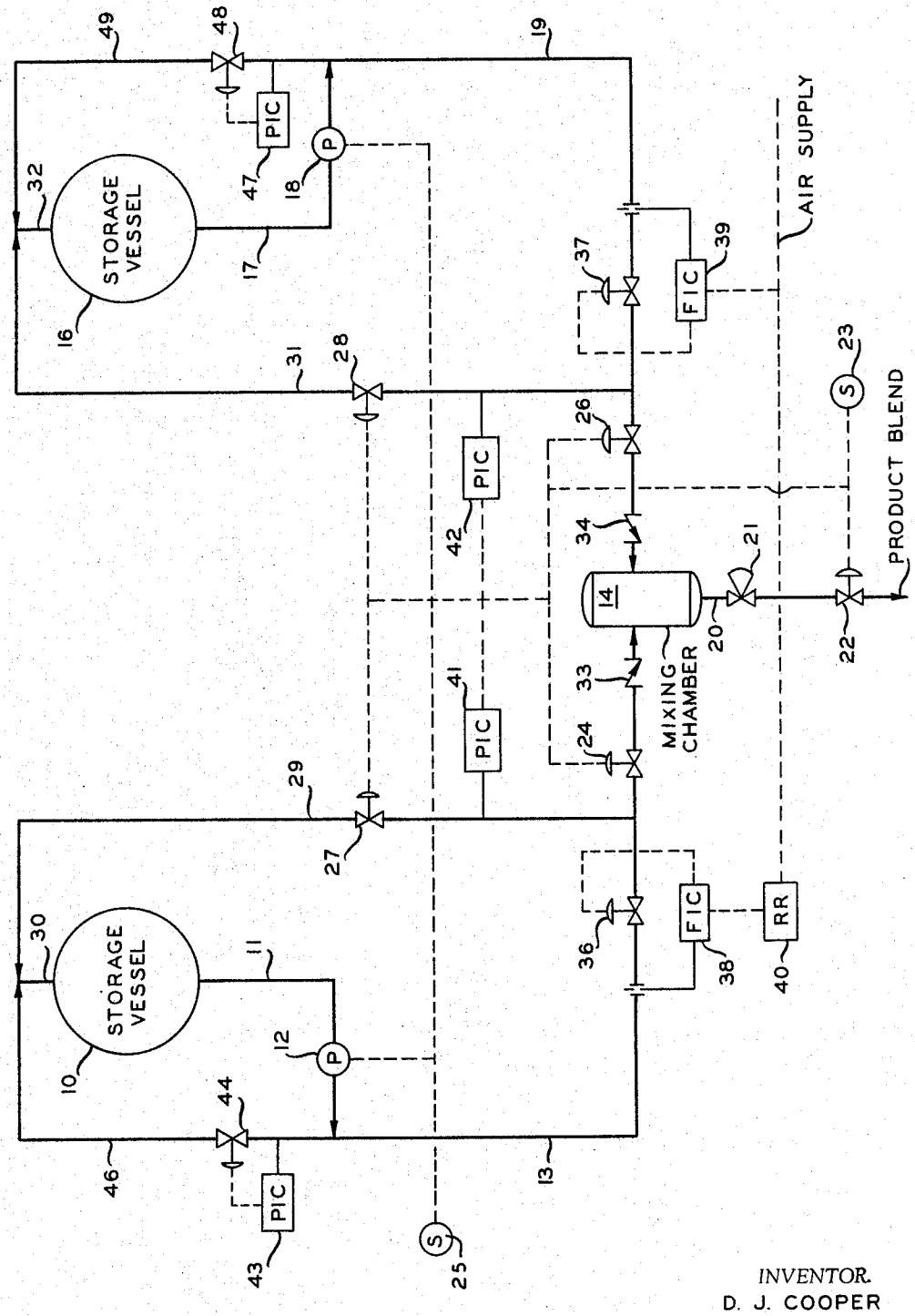
Jan. 17, 1967 D. J. COOPER 3,298,383

FLUID BLENDING SYSTEM

Filed March 23, 1964



INVENTOR.
D. J. COOPER
BY Young & Lugg
ATTORNEYS

United States Patent Office 3,298,383 Patented Jan. 17, 1967

3,298,383

FLUID BLENDING SYSTEM

Delbert J. Cooper, Bartlesville, Okla., assignor to Phillips Petroleum Company, a corporation of Delaware

Filed Mar. 23, 1964, Ser. No. 353,770
8 Claims. (Cl. 137—3)

This invention relates to a fluid blending system. In another aspect, this invention relates to a process for blending fluid streams wherein the flow of fluids to the blending zone and flow of the blended mixture from the blending zone is subject to interruptions. In yet another aspect, this invention relates to the blending of aerosol propellants.

Commercial aerosol propellants are comprised of a blend of liquefied normally gaseous components, such as propane and Freon (fluorinated hydrocarbon). These aerosol propellants must be accurately blended to produce an aerosol propellant mixture that will satisfy the requirements of the product aerosol formulation. As only a relatively small volume of the aerosol propellant is to be utilized in each aerosol package, not only must the correct ratio of blending constituents be introduced into the blending zone, but the aerosol propellant mixture must be substantially uniform throughout. It is often desirable that the aerosol propellant mixture be blended immediately prior to its use in the aerosol package, thereby substantially increasing the difficulty of obtaining an aerosol propellant mixture of constant composition.

Accordingly, an object of my invention is to provide an improved fluid blending system.

Another object of my invention is to provide a fluid blending process and apparatus therefor, wherein two or more fluids are stream blended to provide a blended mixture of substantially constant composition.

Other objects, advantages and features of my invention will be readily apparent to those skilled in the art from the following description, the drawing and appended claims.

By my invention, I have provided a blending process and apparatus therefor wherein each of the fluids to be blended is passed continuously through a control valve means to (1) a blending zone, or (2) is recycled to the storage zone. In addition thereto, by my invention I have provided a fluid blending system wherein loss of flow of one of the fluids to be blended is automatically detected and the flow of each of the fluids to be blended in the blending zone is automatically halted, and each of the fluids to be blended is recirculated to its respective fluid storage zone.

Although not to be limited thereto, the invention will hereinafter be described as applied to the blending of a liquefied normally gaseous hydrocarbon, propane, and Freon-11 (trichlorofluoromethane). It will become readily apparent to those skilled in the art from the following description that the invention is also applicable to the blending of gases and liquids broadly. The invention is of particular value in those areas wherein it is desired to provide blends of substantially constant and uniform composition.

The drawing is a schematic representation of one embodiment of the invention.

Referring to the drawing, therein is illustrated a storage vessel 10 containing a liquefied petroleum gas such as propane. Liquid propane is withdrawn from storage vessel 10 via conduit means 11 and pumped via pumping means 12 through conduit 13 to a mixing chamber 14. Freon-11 stored within storage vessel 16 is withdrawn from vessel 16 via conduit means 17 and pumped via pumping means 18 through conduit 19 to mixing chamber 14. Within mixing chamber 14 the liquefied petroleum gas and Freon

are blended. Mixing chamber 14 can contain baffles or other means for thoroughly mixing the fluid streams passed to said mixing chamber 14.

The blended mixture of liquefied petroleum gas and Freon is withdrawn from mixing chamber 14 via conduit means 20 and passed through a pressure regulator 21 to a means, not herein illustrated, for introducing the resultant aerosol propellant mixture into the aerosol package.

The flow of the blended mixture through conduit 20 is controlled by a solenoid valve means 22 which is actuated by a switch 23. With switch 23 positioned in the "off" position, a signal is transmitted to valve means 22 closing valve means 22. This "off" signal is also transmitted as illustrated to solenoid valves 24 and 26, closing valves 24 and 26. With switch 23 in the closed or "off" position, a signal is transmitted as illustrated to solenoid valve means 27 and 28, opening valves 27 and 28. Therefore, with switch 23 in the off position, liquefied petroleum gas withdrawn from storage vessel 10 via conduit means 11 and pumped via pumping means 12 through conduit means 13 is recirculated to storage vessel 10 via conduit means 29 and conduit means 30. In a like manner, Freon–11 withdrawn from storage vessel 16 via conduit means 17 and pumped via pumping means 18 through conduit means 19 is recirculated via conduit means 31 and conduit means 32 to storage vessel 16. Thus, an interruption of the flow of the blended mixture from mixing chamber 14 automatically results in recirculation of the liquids to be blended to the storage vessels.

Conversely, with switch 23 positioned in the "on" position, valves 22, 24 and 26 are opened and valves 27 and 28 are closed, resulting in the flow of liquefied petroleum gas and Freon to mixing chamber 14. Check valves 33 and 34 are positioned adjacent mixing chamber 14 so as to prevent the flow of fluid from mixing chamber 14 into conduits 13 and 19, respectively.

As herein illustrated, valves 22, 24, 26, 27 and 28 are quick acting solenoid valves actuated by an electrical signal passed from switch means 23. It is also within the scope of this invention to employ other quick acting valve means actuated by electric or pneumatic signals.

The composition of the blend produced in mixing chamber 14 is controlled by controller valves 36 and 37. Controller valves 36 and 37 are operated by conventional flow indicator controllers 38 and 39, respectively. Controller valves 36 and 37 and flow controllers 38 and 39 can be pneumatic or electric acting. As illustrated, the ratio of liquefied petroleum gas and Freon passed to mixing chamber 14 is maintained substantially constant by passing air from an air supply source as a set point signal to flow indicator controller 39 and to a conventional pneumatic ratio relay 40. Responsive to the air input signal, ratio relay 40 transmits a signal as a set point signal to flow indicator controller 38 so as to maintain the desired ratio of liquefied petroleum gas to Freon within mixing chamber 14.

In operation, controller valves 36 and 37 are maintained in a substantially fixed position so as to maintain a substantially constant set flow through each of the said valves.

Flow controller valves 36 and 37 would not be satisfactory operating in the place of solenoid valves 24 and 26, respectively. For example, after interruption of flow of the blended mixture from mixing chamber 14 and the flow of the blending constituents to mixing chamber 14, it is required that upon resumption of flow of blending constituents to mixing chamber 14 that "set flow" be established immediately so as to provide the desired blend in mixing chamber 14 and conduit 20. This would not be possible were the flow of liquefied petroleum gas and Freon to mixing chamber 14 interrupted by valve means 36 and 37, respectively, as valves 36 and 37 are not quick

acting valves. An interval of time would be required before the flow of liquefied petroleum gas through valve 36 and Freon through valve 37 would conform to the predetermined "set flow."

In the event of the loss of flow represented by a loss of pressure of either of the fluid blending constituents in conduit 13 and conduit 19 as determined by pressure indicator controllers 41 and 42, respectively, either or both of pressure indicator controllers 41 and 42 transmit a signal to solenoid valves 22, 24, 26, 27 and 28, closing valves 22, 24 and 26 and opening valves 27 and 28. Pressure indicator-controller 43 positioned in the discharge of pumping means 12 is employed to maintain a constant pressure upstream of valve means 36. Pressure indicator controller 43 will manipulate valve 44 so as to recycle the excess liquefied petroleum gas to storage vessel 10 via conduit means 46 and 30, thereby maintaining a constant pressure in conduit 13 upstream of the orifice for flow indicator-controller 38. In a like manner, pressure indicator-controller 47 will manipulate valve 48 so as to recycle excess Freon to storage vessel 16 via conduit means 49 and 32, thereby maintaining a constant pressure in conduit 19 upstream of the orifice of flow indicator controller 39.

Although the invention has been described as applied to the blending of two fluids, it is within the scope of this invention to blend in a like manner three or more fluids.

As illustrated, it is within the scope of this invention to provide a switch 25 for the transmission of a stop signal to pumps 12 and 18, a close valve signal to valves 22, 24 and 26, and an open valve signal to valves 27 and 28.

As will be evident to those skilled in the art, various modifications of this invention can be made, or followed, in the light of the foregoing disclosure, without departing from the spirit or scope thereof.

I claim:

1. Apparatus comprising a first storage vessel, a second storage vessel, a mixing chamber, a first rate of flow control valve means, a second rate of flow control valve means, first conduit means communicating between said first storage vessel and said first rate of flow control valve means, second conduit means communicating between said first rate of flow control valve means and said mixing chamber, third conduit means communicating between said second storage vessel and said second rate of flow control valve means, fourth conduit means communicating between said second rate of flow control valve means and said mixing chamber, fifth conduit means communicating with said mixing chamber, means for simultaneously interrupting the flow of a fluid flowing through said second, fourth and fifth conduit means, sixth conduit means communicating between said second conduit means upstream of said means for simultaneously interrupting and said first storage vessel, seventh conduit means communicating between said fourth conduit means upstream of said means for simultaneously interrupting and said second storage vessel, third valve means positioned in said sixth conduit means, fourth valve means positioned in said seventh conduit means, and means for simultaneously positioning said third and fourth valve means in the open position upon the interruption of the flow of fluid through said second, fourth and fifth conduit means.

2. The apparatus of claim 1 to include means for measuring a process variable representative of the pressure of a fluid flowing through said second and fourth conduit means, means for simultaneously interrupting the flow of fluid through said second, fourth and fifth conduit means responsive to said means for measuring, and means for positioning said third and fourth valve means responsive to said means for measuring.

3. The apparatus of claim 2 to include a first pumping means for pumping a fluid through said first conduit means, eighth conduit means communicating between said first conduit means downstream of said first pumping means and said first storage vessel, means for measuring a process variable of a fluid flowing through said first conduit means downstream of said first pumping means representative of the pressure thereof, means for manipulating the rate of flow of fluid through said eighth conduit means responsive to the thus determined pressure of said fluid in said first conduit means downstream of said first pumping means, second pumping means for pumping a fluid through said third conduit means, ninth conduit means communicating between said third conduit means downstream of said second pumping means and said second storage vessel, means for measuring a process variable of a fluid flowing through said third conduit means downstream of said second pumping means representative of the pressure thereof, and means for manipulating the rate of flow of fluid through said ninth conduit means responsive to the thus determined pressure of said fluid in said third conduit means downstream of said second pumping means.

4. A process which comprises continuously passing a first fluid from a first storage zone through a first rate of flow control zone, passing said first fluid from said first control zone to a blending zone, continuously passing a second fluid from a second storage zone through a second rate of flow control zone, passing said second fluid from said second control zone to said blending zone, passing a blended fluid mixture from said blending zone, simultaneously interrupting the flow of blended fluid mixture from said blended zone and the flow of said first and second fluids to said blending zone from said first and second rate of flow control zones, respectively, and thereafter passing said first fluid from said first rate of flow control zone to said first storage zone and said second fluid from said second rate of flow control zone to said second storage zone, measuring a process variable of said first and second fluids passed to said blending zone representative of the flow of each of said first and second fluids from said first and second control zones, respectively, controlling the flow of said first fluid from said first rate of flow control zone to said blending zone or said first storage zone responsive to the measurement of the flow of said first fluid from said first flow control zone, and controlling the flow of said second fluid from said second rate of flow control zone to said blending zone or said second storage zone responsive to the measurement of the flow of said second fluid from said second flow control zone.

5. The process of claim 4 wherein said first and second fluids are withdrawn from said first and second storage zones by being passed through first and second pumping zones, respectively, measuring a process variable of said first fluid at the outlet of said first pumping zone representative of the pressure thereof, manipulating a recycle stream of said first fluid from said first pumping zone to said first storage zone responsive to the thus determined pressure of said first fluid, measuring a process variable of said second fluid at the outlet of said second pumping zone representative of the pressure thereof, and manipulating a recycle stream of said second fluid from said second pumping zone to said second storage zone responsive to the thus determined pressure of said second fluid.

6. The process of claim 5 wherein said first fluid comprises propane and said second fluid comprises Freon.

7. A process which comprises continuously passing a first fluid from a first storage zone through a first rate of flow control zone, passing said first fluid from said first control zone to a blending zone, continuously passing a second fluid from a second storage zone through a second rate of flow control zone, passing said second fluid from said second control zone to said blending zone, passing a blended fluid mixture from said blending zone, simultaneously interrupting the flow of blended fluid mixture from said blended zone and the flow of said first and second fluids to said blending zone from said first and

second rate of flow control zones, respectively, and thereafter passing said first fluid from said first rate of flow control zone to said first storage zone and said second fluid from said second rate of flow control zone to said second storage zone, operating said first rate of flow control zone to maintain the flow of said first fluid from said first rate of flow control zone to said blending zone or said first storage zone substantially constant, and operating said second rate of flow control zone to maintain the flow of said second fluid from said second rate of flow control zone to said blending zone or said second storage zone substantially constant.

8. Apparatus comprising a first storage vessel, a second storage vessel, a mixing chamber, a first rate of flow control means, a second rate of flow control means, first conduit means communicating between said first storage vessel and said rate of flow control means, second conduit means communicating between said first rate of flow control means and said mixing chamber, third conduit means communicating between said second storage vessel and said second rate of flow control means, fourth conduit means communicating between said second rate of flow control means and said mixing chamber, fifth conduit means communicating with said mixing chamber, means for simultaneously interrupting the flow of a fluid flowing

through said second, fourth and fifth conduit means, sixth conduit means communicating between said second conduit means upstream of said means for simultaneously interrupting and said first storage vessel, seventh conduit means communicating between said fourth conduit means upstream of said means for simultaneously interrupting and said second storage vessel, first valve means positioned in said sixth conduit means, second valve means positioned in said seventh conduit means, and means for simultaneously positioning said first and second valve means in the open position upon the interruption of the flow of fluid through said second, fourth and fifth conduit means.

References Cited by the Examiner

UNITED STATES PATENTS

3,042,258	7/1962	Mayes	222—57 XR
3,233,620	2/1966	Cooke	137—563 XR

FOREIGN PATENTS

86,692	11/1957	Netherlands.

ALAN COHAN, *Primary Examiner.*

WILLIAM F. O'DEA, D. J. ZOBKIW,
Assistant Examiners.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,298,383 January 17, 1967

Delbert J. Cooper

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 17, after "said" insert -- first --.

Signed and sealed this 22nd day of October 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents