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(54) **PRESSURE WASHER WITH SOFT START WASHER WAND**

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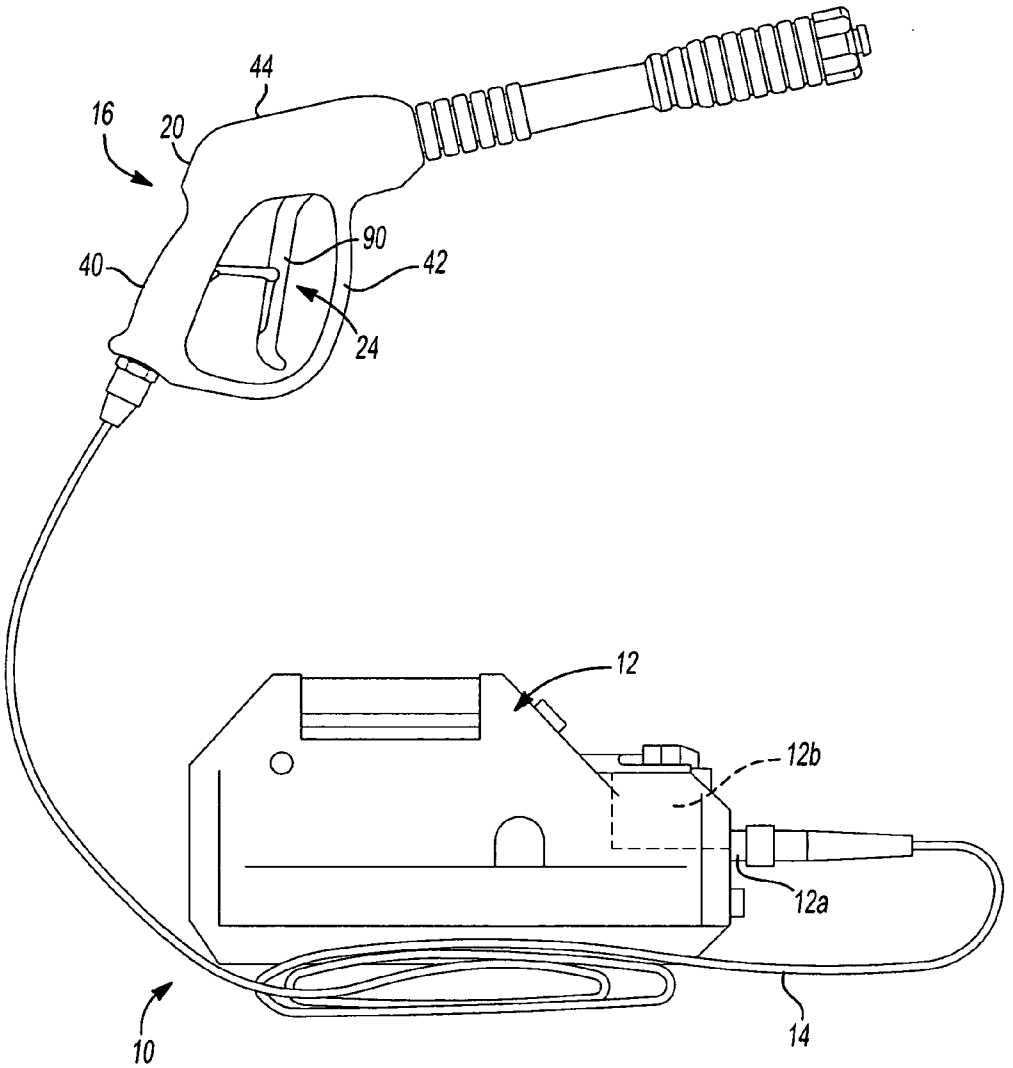
(57) **ABSTRACT**

A pressure washer wand having first and second valves that can be opened in a predetermined or user-adjustable manner through movement of a trigger. In one form, the first and second valves are opened sequentially in response to movement of a trigger to transition from a no-flow condition to a relatively low pressure flow and thereafter to a relatively high pressure flow. In another form, the sequencing of the valves can be changed such that only the first valve, which provides a relatively low pressure flow, is opened in response to movement of the trigger. A pressure washing system having the pressure washer wand is also provided.



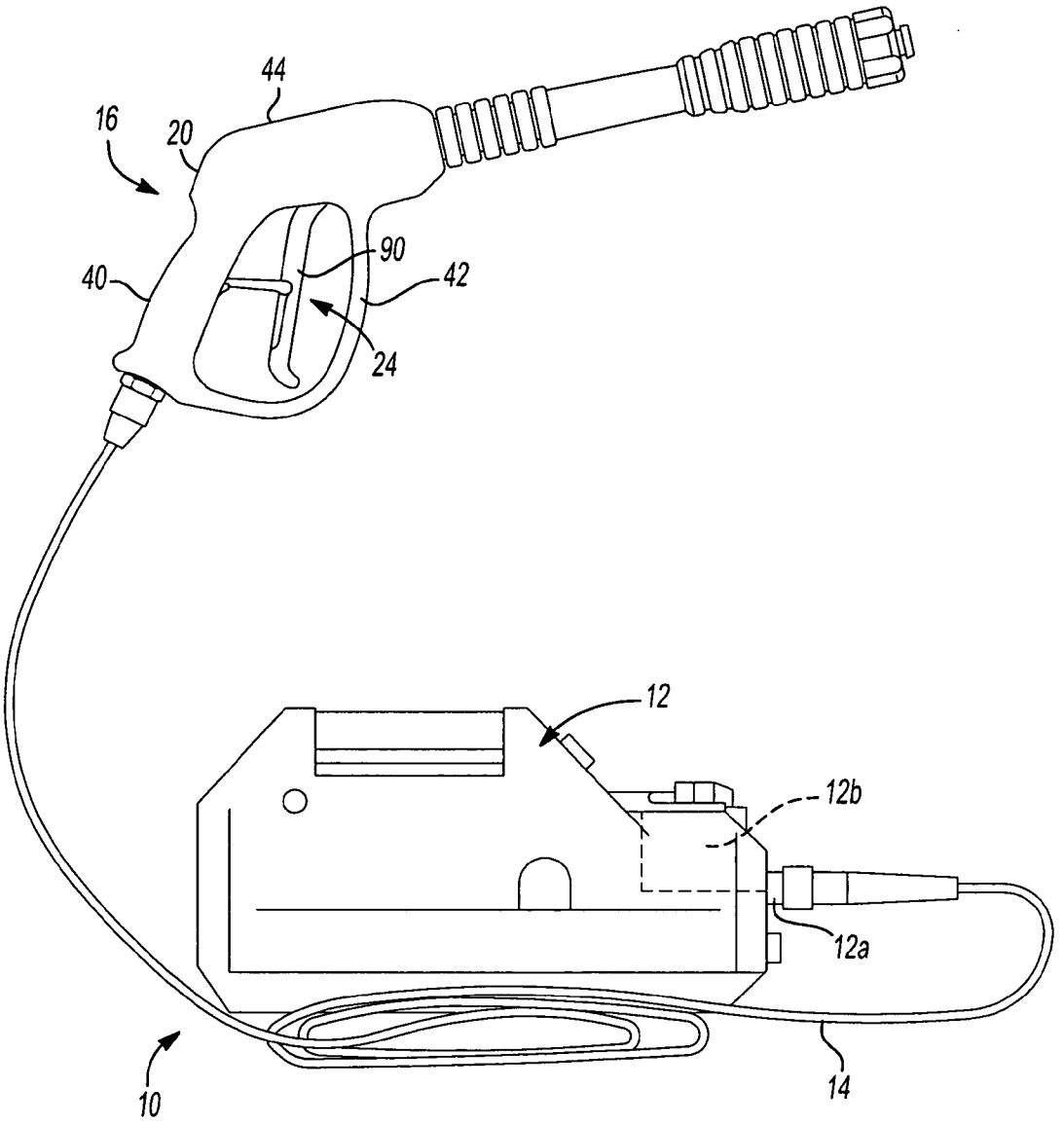
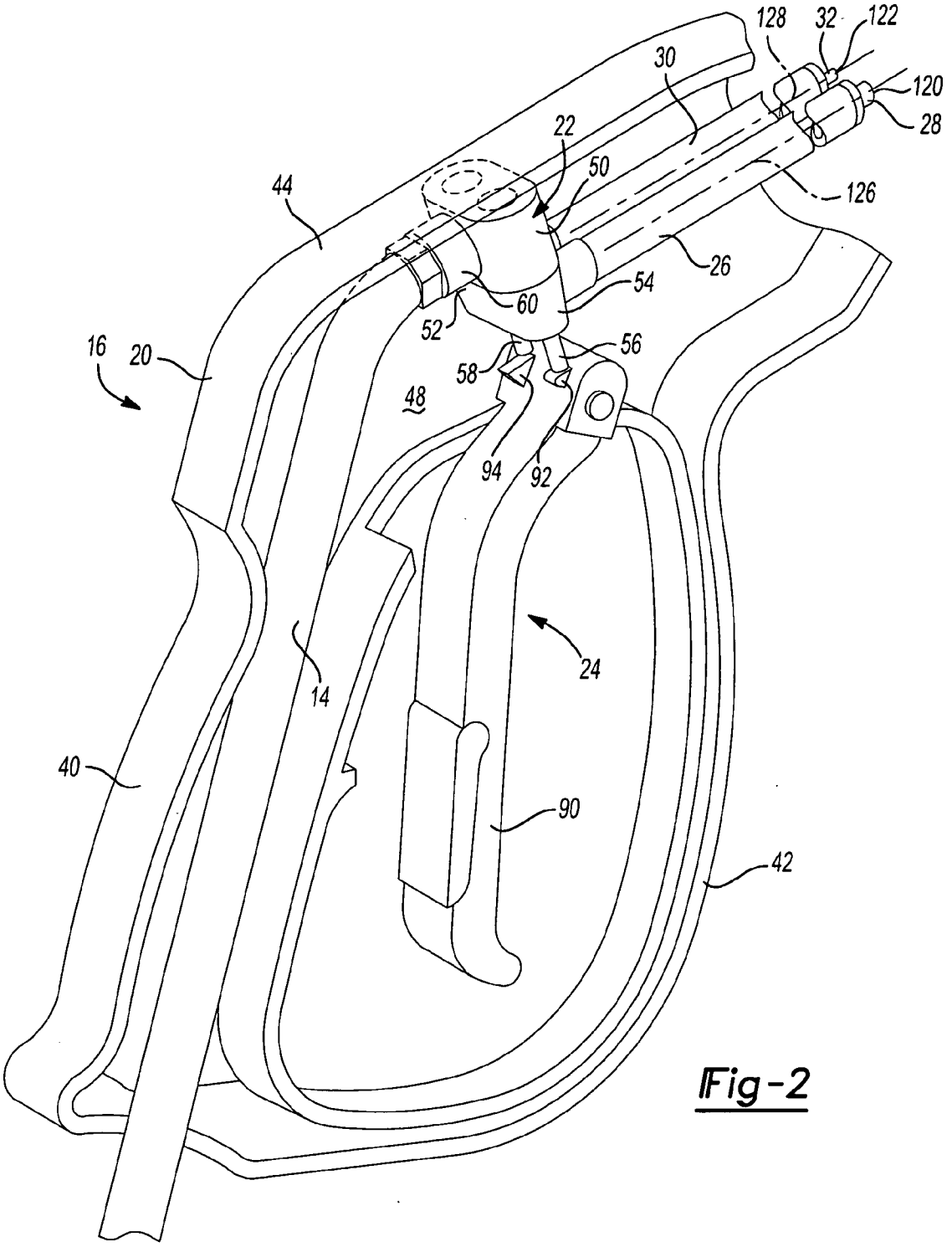


Fig-1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32
122
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120
28
22
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126
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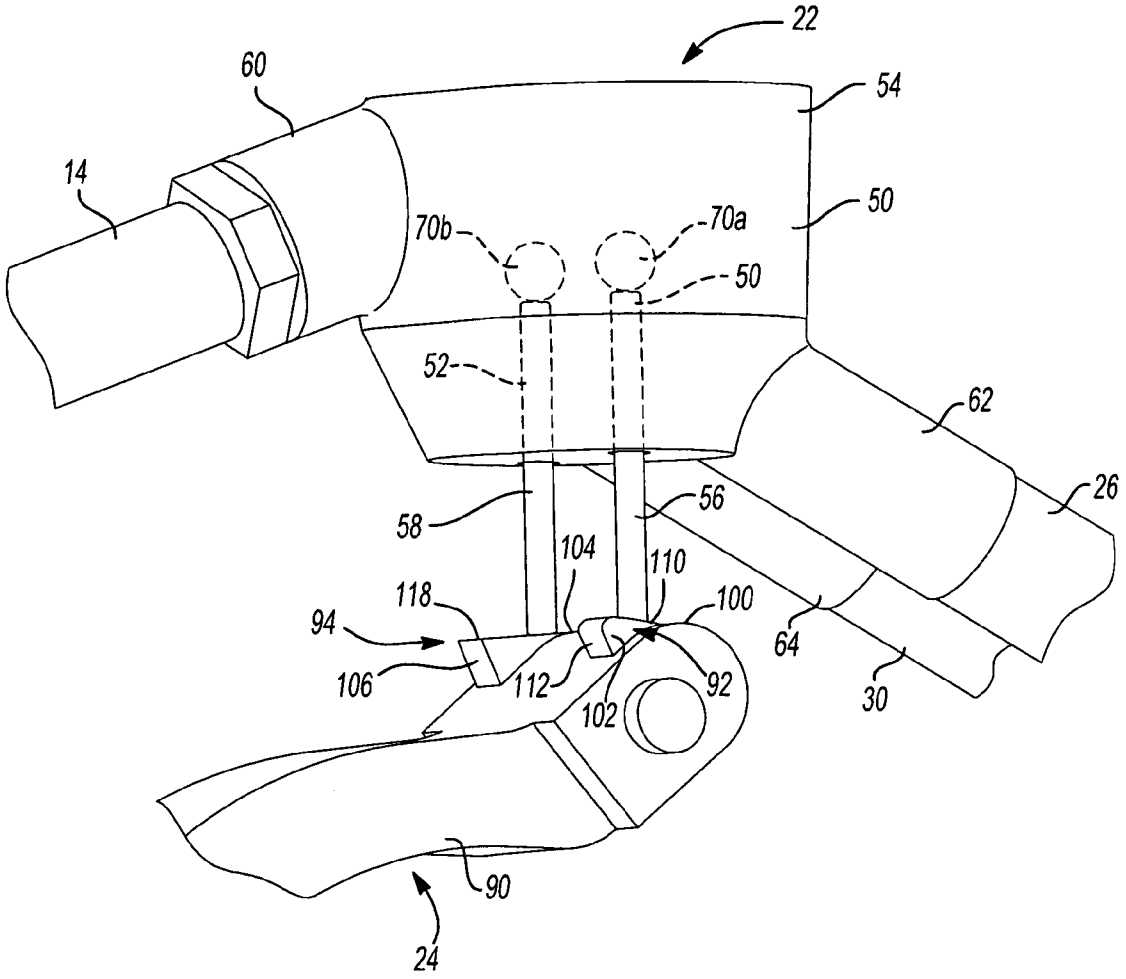
56
58
48
94
92
24
14
40
90
42

Fig-2


22
60
54
14
70b
70a
50
50
52
62
26
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56
104
110
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100
94
64
106
112
92
102
30
90
24

Fig-3

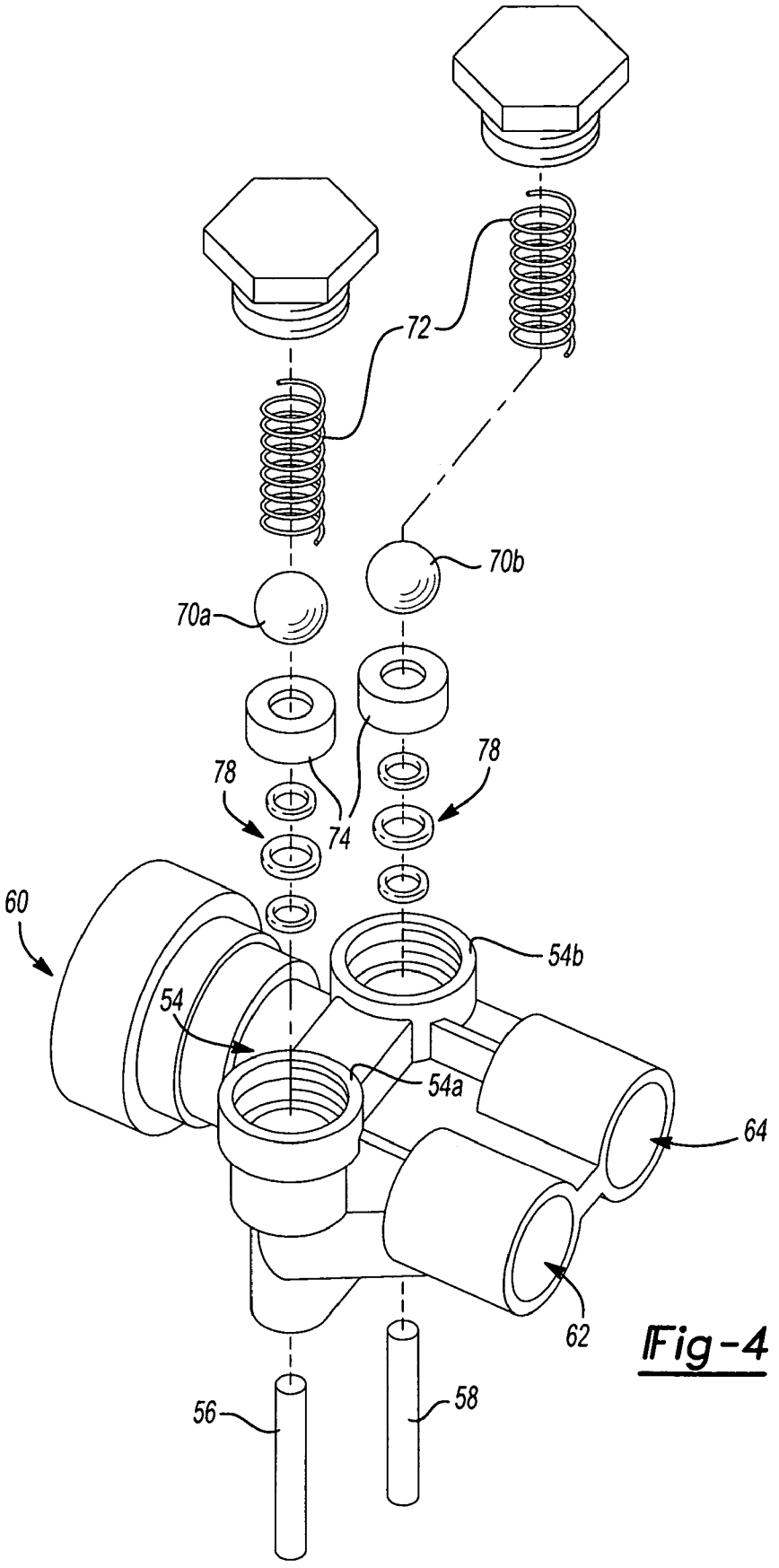

Fig-4

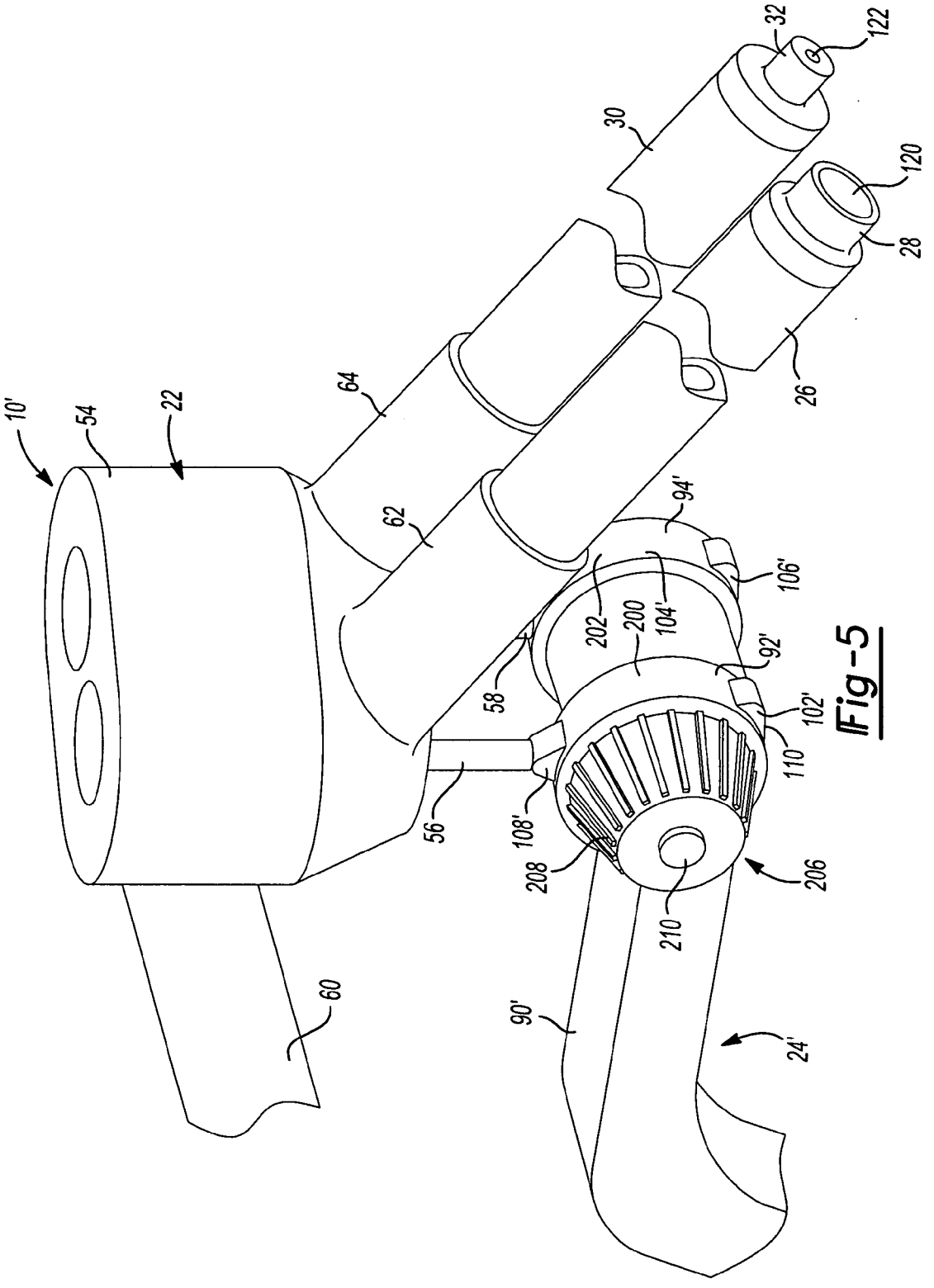
10'
54
22
64
62
58
56
60
30
32
122
120
28
26
94'
106'
202
200
104'
92'
102'
110
108'
208
210
206
90'
24'

Fig-5

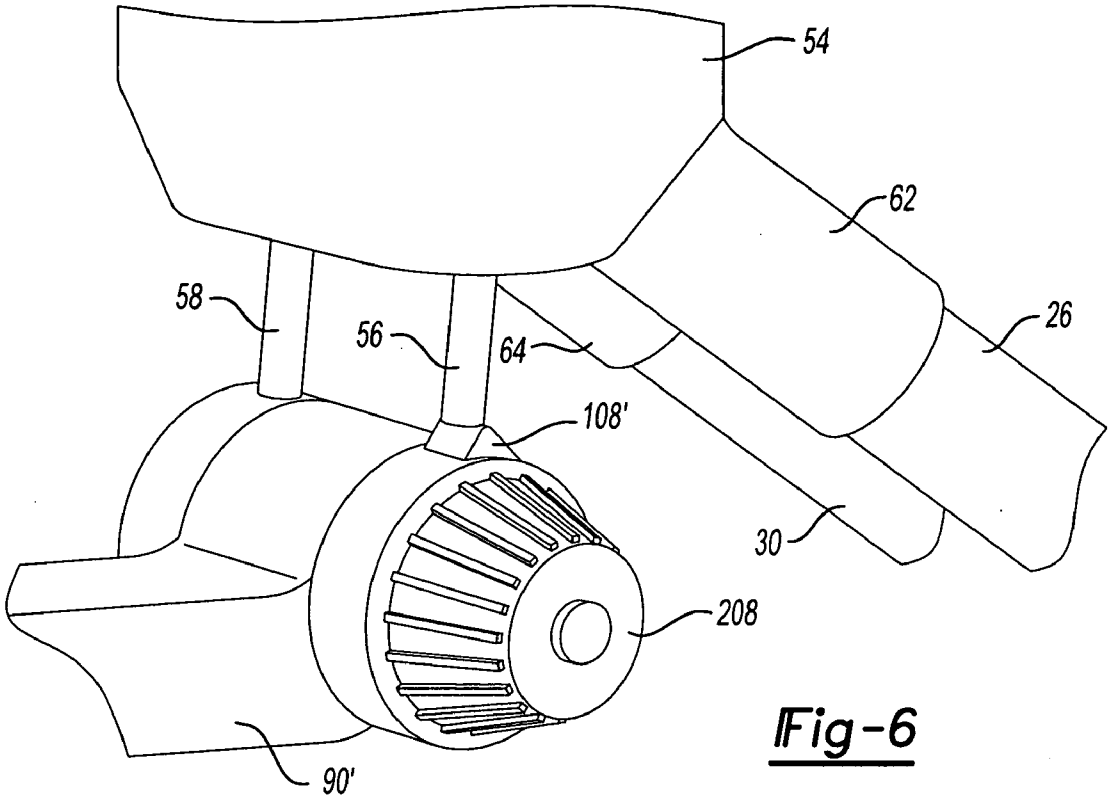
54
62
58
56
64
26
108'
30
208
90'

Fig-6

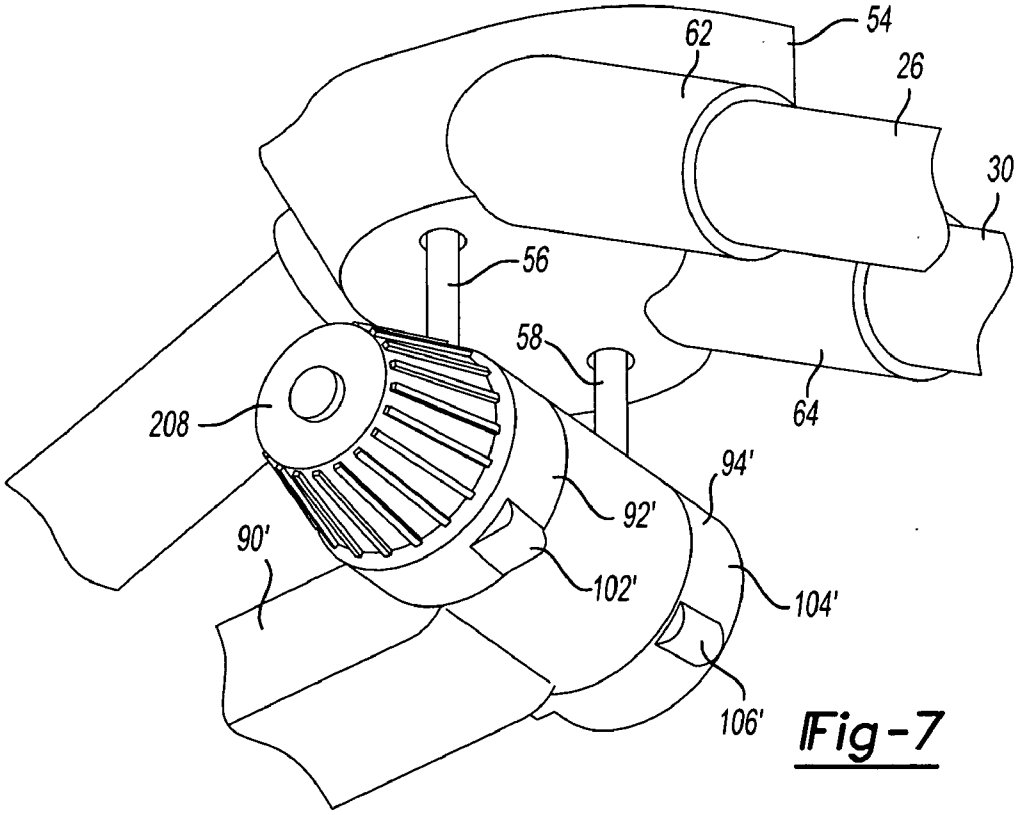
62
54
26
30
56
58
208
64
94'
92'
90'
102'
104'
106'

Fig-7

PRESSURE WASHER WITH SOFT START WASHER WAND

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/715,068 entitled "Soft Start Pressure Washer Gun" filed Sep. 8, 2005, the disclosure of which is hereby incorporated by reference as if fully set forth in detail herein.

INTRODUCTION

[0002] The present disclosure generally relates to pressure washers and more particularly to a pressure washer having a pressure washer wand with a soft start operational mode.

[0003] Pressure washer wands or guns typically employ a single normally closed valve to control the dispensing of fluid from the wand. In such arrangements, the wand can be operated in two conditions: a no-flow condition, wherein the valve is closed, and a high pressure flow condition, wherein the valve is opened. The transition between the two conditions can be very sudden and can result in recoil that can be uncomfortable to the user. Accordingly, it would be desirable to provide a pressure washer having a wand with a soft start mode that permits the wand to transition from a no-flow condition to a flow of relatively low pressure fluid and thereafter to a flow of relatively high pressure fluid to provide the user with a "soft" start as the user moves the trigger to a position that is associated with maximum high-pressure flow.

SUMMARY

[0004] In one form, the present teachings provide a pressure washer wand having a housing, a valve, a first outlet, a second outlet and a trigger. The housing has a pistol-grip handle and a trigger guard. The valve assembly is housed in the housing and includes a first valve and a second valve. Each of the first and second valves includes a valve member that is movable between a closed position and an open position. Each valve member is biased toward the closed position. The first outlet is in fluid communication with the first valve and the second outlet is in fluid communication with the second valve. The trigger is coupled to the housing between the pistol grip handle and the trigger guard. The trigger is movable between a first position and a second position and has a first cam and a second cam. The first and second cams are configured to move the valve members of the first and second valves, respectfully, so that movement of the trigger from the first position to the second position opens a first fluid communication pathway from the first valve to the first outlet when the trigger is positioned in a first intermediate position between the first and second positions, and opens a second fluid communication pathway from the second valve to the second outlet when the trigger is positioned in a second intermediate position between the first intermediate position and the second position.

[0005] Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

[0007] FIG. **1** is a side elevation view of a pressure washer system having a wand constructed in accordance with the teachings of the present disclosure;

[0008] FIG. **2** is a partially broken-away perspective view of the wand of FIG. **1**;

[0009] FIG. **3** is a perspective view of a portion of the wand of FIG. **1** illustrating the valve assembly and trigger lever in greater detail;

[0010] FIG. **4** is an exploded perspective view of a portion of the wand;

[0011] FIG. **5** is a perspective view of a portion of another wand constructed in accordance with the teachings of the present disclosure;

[0012] FIGS. **6** and **7** are perspective views of a portion of the wand of FIG. **5** illustrating the trigger lever and the valve assembly in more detail.

DETAILED DESCRIPTION OF THE VARIOUS EMBODIMENTS

[0013] With reference to FIG. **1** of the drawings, a pressure washer system constructed in accordance with the teachings of the present invention is generally indicated by reference numeral **10**. The pressure washer system **10** can include a pump **12**, a high pressure hose **14** and a wand **16**. The pump **12** and the high pressure hose **14** can be constructed in any appropriate manner. For example, the pump **12** can include an electric motor and an axial piston pump having a wobble plate that is driven by the electric motor. Moreover, the pump **12** can be constructed in the manner described in U.S. Pat. No. 6,892,957 entitled "Pressure Washer With Improved Mobility", the disclosure of which is hereby incorporated by reference as if fully set forth in detail herein. The hose **14** can be coupled to an outlet **12***a* of the pump **12**.

[0014] With reference to FIGS. **2** and **3**, the wand **14** can include a housing **20**, a valve assembly **22**, a trigger lever **24**, a first conduit **26**, a first nozzle **28**, a second conduit **30** and a second nozzle **32**. The housing **20** can include a pistol-grip handle **40** and a trigger guard **42**. The housing **20** can employ a clam-shell construction having a pair of clamshells **44** that cooperate to form an interior cavity **48** that can house the valve assembly **22**.

[0015] The valve assembly **22** can include a first valve **50**, which can be coupled in fluid communication to the first conduit **26**, and a second valve **52** that can be coupled in fluid communication with the second conduit **30**. In the particular example provided the first and second valves **50** and **52** share a common valve body **54** into which first and second valve elements **56** and **58**, respectively, are housed.

[0016] With additional reference to FIG. **4**, the valve body **54** can include an inlet **60**, which can be coupled in fluid connection to the hose **14**, a first valve outlet **62**, which can be coupled in fluid connection to the first conduit **26**, and a second valve outlet **64**, which can be coupled in fluid connection to the second conduit **30**. A first valve body

portion **54***a* of the valve body **54** can be configured to house the first valve element **56** and a second valve body portion **54***b* can be configured to house the second valve element **58**.

[**0017**] In the particular example provided, the first and second valves **50** and **52** are identical in their construction and as such, a discussion of the first valve **50** will suffice for both. A first valve member **70***a* can be biased by a spring **72** against a seat member **74** to sealingly close a passageway (not shown) in the first valve body portion **54***a* between the inlet **60** and the first valve outlet **62**. The first valve element **56** can be received in the first valve body portion **54***a* and can be located in-line with the first valve member **70***a*. Although the first valve member **70***a* and the first valve element **56** are illustrated as being discrete components, those of ordinary skill in the art will appreciate that the first valve member **70***a* and the first valve element **56** could be integrally formed. A seal arrangement **78** can be employed to seal the first valve body portion **54***a* to the first valve element **56** in a manner that permits the first valve element **56** to move relative to the first valve body portion **54***a*. The spring **72** can bias the first valve member **70***a* against the seat member **74** to sealingly close the passageway between the inlet **60** and the first valve outlet **62**. Movement of the first valve element **56** into the valve body **54** by a distance that is sufficient to un-seat the first valve member **70***a* from the seat member **74** opens the passageway between the inlet **60** and the first valve outlet **62** to permit fluid to flow through the first valve **50**.

[**0018**] It will be appreciated from this disclosure that the first valve member **70***a* is biased into a normally closed position to inhibit fluid flow through the first valve body portion **54***a* but can be moved to an opened position to permit fluid to flow from the first valve body portion **54***a* through the first conduit **26** and to the first nozzle **28**. Similarly, it will be appreciated from this disclosure that the second valve member **70***b* is biased into a normally closed position to inhibit fluid flow through a second valve body portion **54***b* but can be moved to an opened position to permit fluid to flow from the second valve body **54** through the second conduit **30** and to the second nozzle **32**.

[**0019**] The trigger lever **24** can include a trigger **90**, a first cam **92** and a second cam **94**. The trigger **90** can be pivotally coupled to the housing **20** and can be moved between a first position and a second position. Although the trigger **90** is directly pivotally coupled to the housing **20** in the example provided, it will be appreciated that as used herein, "coupled to the housing" should be broadly interpreted to mean that the trigger **90** can be pivotally coupled to any structure that is connected to the housing **20**, including the first valve **50** and/or the second valve **52**.

[**0020**] The first cam **92** can be fixedly coupled to a first side of the trigger lever **24** and the second cam **94** can be fixedly coupled to a second side of the trigger lever **24**. In the particular example provided, the first and second cams **92** and **94** are integrally formed with the trigger lever **24**. The first and second cams **92** and **94** can be sized, shaped and positioned to provide the wand **14** with a soft start function as will be described in further detail, below. In the particular example provided, the first cam **92** includes a first base portion **100** and a first cam lobe **102**, while the second cam **94** includes a second base portion **104** and a second cam lobe **106**. The first and second base portions **100** and **104** can be sized such that the first and second valve elements **56** and **58**, respectively, which ride on the first and second cams **92** and **94**, respectively, are not moved into the valve body **54** to move the first and second valve members **70***a* and **70***b* from the closed position. Stated another way, the first and second base portions **100** and **104** are sized to permit the first and second valve members **70***a* and **70***b*, respectively, to be maintained in (i.e., biased into) the closed position. The first cam lobe **102** can include a first ramp member **110** and a second ramp member **112**. The first ramp member **110** can taper radially outwardly from the first base portion **100** between the first base portion **100** and the second ramp member **112**. The second ramp member **112** can taper radially inwardly toward the first base portion **100** between the first ramp member **110** and the first base portion **100**. The second cam lobe **106** can include a third ramp member **118** that extends radially outwardly of the second base portion **104**.

[**0021**] The first and second cam lobes **102** and **106** can be timed in any desired manner to control the opening and closing of the first and second valve members **70***a* and **70***b*, respectively. In the particular example provided, the first cam lobe **102** is positioned such that the first valve element **56** is transitioning from the first ramp member **110** to the second ramp member **112** when the second valve element **58** is being translated into the valve body **54** by the third ramp member **118** to open the second valve member **70***b*.

[**0022**] A first end of the first conduit **26** can be coupled in fluid connection to the first valve outlet **62** of the first valve **50**, while a second, distal end of the first conduit **26** can be coupled in fluid connection to the first nozzle **28**. The first nozzle **28** can have a first outlet **120** through which fluid may be dispensed. The first outlet **120** can have a diameter that can be equal to an inner diameter of the first conduit **26** (i.e., the first nozzle **28** can be the distal end of the first conduit **26**). In the particular example provided, however, the first nozzle **28** is a discrete nozzle that is fixedly coupled to the distal end of the first conduit **26**.

[**0023**] Similarly, a first end of the second conduit **30** can be coupled in fluid connection to the second valve outlet **64** of the second valve **52**, while a second, distal end of the second conduit **30** can be coupled in fluid connection to the second nozzle **32**. The second nozzle **32** can have a second outlet **122** that can have a diameter that can be smaller in diameter than the inner diameter of the second conduit **30**. The second outlet **122** can be relatively smaller than the first outlet **120**. The first and second conduits **26** and **30** can be discrete structures that can be disposed along parallel axes **126** and **128**, respectively.

[**0024**] With additional reference to FIG. **1**, the pump **12** can be operated to supply high pressure fluid (e.g., water) through the hose **14** to the wand **16**. More specifically, high pressure fluid transmitted through the hose **14** is communicated to the first and second valves **50** and **52**. When the trigger lever **24** is positioned in the first position, the first and second valve elements **56** and **58** can be positioned on the first and second base portions **100** and **104**, respectively, of the first and second cams **92** and **94**. Accordingly, the first and second valve members **70***a* and **70***b* are maintained in the closed position and fluid is not transmitted through the first valve **50** or the second valve **52**.

[**0025**] When the trigger lever **24** is positioned to a first intermediate position between the first and second positions,

the first valve element **56** can be positioned on the first ramp member **110** and the second valve element **58** can be positioned on the second base portion **104**. Accordingly, the first valve member **70***a* is maintained in an open position so that fluid is permitted to flow through the first valve **50** through the first conduit **26** and out of the first nozzle **28**, but the second valve member **70***b* is maintained in the closed position and fluid is not permitted to flow through the second valve **52**. As the flow paths through the first conduit **26** and the first nozzle **28** are relatively large in cross-sectional area, fluid can be dispensed from the first nozzle **28** with relatively little backpressure. It will be appreciated in the particular example provided that the first valve member **70***a* can be opened to a maximum amount by further rotation of the trigger lever **24** to a point at which the first valve element **56** is located on the transition point between the first and second ramp members **110** and **112**.

[**0026**] When the trigger lever **24** is positioned to a second intermediate position between the first intermediate position and the second position, the first valve element **56** can be positioned on the second ramp member **112** and the second valve element **58** can be positioned on the third ramp member **118**. Accordingly, the first and second valve members **70***a* and **70***b* can be maintained in the open position so that fluid is permitted to flow through the first valve **50**, the first conduit **26** and out of the first nozzle **28**, as well as through the second valve **52**, the second conduit **30** and out the second nozzle **32**. As fluid is dispensed out of both the first and second nozzles **28** and **32**, relatively little backpressure is developed and consequently, the user experiences relatively little recoil when the second valve **52** is opened.

[**0027**] When the trigger lever is positioned to the second position, the first valve element **56** can be positioned on the first base portion **100** and the second valve element **58** can be positioned on the third ramp member **118** so as to open the second valve element **58** by a maximum amount. Accordingly, the first valve member **70***a* is maintained in the closed position so that fluid is not permitted to flow through the first valve **50**, and the second valve member **70***b* is maintained in the open position so that fluid flows out of the second valve **52** through the second conduit **30** and out the second nozzle **32**. It will be appreciated that due to the shape of the second ramp member **112**, the first valve **50** is closed as the trigger lever **24** is pivoted from the second intermediate position to the second position. It will also be appreciated that the closing of the first valve **50** can be as gradual or sudden as desired and that the timing of the closing of the first valve **50** and/or opening of the second valve **52** is dictated by the degree to which the second and third ramp members **112** and **118**, respectively, are sloped.

[**0028**] While the pressure washer system **10** has been described as including a wand **16** having a trigger **90** with first and second cams **92** and **94** that are fixedly coupled to a trigger lever **24**, those skilled in the art will appreciate that the disclosure, in its broader aspects, need not be so limited. For example, the first and second cams **92'** and **94'** can be adjustably coupled to the trigger lever **24'** as shown in FIGS. **5** through **7**. In the example illustrated, the first cam **92'** is formed on a first drum **200** that can be disposed on a first side of the trigger **90'** and the second cam **94'** is formed on a second drum **202** that can be disposed on a second side of the trigger **90'**. In the particular example provided, the first and second drums **200** and **202** are rotatably coupled to one another and a locking mechanism **206** is employed to selectively lock the first and second drums **200** and **202** to the trigger **90'**. The locking mechanism **206** could include, for example, a threaded nut **208** that is threadably engaged to a pivot pin **210** that extends through the first and second drums **200** and **202** and the trigger **90'**; the pivot pin **210** can be employed to rotatably mount the trigger **90'** to the valve body **54** or the housing **20** (FIG. **2**). Tightening of the threaded nut **208** can apply a clamping force to the first drum **200** to cause an end of the first drum **200** to engage a side of the trigger **90'** to thereby inhibit relative rotation between the first drum **200** and the trigger **90'**. As the first drum **200** and the second drum **202** are rotatably coupled to one another, rotation of the second drum **202** relative to the trigger **90'** is inhibited when the first drum **200** is engaged to the trigger **90'**.

[**0029**] The first and second drums **200** and **202** can be positioned in a first setting that associates the first and second cam lobes **102'** and **106'**, respectively, to the trigger **90'** in a manner that is similar to the manner in which the first and second cams **92** and **94** (FIG. **2**) are associated to the trigger **90** (FIG. **2**) to provide a soft start mode of operation.

[**0030**] The first and second drums **200** and **202** can also be positioned in a second setting wherein the first valve element **56** is disposed on a third cam lobe **108'** and the second valve element **58** is disposed on the second base portion **104'** when the trigger **90'** is in the second position. The third cam lobe **108'** can include one or more tapered ramp members and in the particular example provided, has a geometry and shape that is generally identical to the second cam lobe **106'**. Accordingly, it will be appreciated that fluid may be selectively dispensed through only the first valve **50'** (and out the first nozzle **28**) when the first and second drums **200** and **202** are positioned in the second setting.

[**0031**] Alternatively, the third cam lobe **108'** may be omitted in which case the second setting can comprise the positioning of the first and second drums **200** and **202** such that the first valve element **56** is disposed on the first ramp member **110** and the second valve element **58** is disposed on the second base portion **104'** when the trigger **90'** is in the second position.

[**0032**] It will be appreciated that the wand **10'** could be coupled to the pump **12** (FIG. **1**) and that the pump **12** (FIG. **1**) could include an auxiliary tank **12***b* (FIG. **1**) for dispensing an additive from the auxiliary tank **12***b* (FIG. **1**) to the flow of fluid that is discharged through the outlet **12***a* (FIG. **1**). Those of ordinary skill in the art will appreciate that such dispensing systems typically operate when a difference between the pressure of the fluid flowing out the outlet **12***a* (FIG. **1**) and the pressure within the auxiliary tank **12***b* (FIG. **1**), which is typically atmospheric pressure, is not greater than a predetermined differential and that such condition can be achieved when fluid is dispensed through a wand having a relatively large nozzle that outputs fluid at a relatively low pressure. In contrast to the known systems, which require that the user remove the high pressure nozzle from the wand and attach a low pressure nozzle to thereby activate the dispensing of an additive from an auxiliary tank, a user need only place the first and second drums **200** and **202** in the second setting to activate the dispensing of an additive from the auxiliary tank **12***b* (FIG. **1**). Accordingly, it will be

appreciated that the user may control the dispensing of an additive, such as a soap, from the auxiliary tank **12***b* (FIG. **1**) through a control means that is located on the wand **10'**. Consequently, a user may activate the dispensing of an additive from the auxiliary tank **12***b* (FIG. **1**) and thereafter de-activate the dispensing of the additive from the auxiliary tank **12***b* (FIG. **1**) without attaching or detaching nozzles but rather merely by rotating the first and second drums **200** and **202** into and out of the second setting, respectively.

[**0033**] It will also be appreciated that the second drum **202** could include a fourth cam lobe (not shown) on the second cam **94'** that permits only the second valve element **58** to be moved when the trigger **90'** is moved from the first position to the second position. In this regard, those of ordinary skill in the art will understand from this disclosure that the first and second cams **92'** and **94'** could be configured with multiple cam lobes that permit the first and second valves **52** and **54** to be selectively opened and/or selectively closed in a plurality of predetermined arrangements. The construction of the first and second cams **92'** and **94'** can be shaped and/or sized to open the first and second valves **52** and **54**, respectively, by a desired amount, as well as circumferentially spaced relative to one another to time the opening and/or closing of the first and second valves **52** and **54**, respectively, in a desired manner. It will be further appreciated that a third cam (not shown) may be coupled to the first cam **92'** to control the activation of another valve (not shown) that could be used to control the direct injection or siphoning of an additive, such as soap or wax, into the flow of fluid under certain conditions. For example, the third cam could include a cam lobe (not shown) that was configured to open when the first and second drums **200** and **202** are positioned in the second setting.

[**0034**] While specific examples have been described in the specification and illustrated in the drawings, it will be understood by those of ordinary skill in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the present disclosure as defined in the claims. Furthermore, the mixing and matching of features, elements and/or functions between various examples is expressly contemplated herein so that one of ordinary skill in the art would appreciate from this disclosure that features, elements and/or functions of one example may be incorporated into another example as appropriate, unless described otherwise, above. Moreover, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without departing from the essential scope thereof. Therefore, it is intended that the present disclosure not be limited to the particular examples illustrated by the drawings and described in the specification as the best mode presently contemplated for carrying out the teachings of the present disclosure, but that the scope of the present disclosure will include any embodiments falling within the foregoing description and the appended claims.

What is claimed is:

1. A pressure washer wand comprising:

a housing having a pistol-grip handle and a trigger guard;

a valve assembly housed in the housing, the valve assembly including a first valve and a second valve, each of the first and second valves including a valve member that is movable between a closed position and an open position, each valve member being biased toward the closed position;

a first outlet in fluid communication with the first valve;

a second outlet in fluid communication with the second valve; and

a trigger coupled to the housing between the pistol grip handle and the trigger guard and movable between a first position and a second position, the trigger having a first cam and a second cam, the first and second cams being configured to move the valve members of the first and second valves, respectfully, so that movement of the trigger from the first position to the second position opens a first fluid communication pathway from the first valve to the first outlet when the trigger is positioned in a first intermediate position between the first and second positions, and opens a second fluid communication pathway from the second valve to the second outlet when the trigger is positioned in a second intermediate position between the first intermediate position and the second position.

2. The pressure washer wand of claim 1, wherein the trigger is positionable into a third intermediate position between the first and second intermediate positions in which both the first and second fluid communication pathways are opened.

3. The pressure washer wand of claim 1, wherein the first cam is fixedly coupled to the trigger.

4. The pressure washer wand of claim 3, wherein the second cam is fixedly coupled to the trigger.

5. The pressure washer wand of claim 1, wherein at least one of the first and second cams is adjustably coupled to the trigger.

6. The pressure washer wand of claim 5, wherein the first cam is formed on a first drum that is rotatably coupled to a first side of the trigger.

7. The pressure washer wand of claim 6, wherein the second cam is formed on a second drum that is rotatably coupled to a second side of the trigger opposite the first side.

8. The pressure washer wand of claim 7, wherein the first and second drums are movable into an auxiliary position in which only the first valve is opened when the trigger is moved from the first position to the second position.

9. The pressure washer wand of claim 1, wherein the first and second valves are housed in a common valve body.

10. The pressure washer wand of claim 9, wherein a first conduit couples the first outlet to the first valve and a second conduit couples the second outlet to the second valve.

11. The pressure washer wand of claim 10, wherein the first and second conduits are discrete structures that are disposed along parallel axes.

13. A pressure washer system comprising:

a pump having an outlet;

a hose having a first end, which is coupled in fluid communication to the outlet, and a second end; and

a pressure washer wand having a housing, a valve, a first outlet, a second outlet and a trigger, the housing having a pistol-grip handle and a trigger guard, the valve assembly being housed in the housing and including a first valve and a second valve, each of the first and second valves including a valve member that is mov-

able between a closed position and an open position, each valve member being biased toward the closed position, the first outlet being in fluid communication with the first valve, the second outlet being in fluid communication with the second valve, the trigger being coupled to the housing between the pistol grip handle and the trigger guard, the trigger being movable between a first position and a second position and having a first cam and a second cam, the first and second cams being configured to move the valve members of the first and second valves, respectfully, so that movement of the trigger from the first position to the second position opens a first fluid communication pathway from the first valve to the first outlet when the trigger is positioned in a first intermediate position between the first and second positions, and opens a second fluid communication pathway from the second valve to the second outlet when the trigger is positioned in a second intermediate position between the first intermediate position and the second position.

14. The pressure washer system of claim 13, wherein the trigger is positionable into a third intermediate position between the first and second intermediate positions in which both the first and second fluid communication pathways are opened.

15. The pressure washer system of claim 13, wherein the first cam is fixedly coupled to the trigger.

16. The pressure washer system of claim 15, wherein the second cam is fixedly coupled to the trigger.

17. The pressure washer system of claim 13, wherein at least one of the first and second cams is adjustably coupled to the trigger.

18. The pressure washer system of claim 17, wherein the first cam is formed on a first drum that is rotatably coupled to a first side of the trigger.

19. The pressure washer system of claim 18, wherein the second cam is formed on a second drum that is rotatably coupled to a second side of the trigger opposite the first side.

20. The pressure washer system of claim 19, wherein the first and second drums are movable into an auxiliary position in which only the first valve is opened when the trigger is moved from the first position to the second position.

21. The pressure washer system of claim 13, wherein the first and second valves are housed in a common valve body.

22. The pressure washer system of claim 21, wherein a first conduit couples the first outlet to the first valve and a second conduit couples the second outlet to the second valve.

23. The pressure washer system of claim 22, wherein the first and second conduits are discrete structures that are disposed along parallel axes.

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