United States Patent [19]

Weaver

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[54] **LPG HIGH PRESSURE MOBILE PUMPING UNIT**

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Related U.S. Application Data

[63] Continuation of Ser. No. 845,017, July 25, 1969, abandoned.

[52] **U.S. Cl.** **417/244,** 417/364, 417/426

[51] **Int. Cl.** **F04b 17/00**

[58] **Field of Search** 417/2, 429, 62, 244; 166/304

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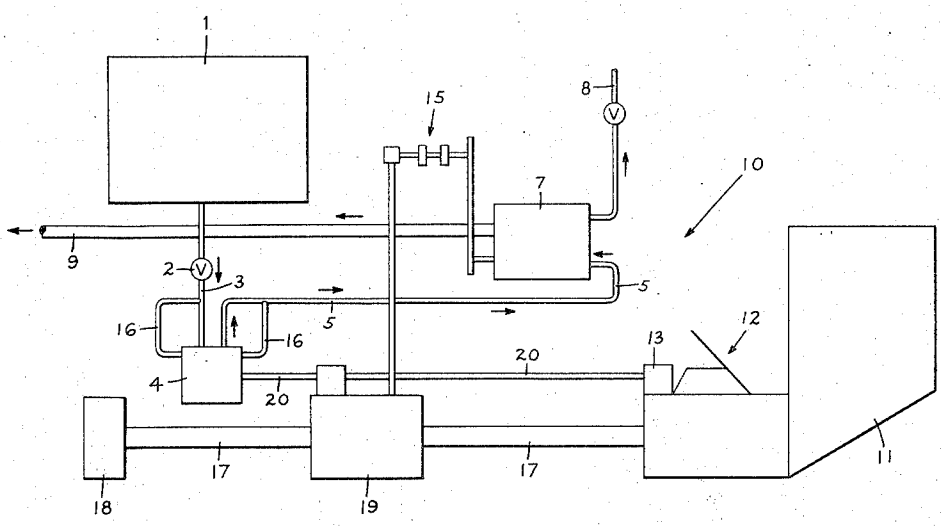
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[57] **ABSTRACT**

A system for pumping liquid solvent with a plurality of pumps separately powered by a variable vehicle engine power supply.

3 Claims, 2 Drawing Figures



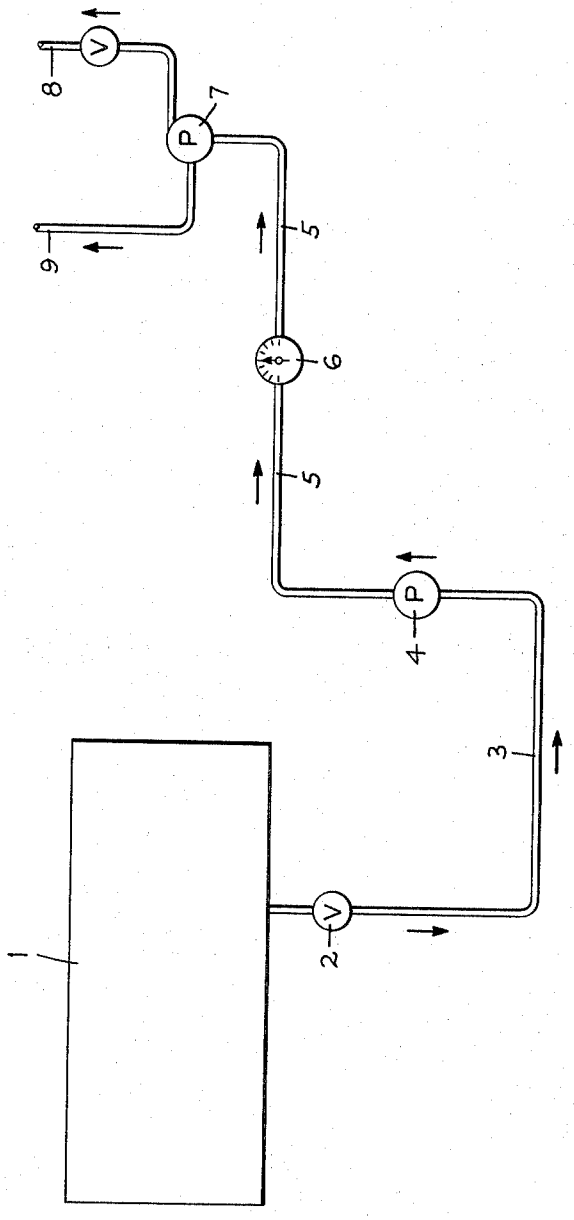
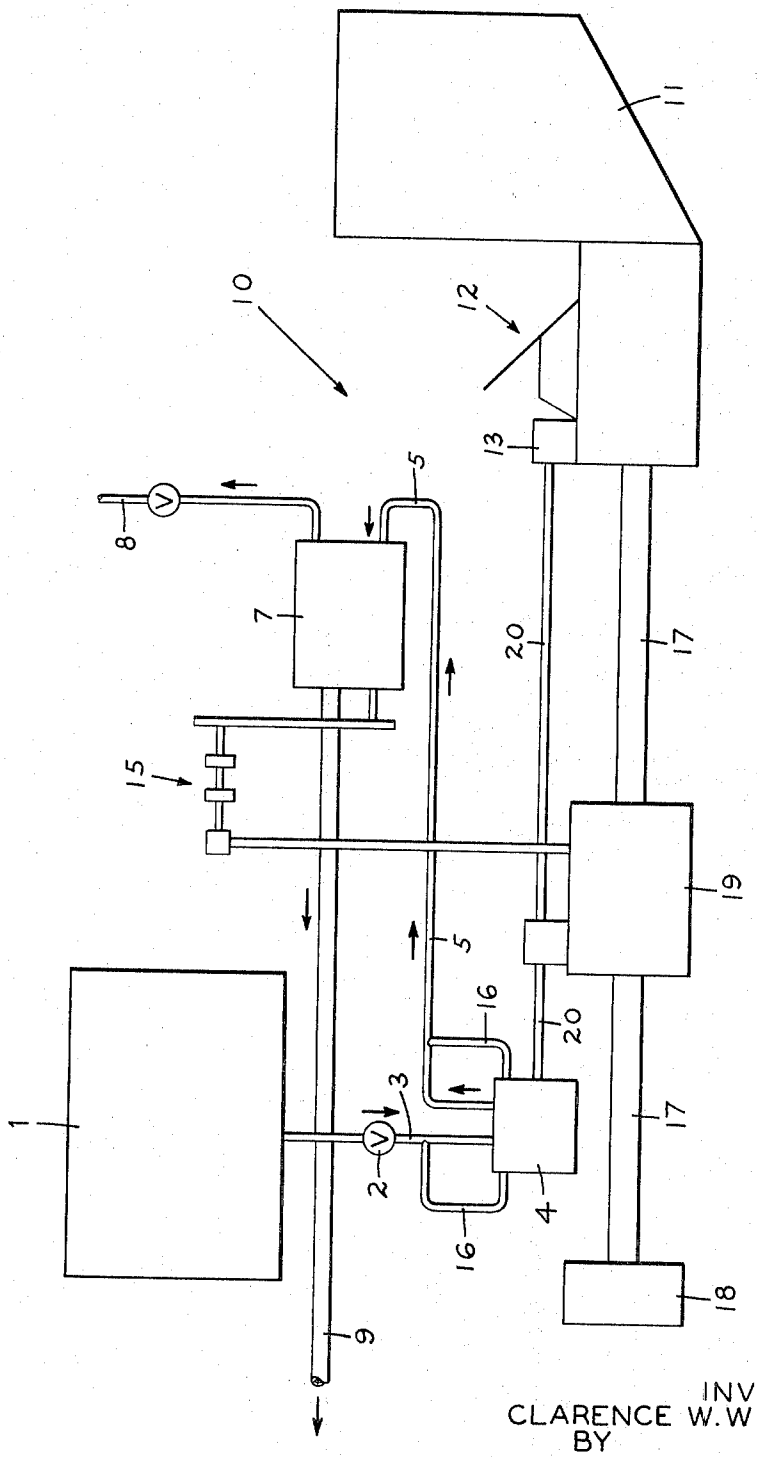


FIG. 1.

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FIG. 2.



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LPG HIGH PRESSURE MOBILE PUMPING UNIT

This is a continuation, of U. S. Pat. application Ser. No. 845,017, filed July 25, 69, now abandoned.

This invention relates to the pumping of a solvent mixture for introduction into a well, flowline, pipeline, storage vessel, etc. for the removal of paraffin therefrom, or for other use as desired. The solvent mixture may be a specific mixture of liquefied propane and/or butane (LPG) and it must be kept under adequate pressure to ensure that it remains in liquefied form. One specific solvent mixture, a mixture of liquefied propane and butane of a ratio propane:butane = 70:30 to 50:50, by volume, as set forth in U.S. Pat. application Ser. No. 727,592, filed May 8, 1968, cleans wells, flowlines, etc. in the manner disclosed in that application.

In order to inject the liquefied solvent mixture into well tubing, flowlines, etc., it is first necessary to get the mixture to the line into which it is to be injected. This presents a number of difficulties, not the least of which is that oil and gas wells, pipelines, flowlines, etc. are often located in extremely rough, inaccessible terrain. Transportation over this terrain demands a compact pumping unit combined with the vehicle which moves it. In order to limit the vehicle carrying the pumping apparatus to a single rear axle, which is often required for transportation in the mountainous, swamp or largely undeveloped terrains which must be traversed, the pumping apparatus should be advantageously compact.

Perhaps more important, as individual pumping conditions vary from well to well, or line to line, etc., it is highly advantageous to develop a pumping system which provides for selectively varying RPM and horsepower powering the pumps. The combination of this variable aspect of the system with an efficient pumping system made of more than one pump allows for adaptability of the pumping system to the well or lines conditions, as will be understood with reference to the later detailed disclosure.

In addition, because of safety and pollution control, it is advantageous to design a compact, mobile, variable pumping system which has a minimum of power supplying (combustion) elements and a maximum of exhaust product control.

GENERAL DESCRIPTION OF THE INVENTION

With the above desirable design features in mind, I have invented a new pumping system for supplying the liquefied solvent to the well, flowline, etc., in a highly efficient and practical manner. Basically, it is desirable to move the liquefied solvent from a container in which it is held under pressure as a liquid through a first intermediary pump, which raises the pressure of that liquid solvent to a first intermediary pressure, from which it is transported to a second main, high pressure, pump for elevation to high pressure and injection through into well or lines, etc. thereafter. In order to achieve that which has just been described as basically desired, I designed the following pumping system which I will now generally describe:

Generally, I mount the intermediary pump and the main high pressure pump with the source of liquid solvent on the rear chasis of a single axle vehicle. Horsepower normally supplied to the rear axle of the vehicle for movement thereof is diverted to power the main high speed pump. In like manner, horsepower normally used in the vehicle operation is also used to power the intermediary pump. Since the horsepower of the vehicle is controlled by manipulation of gears of the vehicle, the power supplied to each of the pumps may be varied by choice by manipulation of the gears. Since the pumps run at different speeds, it has been found especially advantageous not to link each of the pumps to the power of the vehicle through the same power train.

DETAILED DESCRIPTION OF THE INVENTION

The pumping system just generally described will be discussed in greater detail in the following detailed specification thereof, in which objectives and advantages of the invention will become more apparent.

FIG. 1 of the drawing is a schematic showing of the basic pumping requirements which the invention satisfies.

FIG. 2 of the drawing shows schematically a particular embodiment of the pumping system of the invention.

Tank 1 contains liquid solvent; for example, liquid petroleum gas, and in one embodiment, more particularly, a liquid combination of propane and butane in a ratio within the range disclosed in U.S. Pat. application Ser. No. 727,592, filed May 8, 1968. According to the invention, said liquid solvent is moved through a valve 2 and a line 3 to an intermediary 4. The liquid solvent is moved from the pump 4 through a line 5 which may advantageously include a flow meter 6 to a high pressure pump 7. From the high pressure pump 7, which has a safety vent to the atmosphere 8, the liquid solvent moves through the line 9 to the point of use. The intermediary pump 4 in the case of the butane-propane mixture disclosed previously, for example, may raise the pressure of the liquid solvent up to 150 pounds per square inch, while the high pressure pump 7, in the same embodiment may produce pressures up to or even over 3,000 pounds per square inch. In one embodiment the intermediary pump is a Blackmer 2 inch TLGL LPG pump, and the high pressure pump is a Union Quintuplex Plunger pump.

The basic system disclosed with relation to FIG. 1 is mounted upon a truck or vehicle body generally shown at 10 in FIG. 2. That vehicle has a cab 11 with a driver occupancy area generally shown at 12. The container 1 is mounted on the vehicle, as are pumps 4 and 7. The pump 4 is powered by the vehicle 10 as a result of the power take off from the horsepower of the vehicle engine, power take off generally being shown at 13, transmitted to the pump 4 through the shaft 20, and activated by a clutch and lever assembly, not shown. In one embodiment in what is called the power take off 13, a gear is interposed upon activation of clutch and lever assembly into the transmission gearing to mesh therewith in order to divert some of the power transmitted from the vehicle engine through the transmission to the shaft 20 to rotate the pump 4.

The high pressure pump 7 is powered through a gear train 15 and a power divider 19 interconnecting the pump 7 to the horsepower of the vehicle engine. The power divider 19 diverts the power of the vehicle normally transmitted through the drive shaft 17 to the rear wheels 18 to the pump 7 when so engaged. As described with relation to the power take off 13, in one embodiment the power divider assembly 19 is comprised of a gear train which is selectively interposed to connect with the drive shaft 17 and divert the power

transmitted thereby to the high pressure pump 7. In the case of the power divider 19, as compared to the power take off 13, no power can be transmitted to the rear axle of the vehicle simultaneously with the diversion of power to pump 7.

The intermediary pump 4, as previously described with relation to FIG. 1, moves liquid solvent through a valve 2 and a line 3 from the container 1 through a line 5 to the high pressure pump 7, as previously discussed. A bypass line 16 may be used to recirculate that liquid solvent which the intermediary pump is supplying to the large pump and the large pump is not powered to supply through line 9 to the point of use at that time.

The intermediary pump maintains the liquid solvent under such pressure, in the case of the liquid butane-propane mixtures disclosed above about 5psi to maintain required pressure for such ratio of liquefied mixtures, so as to supply the positive suction head required by the large (high pressure) pump at the variable pumping volumes possible according to this pumping system design.

Generally, when the pumping system is to be used, the power system of the vehicle is engaged to the intermediary pump 4' by the use of the power take off 13 and suitable clutch and lever mechanism, for example, as previously discussed. Separately, the power divider 19 is made operative so as to divert power to the high speed pump 7. The gear ratio of the vehicle is selected so as to provide the desired horsepower to the pumps in combination with the selected RPM of the vehicle engine to adequately power them to provide the required volumes of solvent in a given amount of time to the end use. Liquid solvent is drawn from the container 1 by the pump 4, raised to the intermediary pressure and supplied at the desired volume per unit of time (by the choice of gear ratio and RPM) to the high pressure pump 7, which then supplies the liquid solvent at high pressure to the user, as described.

Since the intermediary pump 4 and the high pressure pump 7 described previously run at different speeds, that is, the intermediary pump runs, for example, from 600 to 900 RPM while the high pressure pump runs from 10 to 450 RPM, it has been found highly desirable to operate the two pumps separately off the same vehicle power supply. The use of gearing or some other apparatus to power each of the pumps from the same point of power supply would be cumbersome and produce a less efficient and less practical unit. On the other hand, the use of entirely separate power supplies for the two pumps would not only result in a less efficient, less practical unit for use in the types of terrain already disclosed, but would also probably introduce a second engine compounding the safety (for example, fire) and air pollution considerations.

The speed of both intermediary and high pressure pumps is of course in part in each case dictated by the gear ratio of the transmission of the vehicle, since that gear ratio will dictate horsepower supplied to the pumps. Furthermore, the vehicle engine RPM will also in part determine the flow rate, that is the volume produced by the pumps per unit of time since the speed of the pumps is determined by both the gear ratio and the RPM of the vehicle engine. The volume of flow from the high pressure pump into a well is dictated at a minimum by the pressure conditions of that well. In addition, the cleaning characteristics for well or flowline, etc., will vary so that different volumes per unit of time will be required from the high pressure pump. Utilizing the gear selection found in the vehicle transmission, which may be as many as five or more different gears, and the variable speed (RPM) of the vehicle engine, such a variable characteristic is provided for.

It is pointed out that this condition of being able to vary the horsepower input to the pumps by varying the gear ratio of the vehicle transmission will not only give the operator the versitility of providing for different volume per unit of time, as needed, but will allow for correction of the situation wherein the well or line demands are such so that the pumping system is underpowered and therefore "lugging." In these situations, the gear ratio may be changed and the underpower situation alleviated. In addition, it has been found that when first introducing butane-propane mixtures of the type described into a well, it is advantageous to start the main pump so as to supply the liquid solvent at a low volume in order to first discover the pressure conditions of the well until a safe operation has commenced. Later, when these pressure conditions are understood, the volume of the supply from the main (high pressure) pump is increased, by changing the gear ratio and therefore the power driving the pump and/or the speed of the engine.

I will now describe the operation of the embodiment shown in FIG. 2 in its start up and then pumping operations, after the vehicle is driven to the location of a well or flow-line, etc., in order that the butane-propane mixture already described may clean the tubing of the well or flowline, etc. of the paraffin contained thereon.

The vehicle carrying the pumping system and the liquid petroleum gas is brought right to the point of the well. The single rear axle allows for the maneuverability of the vehicle required to bring it to that point. The operator of the vehicle turns the vehicle off and then connects with suitable tubing the high pressure pump to the well or flowline, etc.

As a matter of convenience the controls, pressure gauges, etc. may be mounted on a control panel, as previously mentioned, and it may be mounted outside of the cab 11 of the truck. This control panel may include alternate control levers to change the RPM and gear ratio of the vehicle engine, for example. This convenience will allow the operator of the truck to remain outside of the cab of the vehicle during pumping operation.

The operator disengages the power divider 19 from the rear wheels of the truck to the neutral position of the power divider. The operator opens the valve 2 supplying the LPG from the tank 1 to the intermediary pump 4. With the valve 2 open the vapor or liquid is sent into the piping system by virtue of the vapor pressure from the storage tank. At this time the operator bleeds down all truck vents, hose vents, etc. to assure that no air traps remain in the system. At this time he engages the truck transmission to a pre-selected gear ratio — normally a low first or second position for initial pumping. The pump 4 is powered through the power take off (PTO) assembly 13 from the trucks multi-speed transmission through a standard drive shaft 20. The operator engages the clutch and therefore power take off assembly 13 which starts the small pump 4 rotating. The small pump is allowed to rotate until a positive suction head is delivered to the large (high pressure) pump. When this is noted, the operator then engages the power divider 19 to the position of rotating

the large positive displacement pump 7. This pump is rotated slowly until all systems are checked and that a pure liquid is being pumped. To increase or decrease the speed of each pump simultaneously the RPM of the engine can be varied by a slam type, safety throttle, for example, mounted at the control panel (not shown but previously discussed). When volume and pressure requirements indicate a need for a change the operator can change the RPM of the engine directly from the control station or if need be the gear ratios through the truck transmission.

The invention has been described with relation to a particular design of apparatus, especially with relation to FIG. 2. It is understood, however, that modification may be made without departing from the spirit and the scope of the invention and that it is intended that my invention only be limited by the following claims:

I claim:

1. A system for pumping a liquid solvent to be supplied at variable flow characteristics without lugging of the pump system, comprising a vessel for carrying said liquid solvent, said vessel mounted upon a vehicle powered for self-propulsion by an engine contained therein, a transmission connected to said engine and to a drive shaft for transmitting power from the engine to the drive shaft, said drive shaft connected to an axle of the vehicle for transmitting the vehicle engine power thereto, means for disengaging the drive shaft from said axle, a high pressure and an intermediary pressure pump carried by the vehicle, said intermediary pump capable of pumping to a pressure in the range of about 5 to 150 pounds per square inch, means for separately engaging said high pressure pump to said drive shaft, means for engaging said intermediary pressure pump to drive means independent of said drive shaft and associated with the transmission of the vehicle, and conduit means interconnecting said vessel to said intermediary pressure pump and said intermediary pressure pump to said high pressure pump so that liquid solvent may be variably pumped from said vessel through and from the intermediary pump and through the high pressure pump to a substantially higher pressure as a result of use of said vehicle engine power, said high pressure pump being capable of delivering independently the demands of the pump system and means for controlling both RPM and gear ratio of said engine power while engaged to said pumps to vary pumping conditions.

2. A system as set forth in claim 1, said liquid solvent being comprised of liquefied petroleum gas.

3. A system as set forth in claim 1, said liquid solvent consisting of mixed liquefied propane and butane in a ratio, propane:butane = 70:30 to 50:50.

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