting of the valve mechanism.
LIQUIDS MIXING AND SELECTIVE DELIVERY SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to the field of fluid delivery or spraying systems which selectively deliver or spray a carrier liquid alone or in admixture with a supplemental solution, the delivery being effected through a manually manipulated nozzle. The present invention constitutes an improvement upon the prior art proposals of the U.S. Patents of Hayes No. 3,104,823 and Rusninik No. 3,429,508. The two primary drawbacks in a main delivery conduit a source of carrier liquid, e.g., water, a pump, a power eductor and a spraying nozzle. This power eductor includes an inlet constriction to create a back pressure followed by a mixing chamber. Hayes provides a bypass conduit for a portion of the carrier liquid or water between the pump outlet and the mixing chamber of the power eductor, which includes a second eductor having an aspirating chamber for drawing into the bypassed water the chemical liquid, e.g., an insecticide solution, and a flow control valve. The inlet constriction of the power eductor forces diversion of a portion of the pumped water through this bypass to draw into the aspirating chamber of the second eductor at a certain rate a quantity of the insecticide, so as to form a first mixture thereof, and this mixture is then admixed with the water flowing through the first or power eductor to provide the ultimate mixture to be delivered from the spraying nozzle. The only control of delivery of the chemical liquid or insecticide is by means of the flow control valve in the bypass line, i.e., when this valve is closed only water is delivered from the nozzle. This Hayes system is inconvenient to control for determining the nature of the sprayed discharge, and is undesirably expensive due to the costs of the many units embodied therein.

Rusninik proposes an entirely different type of system in which a pump delivers base liquid, e.g., water, to a discharge spray gun. The outlet of the pump is also connected to the throat chamber of a spring-braced piston valve so as to supply thereinto a back pressure of the pumped water. This valve controls flow of an additive liquid, e.g., soap or detergent solution, from a source thereof to the suction inlet of the pump. The spray gun is equipped with a two-way valve having a pair of delivery orifices of different sizes, with only the flow through the smaller creating a great enough back pressure on the piston valve sufficient to open the latter and allow the pump to draw into its inlet the detergent solution. This valve is relatively expensive, and its spring is subject to fatigue deterioration while the gasketing of the piston can wear or fail, to require costly repair or replacement. This Rusninik system is limited in use to services where the additive liquid that is sucked into the pump inlet will not be of such a nature as to foul up or corrosively damage the pump mechanism.

These problems, among others, of such prior art proposals are efficiently and simply eliminated by the present invention.

The present mixing and selective delivery system embodies means defining a main supply flow path that is connectable to a source of carrier liquid, e.g., water, through pressurizing means, such as a pump. The carrier liquid is pumped only through this main supply flow path. An eductor passage is provided in this flow path. The eductor passage has a constructed, pressure-reducing throat area that has a suction duct connected directly to the latter and the pressure in the duct at its point of connection to the throat area is reduced to below an environmental pressure. Means, such as a check valve, limits flow in the suction duct to the direction toward the eductor throat area. Means are provided which define at least one relatively impermeable, supplemental liquid supply that is maintainable substantially at the environmental pressure, and it is connected to the suction duct at a point preceding the flow direction limiting means. The supplemental liquid may be of a large variety of types since it does not flow through the pump to risk fouling or damage of the mechanism of the latter. Adjustable flow delivery means, which in some embodiments may be a manually manipulated and flow rate controlling nozzle device, is connected to the output end of the main supply flow means beyond the eductor throat area. This delivery means has at least a pair of alternative, predetermined delivery rate settings, each of which is temporarily maintainable at the will of the manipulator, of the delivery device or nozzle. The person manipulating the delivery device or nozzle selectively can control the rate of delivery flow to dictate the rate of flow through the eductor throat area alternatively between that which will create a negative pressure at the connection of the suction duct to this throat area sufficient to draw into the flowing carrier liquid some of the supplemental liquid, and that which is insufficient to do so.

In a preferred embodiment of the present system a selector valve mechanism is provided between the eductor and one or more relatively unpressurized sources of supplemental liquid. The selector valve mechanism is in a form whereby, if sources of a plurality of differing liquids are provided, they may be maintained segregated from each other until time of use. Adjustment of the selector valve mechanism permits any particular one of the differing supplemental liquids to be sucked into the system along or together with any other particular one or ones of these supplemental liquids as may be desired. The selector valve mechanism is of unique construction featuring a rotary hollow shaft that can be automatically or manually turned from one predetermined rotary position to any one of others for the purpose of opening selectively valves in segregated conducting passages which separately connect the several supplemental liquid sources to the shaft passage or bore. These valves are distributed along the axis of the rotary shaft and at the location of each valve the shaft is provided with an annular valving zone in which is located a localized valve manipulating land or cam extending radially outward rotatably to intercept the valve body and push it away from its ported seat for opening communication between the latter and the shaft bore through a flow conducting opening or shaft port in each such zone.

The rate of delivery flow controlling delivery device may for some uses of the present system be a manually manipulated spraying nozzle structure or hand held wand of improved design and construction. For the service intended, such as washing and associated functions, e.g., degreasing and jet-waxing of trucks, buses, planes, etc., it may be preferable that such wand include a base section which will serve as a handgrip having a delivery passage to receive the liquid output from the eductor. Such handgrip base section is provided with a pair of delivery branches or discharge conduits respectively communicable with the delivery passage through separate on-and-off valves with a pair of manually engageable valve manipulators, respectively associated with one of these valves, and mounted on the exterior of the base section at locations convenient to finger control operations. This arrangement permits the manipulator easily to open simultaneously communication between the delivery passage and the pair of discharge conduits, or alternatively to effect such communication through the valve of a selected one of the branch discharge conduits with maintenance of closure of the other valve to obtain the desired alternative delivery rate settings. Desired and advantageous structural details of such hand held wand are indicated in a following description of a preferred embodiment thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of the invention will in part be obvious and will in part appear from reference to the following detailed description in connection with the accompanying drawings, wherein like numerals identify similar parts throughout, and in which:

FIG. 1 is a largely diagrammatic view of the liquids mixing and selective delivery eductor system of the present invention, with parts indicated in section, broken away, and omitted;

FIG. 2 is a view of the delivery valve of the system shown in FIG. 1, with parts in section and broken away, illustrating a
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different position of this valve to obtain an alternative, temporarily maintainable, predetermined delivery rate setting;

FIG. 3 is a view similar to FIG. 2 illustrating a variation thereof and a particular delivery rate setting for obtaining a certain one of the alternative delivery rate settings. FIG. 4 is a view similar to FIG. 3 of the valve embodiment illustrated in the latter, illustrating the alternate delivery rate setting;

FIG. 5 is a view, with parts in section and broken away, of the valve shown in FIG. 1 for controlling the supply of supplemental liquid to the eductor section, with the position thereof shown in FIG. 1 indicating connection to a source of a first supplemental liquid supply and the position of this valve in this figure indicating a connection to a source of a second supplemental liquid supply;

FIG. 6 is a view similar to FIG. 5 illustrating a third position of this valve whereby both of the supplemental liquid supply sources are communicated to the eductor section simultaneously;

FIG. 7 is a view similar to FIGS. 5 and 6 illustrating cut off of both supplemental liquid supplies from communication with the eductor section, with one desirably provided with a check valve;

FIG. 8 is a perspective view of a selector valve mechanism which may be used to advantage in the systems of FIGS. 1 and 3;

FIG. 9 is a side elevation view, with parts broken away, of the selector valve mechanism illustrated in FIG. 8;

FIG. 10 is a sectional view, with parts broken away, taken on line 10—10 of FIG. 9;

FIG. 11 is an axial section, to larger scale, of the selector valve mechanism illustrated in FIGS. 8 to 10 inclusive, with the control knob diagrammatically indicated in broken lines and a portion of the end of this shaft which carries this knob being indicated in side elevation;

FIG. 12 is a side elevation view, with parts broken away and in section, of the selector valve mechanism operating shaft illustrated in FIG. 11;

FIGS. 13 and 14 are sectional views respectively taken substantially on lines 13—13 and 14—14 of FIG. 12;

FIG. 15 is a diagrammatic layout of a portion of the circumference of the valve operating structure of the selector shaft shown in FIGS. 11 to 14 inclusive showing the camming means which selectively effects operation of the various supplemental liquid supply valves and the relative location of parts in four quarter-point settings of this shaft;

FIG. 16 is a view, with parts broken away and in section of the housing of FIG. 11 for the rotary selector shaft;

FIG. 17 is a sectional view taken substantially on line 17—17 of FIG. 16;

FIG. 18 is a top plan view of a manually held wand which may serve as the delivery and discharge device of the system illustrated in FIG. 1, with the preferred embodiment therein of the selector valve mechanism of FIGS. 8 to 17 inclusive;

FIG. 19 is an exploded top plan view of a delivery duct connector illustrated in FIG. 18, with parts broken away and omitted;

FIG. 20 is an enlarged, exploded side elevation view of the connector illustrated in FIG. 19;

FIGS. 21 and 22 are enlarged sectional views respectively taken on lines 21—21 and 22—22 of FIG. 18;

FIG. 23 is a side elevation view, with parts broken away, of the front end portion of the base section handgrip of the wand depicted in FIG. 18, showing in broken lines a portion of a housing swiveled thereon;

FIG. 24 is a sectional view taken substantially on line 24—24 of FIG. 23;

FIGS. 25 and 26 are enlarged sectional views respectively taken substantially on lines 25—25 and 26—26 of FIG. 18, with parts of the poppet valve there located being broken away; and

FIG. 27 is an enlarged sectional view, with parts broken away, of the handgrip base section of the FIG. 18 wand shown in the tip portion of this figure and with the additional handgrip and disconnect connector assembly shown in the bottom portion of this figure.

Referring to FIGS. 1 to 7 inclusive, it will be seen that the liquids mixing and selective delivery eductor system of the present invention comprises certain essential units. In the system diagrammatically depicted in FIG. 1, means, such as piping 28, defines a main supply flow path or passage 29 which is connectable to a suitable source of carrier liquid. This piping 28 has mounted therein a suitable pump 30 which draws the carrier liquid from the source and delivers it through the piping 28 for pressurizing it to an elevated value which, for certain washing service, etc., may be of the order of about 500 to 600 p.s.i. Inlet 31a of the pump 30 is connected by a section of such piping to the source of carrier liquid, and its outlet 31b is connected to another section of this piping which leads to an eductor section 32. The eductor section 32 that is inserted in this piping 28 may be of a conventional Venturi type having a constricted, pressure-reducing, throat area 33. A suction duct 34 is flow connected directly to this throat area 33, and the relationship between the sizes of the passages including that through the eductor section, and the flow rate dictated and elevated pressure imposed by the pump 30 are such as to reduce the pressure in this suction duct at its connection with the throat area to below an environmental pressure, e.g., atmospheric pressure. This suction duct 34 includes means, such as a check valve 35, which limits flow therein to the direction toward the eductor throat area 33.

Means (not shown) such as a supply tank, are provided which defines at least one relatively unpressurized supplemental liquid supply which is maintainable substantially at the environmental pressure. This source is connected to the check valve-equipped suction duct 34 preceding the point at which the check valve 35 is located. For example, such supplemental liquid supply may be in the form of a pair of conduits 36 and 37 respectively leading from separate sources of supply of two different supplemental liquids or solutions. The outlet ends of the supply conduits 36 and 37 are connected respectively to inlet ports 38 and 39 of a selector valve mechanism which is diagrammatically illustrated as a two-way valve 40, which may be of any conventional and suitable design, including a rotary valve body 41, with the output port 42 thereof being flow connected to the check valve-equipped suction duct 34.

The main supply flow piping 28 has its output section 43, beyond the eductor section 32, flow connected to suitable valve structure such as that indicated at 44, which, when manipulated between a pair of alternative, maintainable, predetermined delivery rate settings the delivery through this valve in one setting will provide a certain rate of flow through the eductor throat area 33 as to create a negative pressure at the connection to the latter of the suction duct 34 which is insufficient to draw into the carrier liquid flowing through the main supply piping passage any supplemental liquids from either of the first and second sources thereof that may be flow connected through the supply valve 40. Delivery valve 44, when manipulated to its second delivery rate setting, will dictate a higher rate of such flow through the eductor throat area 33 which is sufficient to draw into the carrier liquid that is flowing through the eductor section 32 some of the supplemental liquid or solution in whichever of the two sources thereof that is flow connected through the valve 40 to the check valve-equipped suction duct 34. By way of example and for the purposes of illustration, the delivery valve 44 may be a two-way valve having an inlet port 45 flow connected to the output section 43 of the main supply piping 28 and a pair of outlet ports 46 and 47. Outlet ports 46 and 47 respectively may have flow connected thereto discharge tubes 48 and 49 which may lead to any suitable and desired discharge devices, such as spray heads. In the system of FIG. 1 it is indicated that the rotary valve body 50 of the two-way valve 44 is so positioned as to provide discharge through both of the outlet ports 46 and 47 and the tubes 48 and 49 respectively connected thereto, for attainment of the higher discharge flow rate that
will create sufficient suction on suction duct 34 as to draw therethrough whatever supply of liquid may be communicated therewith.

In operation of the system of FIG. 1 let it be assumed, by way of example, that the main supply flow path or passage 31 is connected to a source of water and that the supplemental liquid supply ducts 36 and 37 are respectively connected to sources of a concentrated detergent solution and a concentrated jet-washing solution. It may also be assumed that the delivery ducts 48 and 49 are respectively connected to separate spray heads or to a common discharge spray head of a manually manipulated wand, which may carry the two-way valve 44 with the control of its valve member 50 being readily accessible to hand manipulation thereon. In operation of such system of FIG. 1 the manipulator may turn the supply valve body 41 to the position depicted therein for flow connection therethrough between its inlet port 38 and its outlet port 42 of the detergent solution source to the suction duct 34. When the pump 31 is started it will force water through the main supply piping 30 for pressurized flow through the eductor section 32 and piping outlet section 43 for delivery through the valve 44 (having its rotary valve body 50 positioned as depicted in FIG. 1) for delivery in discharge of both of the delivery ducts 48 and 49. As a result, pressurized water flows through the eductor section 32 sufficient suction is created at the connection of the suction duct 34 with the throat area 33 of the eductor as to open the check valve 35 and draw detergent solution through the supply valve 40, for admixture with the water in the eductor section and then delivery of this mixture out through both of the discharge ducts 48 and 49.

Let it be assumed that after the detergent washing operation the operator then wishes to rinse the structure being washed.

In order to do so the manipulator operates the manual valve 44 to the position of FIG. 2 whereby the rotary valve body 50 thereof is reset to a position flow connecting its inlet port 45 only to the outlet port 47 for discharge of the flow exclusively through the delivery tube 49. The rate of flow of the water through the eductor section 32 is insufficient to create enough suction at the connection of the latter to the throat area at 33 for opening the check valve 35 and drawing in detergent solution through the supply valve 40. Thus rinse water may be delivered to wash off the water and detergent mixture.

Thereafter the manipulator may wish to spray the structure with a detergent solution. In order to do so he will manipulate the rotary valve body 41 of the supply valve 40 to the position illustrated in FIG. 5, which connects the outlet port 42 thereof to the inlet port 39 for communicating the source of concentrated washing solution through the conduit 37 and valve 40 to the suction duct 34. He will then return the rotary valve body 50 of the delivery valve 44 to the setting illustrated in FIG. 1, for simultaneous discharge of the output through the delivery ducts 48 and 49, as in the case of delivering a detergent mixture. Since this suction is sufficient to open the check valve 35 the washing solution will be drawn through the suction duct 34 into the throat area at 33 of the eductor section 32 for mixture with the pressurized flowing water, to apply jet-washing solution to the washed structure.

It will be seen from FIGS. 3 and 4 that there may be substituted for the delivery valve 44 another type of delivery valve 51 which will alternately connect the passage through its rotary valve body 52 to a pair of outlet ports 53 and 54 thereof which are respectively communicated to delivery ducts 55 and 56. The flow capacity of the outlet port 53 and delivery duct 55 are appreciably greater than the flow capacity of the outlet port 54 and delivery duct 56, and this difference is sufficient to greater so that the flow rate for delivery through port 53 and duct 55 will create sufficient negative pressure in the throat area 33 of the eductor section 32 as to open the check valve 35 and draw in whatever supplemental solution may be connected thereinto through the supply valve 40 at the setting of the delivery valve 51 illustrated in FIG. 5. It now the rotary valve body 52 of the delivery valve 51 is manipulated to the second setting illustrated in FIG. 4 the outlet port 54 will be flow connected therethrough to the inlet port 45 for delivery through this valve and port to the much smaller delivery duct 56 for obtaining a reduced flow rate which is insufficient to create enough suction in the throat area 33 of the eductor section 32 as to draw into the flowing carrier liquid any of the supplemental supply liquid.

It is illustrated in FIG. 6 that if the system of FIG. 1 is employed for other services where it is desired to admit two different supplemental supply solutions for simultaneous draft thereof into the throat area 33 of the eductor section 32, for mixing with the carrier liquid flowing through the connecting pipe 30, the supply valve 40 may have its rotary valve member 41 manipulated to a third setting for simultaneous connection of the supply ducts 36 and 37 to the suction duct 34.

In FIG. 7 it is illustrated a fourth position of the supply valve 40, which shuts off communication between the suction duct 34 and both of these supply ducts 36 and 37, so that under no circumstances, with the supply valve in this position, will any supplemental solution be drawn into the delivery system regardless of the setting position of the delivery valve 44. Since it is intended, as a matter of convenience, to maintain the sources of the differing supplemental solutions at the normal environmental pressure, i.e., atmospheric pressure, it may be desirable, due to the character of the differing supplemental solutions, to assure maintenance of the segregation regardless of the position of the supply valve 40. Thus, such a source may be obtained by inserting a check valve into one or both of the supply lines leading from such sources, such as indicated at 57 with respect to the supply duct 37.

DESCRIPTION OF A PREFERRED EMBODIMENT

A unique and practical selector valve mechanism, to be used to advantage in the liquids mixing and selective delivery eductor system of FIG. 1 for that which is diagrammatically illustrated at 40 therein, is shown in FIGS. 8 to 17 inclusive. For convenience, its design is such as to embody also the check valve 35, the eductor section 32 and the section of the suction duct 34 which intervenes this check valve and the throat area of the eductor section. This selector valve mechanism 140, which may be of the form illustrated in FIG. 8, includes an eductor housing 60, a valve housing 61 superposed by a plurality of pipe elbow fittings 62, 63 and 64 for connecting thereto a plurality of sources of the detergent solutions, and means 65 (such as a manual knob) for manipulating the housed valve mechanism between a plurality of predetermined settings. The eductor housing 60 is provided with inlet sleeve 32a equipped in its inlet passage 66 with pipe threads, and outlet sleeve or retainer pipe fitting 32b having its outlet passage 67 (FIG. 11) also provided with pipe threads, for respective connection to the piping section (shown in FIG. 1) that leads from the pump outlet 31a and the section 43 which is connected to the delivery valve inlet port 45.

As will be seen in FIG. 11 the chamber 68 in the eductor housing 60 is stepped to provide an annular shoulder 69 therein against which the bottom end 70 of an eductor Venturi unit 71 is seated. The bottom end of this eductor Venturi unit 71 is counterbore to provide a stepped socket 72 for reception and carrying an eductor nozzle 73. The Venturi unit 71 is provided with a through passage 74 which may gradually increase in diameter from its bottom end to the vicinity of the internally threaded outlet 67. The nozzle 73 is provided with a through passage 75 which progressively decreases in diameter, at least in a downstream portion thereof, and the tip 76 of the nozzle and the bottom end of the Venturi passage 74 are inter-vened by a mixing chamber 77, with these opposed parts and chamber constituting the throat area of the eductor. Through the sidewall of the Venturi unit 71 is provided a port 78 which forms the outlet end of the suction duct passage 34.

The retainer pipe fitting 32b telescopically receives therein the top end of the Venturi unit 71 and they are suitably gasketed together, such as by an O-ring 79. The bottom end of
the retainer pipe fitting 32b is gasketed into the housing chamber 68 by suitable O-ring 80, and a retaining ring 91 holds these parts together. The bottom end of the Venturi unit 71 is gasketed on an O-ring 98, and the bottom of the housing chamber 68, and another O-ring 83 gaskets the nozzle 73 into the Venturi unit socket 72. One side of the eductor housing 60 is provided with an integral collar 84 which has a stepped counterbore to define the passage of the suction duct 34 and a pair of successive sockets 85 and 86.

Rotary shaft 41 is hollow for an appreciable extent of its length to define the middle bottom of the axial chamber or passage 87. One end of the rotary shaft 41 is provided with coxial enlargement 88 which seats within the eductor housing socket 85 with suitable gasketing by an O-ring 89. This shaft enlargement 88 is provided with a polygonal or square socket 90 (FIGS. 11–13) and it houses a check valve ball 91 which seats against an annular valve port 92 to close the open end of the axial shaft chamber 87 when the pressure in the latter is less than that which may be imposed by liquid in the outlet end 78 of the suction duct 34. A transverse roll pin 93 may be employed to retain the check valve ball 91 in the square socket 90 and prevent it from plugging suction duct 34. The resulting check valve 39 thus intervenes the shaft chamber passage 87 and the outlet suction duct section 34.

The retainer pin 96 is a longitudinal bore 94 which carries a shaft bearing sleeve 95 in the bore 95a of which the major section of reduced diameter of the rotary shaft 41 is rotatably mounted. The external diameters of the bearing sleeve 95 and the enlarged end portion 88 of the rotary shaft 41 are substantially equal so that the latter is also snugly received in one portion of the housing bore 94 with close tolerance, and the end of this portion of the bottom of the housing portions 85 of the eductor housing 60 with a retainer annulus 99 and retainer rings 98 and 99 serving to hold these parts together. O-rings 100 gasket opposite ends of the shaft bearing sleeve 95 to the rotary shaft 41.

The valve housing 61 has a superstructure 101 which is provided, at three longitudinally spaced points, with three stepped bores 102, 202, and 302 respectively, for support in each of one of three similar valve structures. These valve structures are adjustable flow control needle valves for determining proportionate mixture fractions that will flow therethrough from the segregated supplies of the supplemental solutions. For example, the stepped bore 102 supports the valve sleeve 103 which is suitably rotatably mounted in the socket 85 of the eductor housing 60 with a retainer annulus 99 and retainer rings 98 and 99 serving to hold these parts together. O-rings 100 gasket opposite ends of the shaft bearing sleeve 95 to the rotary shaft 41.

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tion; and the third source of supplemental solution, connected to fitting 64, contains a jet-waxing solution for mixture with water and spraying of the mixture upon the venicle body. The manual knob 65 first may be set by hand to the position illustrated in FIG. 11, wherein valve balls 212 and 312 are securely seated, respectively, on their ported seats 214 and 314 to close off communications through the elbow fittings 63 and 64 with the rotary valve shaft chamber 87, while the valve manipulating land 117 on this shaft is located beneath the valve ball 112 to hold it radially outward in spaced relation to its ported seat 114 for communicating the soap or detergent solution through the elbow fittings 62 to the rotary valve shaft chamber 87. This is the rotary position No. 1 illustrated in FIGS. 11 to 15 inclusive.

When then the pump 30 is started up pressurized water will be forced through the eductor section 32 toward the delivery valve 44. If this delivery valve 44 is manipulated by the operator to the setting illustrated in FIG. 2 so that the delivery flow rate is insufficient to create a negative pressure in the throat area 33 of the eductor section 32 that will open the check valve 35 and draw in past the open selector valve ball 112 the soap or detergent solution, rinse water will be delivered from whatever spray nozzle head may be connected to the delivery duct 49. After the water rinse operation, if the operator now manipulates the delivery valve 44 to the setting of FIG. 1 for increasing the delivered flow rate by permitting discharge through both of the delivery tubes or conduits 48 and 49, respectively, to suitable delivery nozzles the resulting negative pressure created in the eductor throat area 33 will be sufficient to open the check valve 35, i.e., move the check valve ball 35 radially forward away from its ported seat 32, so as to impose the negative pressure on the rotary valve shaft chamber 87 for drawing thereinto the concentrated soap or detergent solution through the openings 118 in annular groove 115, past the open check valve 112 and from the supply passage 108. This supplemental solution is mixed in the eductor section mixing chamber 77 with the pressurized water flowing therethrough, for delivery of the resulting admixture to the dual nozzle delivery unit. After this detergent washing action is completed the operator may then wish to perform a degreasing action, and he will thus shut down delivery through the delivery valve 44 by manipulating this valve to a position where passage through the rotary delivery valve 50 is disconnected from the inlet port 45. In the event that it is not desired to shut off the operation of the pump 30 at such time that the latter may recirculate water about the pump between its inlet port 31a and outlet port 31b by a suitable pressure relief valve-equipped bypass (not shown).

With the delivery valve 44 closed the operator may then manipulate the selector valve mechanism manual knob 65 through 90 to the next setting, which is position No. 2 of FIG. 15. In this position the shaft land 217 is now located under valve ball 212, holding the latter raised above its ported seat 214, while ball valves 112 and 312 are respectively seated on their ported seats 114 and 314. Communication is thus established from the second source of supplemental solution through the supply passage 208 of valve fitting 63 to the rotary valve shaft chamber 87. If the delivery valve 44 is now manipulated to the FIG. 2 position rinse water will again be delivered alone since negative pressure created in the eductor throat area 33 is insufficient to open the check valve 35. When the operator then manipulates the delivery valve 44 to the FIG. 1 position, for increasing the flow rate of delivery therefore, sufficient negative pressure is developed in the eductor throat area 33 so as to draw into the eductor mixing chamber 87 the degreasing solution for mixing with the pressurized water and for delivering the resulting admixture through the delivery valve.

If such washing, soap or detergent cleaning, and degreasing action are to be followed by an additional operation (such as, for example, jet-waxing), the selector valve mechanism 140 is to be further manipulated manually so as to close the valves embodying the valve balls 112 and 212 and their respective ported valve seats 114 and 214, with simultaneous opening of the third valve by lifting its valve ball 312 up off of its ported seat 314. The operator performs this manipulation with the manual knob 65 by rotating it another 90° to the third position No. 3. It will be seen from FIG. 15 that this rotates the land 317 of the rotary valve shaft 41 to beneath the third valve ball 312 to lift and hold it up free from its ported seat 314, so as to communicate the third source of supplemental solution through the supply passage 308 past this open valve to the rotary shaft chamber 87. Then, by manipulating the delivery valve 44 in the manner indicated above to the setting of FIG. 2 a rinsing operation with water alone is had, after which this delivery valve may be manipulated to the FIG. 1 setting so that the negative pressure in the eductor throat area 33 will be sufficiently increased as to open the check valve 35 and draw into the eductor mixing chamber 77 the jet-waxing concentrate for mixing with the water and spray application of the resulting jet-waxing admixture.

If, at any time, it is desired to close off communications between all of these supplemental solution supplies to the rotary valve shaft 87 the manual knob 65 may be rotated to a fourth setting of position No. 4. As is indicated in FIG. 15, in this fourth position No. 4 all of the valve balls 112, 121, and 312 are permitted respectively to seat on their ported valve seats 114, 214, and 314.

It is to be understood that the manipulations of the rotary selector valve shaft 41 between the plurality, e.g., four, settings or positions thereof do not necessarily require manual manipulation by the use of manual knob 65. A completely automated selector valve mechanism unit, of the general design illustrated in FIGS. 8 to 17 inclusive, may be used, in which the selector rotary shaft 41 is turned from setting to setting by suitable motive means, such as an electrical rotary step actuator or a servomechanism controlled by timer mechanisms. If the supplemental liquid concentrates or solutions which are to be supplied through the selector valve mechanism unit 140 are of corrosive nature materials for the various parts of this unit are selected which resist corrosive damage. For example, an embodiment of the system of the present invention advantageously may have the parts of the eductor assembly 60 and the valve housing 61, made of brass, aluminum or other suitable material such as acrylonitrile butadiene styrene (ABS) synthetic plastic, may be dictated by the service intended. This is likewise true with respect to the fitting elbows 62, 63, and 64 and needle valve parts housed in or carried thereby. The selector rotary valve shaft 41 and the tubular bearing sleeve 95, in which the former is telescoped for rotary action therein, may be desirably formed from an automotive engine having high strength and stiffness and which is tough and resilient over a wide temperature range, that is available on the market under the trademark of Delrin. The valve balls 91, 112, 212, and 312, respectively, for the check valve 35 and the supplemental supply valves may be in the form of stainless steel balls or of other corrosive resistant suitable material. It is also to be understood that the construction of the eductor section 32 need not be in the form illustrated at 60 in FIG. 11 since edutors of differing designs will serve the required purpose, such as the various types illustrated in FIGS. 5 to 9 inclusive of the Hayes Pat. No. 3,104,823, but the form illustrated in present FIG. 11 may be preferred.

The adjustable flow delivery means, such as that illustrated in FIGS. 1 and 2 or in FIGS. 3 and 4, may be in the form of a manually held wand 129 of a construction similar to that illustrated in FIGS. 18 to 27 inclusive, which is particularly adapted to manual manipulation for delivering and applying in spray form the delivered carrier liquid alone or admixtures thereof with suitable supplemental liquid concentrates or solutions. It is well adapted to a manual valving operation which will effect the alternate settings illustrated in FIGS. 1 and 2. Such wand is connected to the eductor outlet 326 by a suitable main conduit section 43, which may be in the form of a flexible hose 143, as is depicted in FIG. 18. This wand includes a base section 130 which is advantageously designed to serve as
a handgrip. As will be seen in FIGS. 18 and 22 to 27 inclusive this base section 130 supports a swiveling housing 131 which connects to the base section a pair of branch discharge conduits or delivery tube assemblies 148 and 149 that include terminal end sections 248 and 249 which respectively terminate in discharge spray nozzles 132 and 232 of like construction, if desired. In the general vicinity of the swiveling housing 131 the delivery tubes 148 and 149 are tied together by a bridging structure 133 (see FIGS. 18, 21 and 27) which preferably also serves as a second handgrip.

As will best be seen in FIGS. 25 to 27 inclusive, the first handgrip 130 is a round or substantially cylindrical body 134 having an oblique end face 135 in which is provided an internally threaded inlet socket 136, into which is mounted connector 137 (FIG. 18) for the supply hose 143. This handgrip base section 134 is provided with an elongated and longitudinally extending blind hole 138 which terminates short of the swiveling housing 131. This blind hole constitutes a supply passage that communicates with the inlet socket 136 and is plugged at its outer end by a suitable plug 139 with the use of an O-ring gasket 141. In the transverse planes 142 and 144, on which sectional views 25 and 26 respectively were taken, the base section body 134 is provided with transverse stepped bores 242 and 244 in which similar poppet valves 150a and 150b are respectively mounted. As will be seen from FIGS. 25 and 26 the axes of these transverse poppet bores 242 and 244 are elongated in different longitudinal planes which are oblique with respect to each other and with each intercepting the supply passage 138. The transverse bore 242 is intercepted by a longitudinal blind hole 145 extending back from the front end 146 of a reduced front end section 151 of the base grip body 134, and serves as one outlet. The cross bore 244 is intercepted by another blind hole 147 which also extends back from the front end 146 of this base section body 134 to serve as another outlet. The outlet blind hole 145 is communicated through a port 152 with an annular channel 153 (FIGS. 23 and 27); and the outlet blind hole 147 is communicated through a port 252 with a similar annular channel 253. These annular flow channels 153 and 253 are flanked and intervened by a plurality of annular channels 254, 255, and 354 in which separating and leak-preventing O-rings 155 are seated (FIG. 27). The front end 146 of the grip base body 134 is provided with a cylindrical socket 157 (FIGS. 23 and 27).

The poppet valves 150a and 150b constitute separate manual on-off valves and preferably are of similar construction. Thus the valve mechanism shown in FIG. 27 with respect to the discharge valve serves to provide the structures of both of these valves. The poppet valve 150a of valve 150a seats against a ported seat 159 at the communication between the cross bore 242 and the supply passage 145. Its stem 160 is suitable gasketed in this cross bore and extends into a socket 161 in the surface of the grip body 134, to carry therein one of a pair of manually engageable valve manipulators or a pushbutton operator 162, with the top end of the latter normally projecting out above the circumferential surface of the grip body. The lower end of the valve poppet 158 is provided with a depending sleeve 163 to house therein a biasing spring 164. The spring-housing sleeve 163 is reciprocative ly guided within the cross bore 242 by a spacer or guide cup 165 which is gasketed to the wall of the lower end section of the cross bore, and is held therein by a retaining ring 166. It will be noted from FIG. 27 that since the cross bore 242 communicates respectively with the inlet blind hole passage 138 and the outlet blind hole passage 145 on opposite sides of the ported valve seat 159 communication between these blind hole passages is established when the poppet valve is depressed by application of pressure upon the button head 162. Whereas is removed pressure is removed from the button head 162 the poppet valve 158 is permitted to be raised by its biasing spring 164 to the valve closing position shown in FIG. 27, for cutting off such communication.

The swiveling housing 131 is in the form of an annulus and is provided in its front end with a pair of diametrically located sockets 168 and 268, with these being respectively flow connected by longitudinal passages 169 and 269 which respectively communicate with annular grooves 153 and 253. As is indicated later these sockets 168 and 268 serve to anchor the ends of the conduit tubes 148 and 149 to the swiveling housing 131 in flow connection to the outlet passages 169 and 269 respectively. Each of the front ends of the blind hole passages 145 and 147 is closed off by a suitable gasketed plug 170, and these are held in plugging positions by the head 171 of a pivot body 172 that is anchored into the socket 157 of the front end of the grip body 134 by a suitable retaining ring 173 (FIG. 27). The swiveling housing 131 has a stepped, longitudinal bore 174 extending therethrough and after it has been slipped upon the projecting end of the pivot body 172 it is rotatably anchored thereon by means of a retaining ring 175. The back end of each of the delivery conduits or tubes 148 and 149 is equipped with a collar 176 fixed thereto which is snugly received into the anchoring socket 168 (or 268 as the case may be) with the provision of suitable gasketing, such as an O-ring 177. A retaining ring 178 is provided to hold the collar 176, and the delivery tube which carries it, within this socket.

It will thus be understood that the swiveling housing 131 may be freely rotated upon this grip body 134 to swing the delivery tubes 148 and 149 about the axis of the latter for desired orientation of the spray nozzles 132 and 232 relative thereto. This pivot 172 is further designed to be mounted on the pivot pin 172 for free rotation thereon thereafter.

The second handgrip 133 conveniently may be provided in the form of a pair of semicircular auxiliary strips 180 and 280 having their opposed faces each provided with a pair of longitudinal grooves 181 and 281 to receive in each opposed pair thereof one of the delivery conduit tubes 148 and 149. As will be seen in FIG. 21 these opposed pair of strips 180 and 280 are clamped together by any suitable means, such as a plurality of machine screws 182. Thus the wand 129 of FIG. 18 is provided with a pair of hand grips 130 and 133 and the former may be grasped in the right hand with the middle finger curled around it for engagement of the tip of this finger against the manual operating valve button 162, and with the index finger curled around in like fashion so that the tip of the latter rests upon the manual operating valve button 262. The operator's left hand may then grasp the second grip 133 for easy manipulation of the delivery wand. By providing the pair of handgrips 130 and 133 the latter may serve at a convenient location as means to restrain the upward movement of the wand in use that results from the reaction forces of the discharge sprays 122 and 232. Also, this grip 133 serves as a means readily to swivel the delivery tubes and nozzles with the swiveling housing 131 relative to the valve-equipped grip 130, so as to allow the operator a desirable degree of freedom in directing the sprays emitted from the spray heads.

Desirably, a quick disconnect joint 183 is provided in the delivery tube section of the wand. This permits rapid change of the spray nozzles, or interchange therewith of another device, such as one or more hydraulically powered brushes, etc. As will be seen from FIGS. 18, 19, 20, and 27 such quick disconnect joint 183 may be in the form of a pair of complementary connector housings 184 and 185. The housing 184 preferably is provided with a pair of spring-biased pins 186 projecting from the front face 187 thereof, which are adapted to mate in a pair of sockets 188 formed in the back face 189 of the complementary connector housing 185. The connector housing 184 is also provided with a pair of through bores 190 adapted to receive therein collars 191 fixedly mounted on the front ends of the back end sections of the delivery tubes 148 and 149 which are to be anchored therein by suitable retaining rings 192. The front ends of the bores 190 also are designed to receive therein similar collars 291 which are fixed on the back ends of the front end sections 248 and 249 of the delivery tubes, with the latter extending through and after it is threaded into a pair of through bores 193 in the complementary connector housing 185 for location of the collars 291 beyond the
Having described my invention, what I claim as new and desire to secure by Letters Patent is the novel subjects matter defined in the following claims.

1. A liquids mixing and selective delivery eductor system comprising

1. means defining an inlet that is connectable directly to a pressurized source of carrier liquid,
2. adjustable flow capacity delivery means which employs for effective operation the pressure of the carrier liquid source without imposing thereon booster pressure,
3. means defining a single main supply flow path that is connected directly between said pressurized carrier liquid inlet and said adjustable flow delivery means with the exclusion of means defining any supplemental bypass between said inlet and delivery means,
4. means defining an eductor passage having a constricted, pressure-reducing throat area and forming a section of said single main supply flow path between said inlet and delivery means with said throat area preceding the latter and with the exclusion of any pressure boosting pumping equipment between said throat area and said delivery means,
5. means defining a suction duct connected directly to said eductor passage throat area for reducing the pressure in said duct at its connection with said throat area to below an environmental pressure,
6. means limiting flow in said suction duct to the direction toward said eductor throat area,
7. means defining at least one relatively unpressurized supplemental supply of liquid differing from and carryable by the carrier liquid with said supplemental liquid supply being maintainable substantially at the environmental pressure and connected to said suction duct at a point preceding said flow direction limiting means, and
8. means providing said adjustable flow delivery means with at least a pair of alternative, temporarily maintainable, predetermined flow capacity delivery rate settings whereby the rate of flow through said preceding throat area may be controlled alternatively to attain a certain rate of such flow that will create a negative pressure at the connection to the latter of said suction duct which is sufficient to draw into the carrier liquid when flowing through said throat area some of the supplemental liquid and to attain another certain rate of flow which will not create such a negative pressure so as to prevent some of the supplemental liquid from being drawn into the carrier liquid.

2. The eductor system defined in claim 1 characterized by inclusion therein of selector valve means comprising said eductor suction duct, means defining a section of a supplemental supply passage leading to said suction duct and connectable to a relatively unpressurized source of the supplemental liquid, and flow-controlling manipulatable valve means in said supplemental supply passage section.

3. A liquids mixing and selective delivery eductor system comprising

1. means defining a main supply flow path connectable to a pressurized source of carrier liquid,
2. means defining an eductor passage having a constricted, pressure-reducing throat area and forming a section of said main supply flow path with a suction duct connected directly to said throat area for reducing the pressure in said duct at its connection with the latter to below an environmental pressure,
3. means limiting flow in said suction duct to the direction toward said eductor throat area,
4. means defining a section of a supplemental supply passage leading to said suction duct and preceding said flow direction limiting means,
5. means defining a plurality of separate, relatively unpressurized sources of supplemental liquids maintainable substantially at the environmental pressure,
6. selector valve mechanism including means defining a plurality of segregated conducting passages all flow con-
connected to said supplemental supply passage section and individually connectable to said separate, relatively unpressurized sources of supplemental liquids and a plurality of flow-controlling manipulatable valve means in said supplemental supply passage section capable of flow connecting to said suction duct at will through said supply passage section and said flow direction limiting means by way of said separate conducting passages one or more of said supplemental liquid sources, and

7. adjustable flow delivery means connected directly to the output end of said main supply flow means beyond said eductor throat area and provided with at least a pair of alternative, temporarily maintainable, predetermined delivery rate settings whereby the rate of flow through said throat area may be controlled alternatively to attain a certain rate of such flow that will create a negative pressure at the connection to the latter of said suction duct which is sufficient to draw into the flowing carrier liquid some of the supplemental liquid and another certain rate of flow which will not create such a negative pressure, thereby preventing some of the supplemental liquids from being drawn into the carrier liquid.

4. The eductor system defined in claim 3 characterized by said selector valve mechanism comprising a tubular housing structure having an elongated bore therein which is rotatably mounted a hollow valving shaft provided with a longitudinal passage open at one end which is connected with said suction duct to serve as said supply passage section, the open delivery end of said shaft passage being equipped with said flow direction limiting means in the form of a check valve with this passage being closed at its other end, valve manipulating means connected to said shaft rotatably to adjust the latter between a plurality of predetermined rotary positions, means carried by said housing defining said plurality of segregated conducting passages communicating with said bore at axially separate points, a plurality of normally closed flow controlling valves with one thereof mounted in each of said flow conducting passages and having valve opening means projecting into said bore, said hollow shaft being provided at each such point with an annular valving zone communicated with said shaft passage, and means defining in each said annular zone a localized valving land extending radially outward to be rotated in an annular path intercepting said valve opening projecting means associated with this zone to open the valve controlled thereby when said projecting means is engaged by said land upon shaft rotation, at least some of said valve manipulating lands being annularly staggered selectively to communicate said segregated conducting passages with said shaft passage.

5. The eductor system defined in claim 4 characterized by each of said annular valving zones of said selector valve mechanism being defined to annularly opposite sides of its valve manipulating land by an accurately arranged groove communicated with said shaft passage by at least one shaft port therein, each of said zone lands constituting a portion of the exterior surface of said shaft at substantially the same radial distance from the shaft axis as are the shaft exterior surface portions flanking opposite sides of said arcuate grooves.

6. The eductor system defined in claim 5 characterized by each of said normally closed valves being in the form of a radially inwardly biased valving body seating in flow blocking position on a ported seat defined on said tubular housing structure in radial alignment with one of said annular valving zone grooves with a portion of said valve body extending through the port of said seat into the path of said land of this zone, whereby said valve body is moved radially outward away from said seat to valve open position when said shaft is rotated to align said land with said seat port and said shaft is stopped in this aligning position with said valve body resting on this land with flow connection established between the conducting passage containing this valve body and said shaft longitudinal passage past said valve body, through said seat port, to at least one side of said land, into said groove and from the latter through said shaft port.

7. A liquid mixing and selective delivery eductor system comprising

1. means defining a main supply flow path connectable to a pressurized source of carrier liquid,

2. means defining an eductor passage having a constricted, pressure-reducing throat area and forming a section of said main supply flow path with a suction duct connected directly to said throat area for reducing the pressure in said duct at its connection with the latter to below an environmental pressure,

3. means limiting flow in said suction duct to the direction toward said eductor throat area,

4. means defining at least one relatively unpressurized supplemental liquid supply maintainable substantially at the environmental pressure and connected to said suction duct at a point preceding said flow direction limiting means, and

5. adjustable flow delivery means connected directly to the output end of said main supply flow means beyond said eductor throat area and provided with at least a pair of alternative, temporarily maintainable, predetermined delivery rate settings whereby the rate of flow through said throat area may be controlled alternatively to attain a certain rate of such flow that will create a negative pressure at the connection to the latter of said suction duct which is sufficient to draw into the flowing carrier liquid some of the supplemental liquid and another certain rate of flow which will not create such a negative pressure, thereby preventing some of the supplemental liquid from being drawn into the carrier liquid; said adjustable flow delivery means being in the form of a manually held wand having a base section serving as a handgrip and provided with a longitudinal delivery passage communicating with the output end of said eductor passage, a pair of branch discharge conduits respectively communicable with said base section delivery passage through separate manual on-and-off valves with a pair of manually engageable valve manipulators respectively associated with one of the latter valves and mounted on the exterior of said base section whereby a person holding said wand simultaneously may open communication between said delivery passage and said pair of discharge conduits or alternatively open such communication through the valve of a selected one of said branch discharge conduits with closure of the valve of the other of the latter to constitute the alternative delivery rate settings.

8. The eductor system defined in claim 7 characterized by said wand being provided with a pair of separate discharge nozzles each individually connected with the outlet end of one of said pair of branch discharge conduits.

9. The eductor system defined in claim 8 characterized by said wand having a discharge section provided with a swiveling portion rotatably supported on said handgrip base section beyond said pair of manual valves and embodying sections of said pair of branch discharge conduits respectively leading from said swiveling portion to said discharge nozzles, and means defining in said base section and said swiveling portion ducts which constantly maintain separate communications between the outlets of said manual valves and said discharge conduit sections in all rotary positions of said swiveling portion relative to said handgrip base section.

10. The eductor system defined in claim 9 characterized by said wand discharge section having a quick disconnect joint located between said swiveling portion and said nozzles which in assembled condition maintains separate communication therethrough of said discharge conduits between said swiveling portion and said nozzles and permits substitution of other pairs of nozzles.