

May 14, 1963

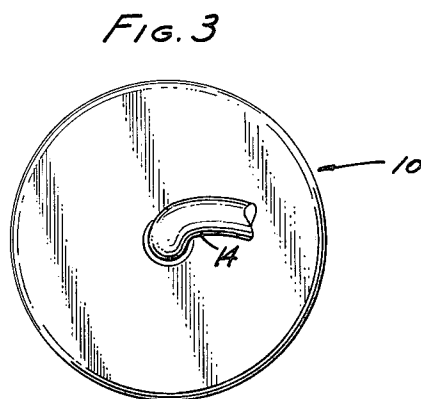
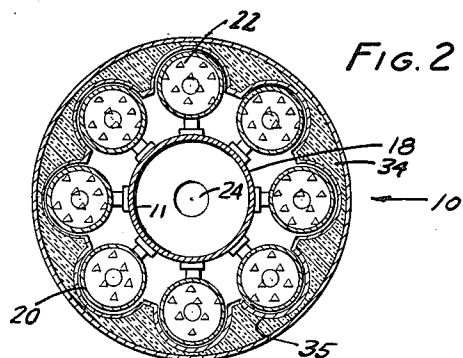
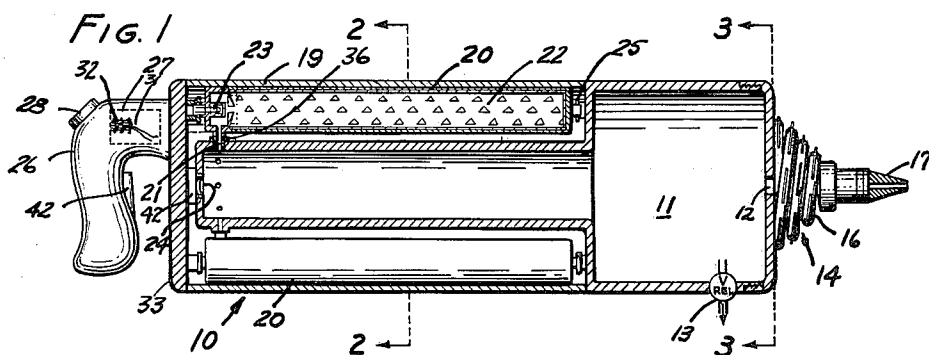
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3,089,419

GAS-GENERATING POWER SOURCE

Filed May 8, 1961

2 Sheets-Sheet 1



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FIG. 4

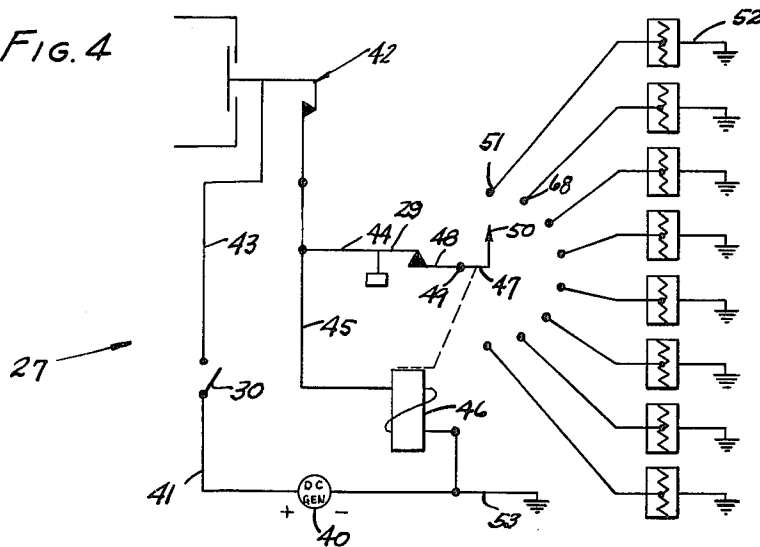


FIG. 5

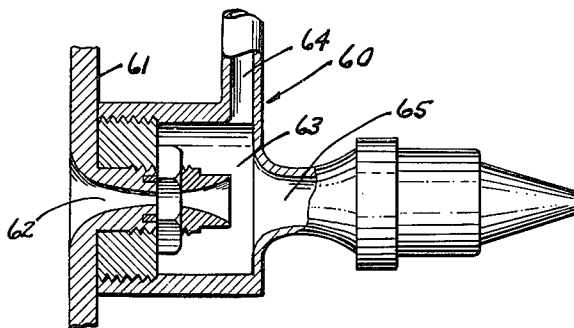
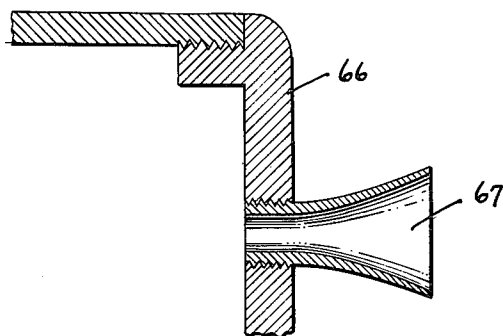


Fig. 6



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GAS-GENERATING POWER SOURCEFrank B. Pollard, 2722 Ardmore Ave.,
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4 Claims. (Cl. 102—39)

This invention relates to a gas-generating power source.

There are numerous relatively new uses for a power source which is itself relatively light and compact, but which can provide a volume of gases of very much greater volume. Examples of some such uses are as means for inflating objects, such as lift rafts, as a power source for operating tools and other mechanisms, and as a reaction device for orienting a man in space. It is evident that for all these uses, the device ought to be quite portable, relatively light in weight, and easy to use. Other requirements are that it be useable by untrained personnel without hazard, have a long service life, and be made insofar as possible of standard commercially available items. Furthermore, it should possess long shelf-life characteristics.

This invention provides a gas-generating power source with all of the above advantages and comprises an accumulator chamber in fluid connection with a casing having therein a solid charge of the type which burns to produce gaseous products, and which is so disposed and arranged in the casing as to discharge the products of its burning into the accumulator chamber. Igniter means are provided for causing the charge to burn together with actuator means for actuating the igniter means.

According to a preferred but optional feature of the invention, heat transfer means are provided to lower the temperature of the gases so that they will not damage articles being inflated with them.

According to another preferred but optional feature of the invention, a plurality of charges is provided together with means for igniting them sequentially, and with pressure-sensitive means for preventing the ignition of charges unless and until the pressure in the accumulator chamber is within a safe range.

According to still another preferred but optional feature of the invention, aspiration means are provided for increasing the mass of fluid delivered by the device.

The above and other features of this invention will be fully understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a side view partly in cutaway cross-section showing the presently preferred embodiment of the invention;

FIG. 2 is a cross-section taken at line 2—2 of FIG. 1;

FIG. 3 is a cross-section taken at line 3—3 of FIG. 1;

FIG. 4 is a circuit diagram of an electric circuit useful in the device of FIG. 1;

FIG. 5 is a fragmentary showing partly in cutaway cross-section of an aspiration means; and

FIG. 6 is a fragmentary cross-section of a nozzle device used when the device is to function as a reaction means.

FIG. 1 illustrates the presently preferred embodiment of gas-generating power source 10, which includes an accumulator chamber 11 that has a conduit 12 discharging therefrom. A safety relief valve 13 is installed in the wall of the chamber so as to provide a secondary means for gas to escape through if the pressure in the accumulator chamber exceeds a safe value.

Conduit 12 connects to and discharges into a heat transfer means 14 which comprises a spiral tubing 15 with fins 16 on the outside. The heat transfer means, in turn, discharges into a nipple 17, which nipple is adapted to be placed in fluid communication with an object to be inflated or powered. The passageway through the

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nipple may be provided with a variable orifice to act as a control over the discharge rate and pressure.

The accumulator chamber has a neck portion 18 which fits within a housing 19, leaving an annular spacing between them. Within this annular spacing, there are eight cylindrical casings 20, which casings are fluidly interconnected to passages 21 to the chamber. The casings serve to house solid charges 22 of the class whose burning will produce gaseous products. The presently preferred embodiment of such charges are propellants and there are many which are useful for this purpose. The term "burning" is used herein in its broadest sense, even as to mono-propellants, and includes any process whereby a solid charge produces gaseous products. Double-base propellants are presently preferred and an example is as follows (final analysis in percentage by weight): Nitrocellulose (13.25% N), 69.1; nitroglycerin, 19.3; dinitrotoluene, 9.0; diphenylamine, 1.0; acetone, 1.6.

Mono-propellants, single-base propellants, and other types are also suitable. In general, a suitable charge should be solid and have stable shelf characteristics.

It will be noted that the left hand end of the charge in FIG. 1 is in fluid communication with the passage, and that an igniter means 23 is positioned adjacent to that end, whereby when the left hand end of the charge in FIG. 1 is ignited by the igniter, the gaseous products will pass through passage 21 into the accumulator chamber.

A pressure-sensitive switch 42 is placed in the wall of the accumulator with a diaphragm 24 exposed to pressure in the accumulator chamber, the position of the diaphragm determining whether the switch is open or closed. It has a switching portion to be described which is closed at pressures which are safe for firing, and which is open when the pressures are too high.

Attachment means 25 are provided for connecting and disconnecting the casings, so that the charges can be replaced.

A handle 26, in the nature of a pistol grip, is attached to the housing and contains within it actuator means 27 for actuating the igniter means. A button 28 is provided for an override switch 29, yet to be described, and a trigger 42 for firing switch 30 is also provided. Current for igniting the igniter means is provided by the actuator means through leads 31 in a harness 32.

FIGS. 1 and 2 illustrate the physical construction of the device. Removal and replacement of the charges can be accomplished by removing end plate 33 which may be attached to the casing by fastener means (not shown) of any suitable type. Within the casing, there is a layer of insulation 34 and a retainer sheet 35 to hold the insulation in place and also to give side support to the casings to hold them in place. Collars 36 may be utilized to center the conduits in which passages 21 are formed.

The actuator means for sequentially actuating the igniter means will now be described in connection with FIG. 4. In FIG. 4, a source 40 of firing current is shown as a D.C. generator. This may either be a battery or, if preferred, may be a squeeze-type generator. Lead 41 connects the source 40 to firing switch 30 which, when the D.C. power source is a battery, will simply be a normally open switch closed by depressing trigger 42 on the handle. When the source 40 is a squeeze generator, then trigger 42 and switch 30 will be combined so that pulling the trigger will actuate the generator and also close the switch.

Pressure-sensitive switch 42, which is actuated by the diaphragm, is connected to firing switch 30 by lead 43. Switch 42 is normally closed at lower pressures, ordinarily between 0 and 100 p.s.i., when it is safe to fire an additional charge. It is open at higher pressures. Switch 42 is shown in its closed condition. It is connected by lead

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44 to override switch 29, and to solenoid 46 by lead 45, the solenoid acts as stepping means to control rotary selector switch 47.

Override switch 29 is shown in its normally closed position. Pressing button 28 will open this switch. Override switch 29 is connected by lead 48 to the central contact 49 of the selector switch. The contactor 50 of the rotary selector switch selectively contacts one at a time of contacts 51. Each contact is individually connected to one of the igniter means. The igniters are individually connected to ground by ground leads 52. Solenoid 46 is grounded by lead 53.

The resistance to current flow through solenoid 46 is higher than the resistance through the rotary selector switch and the igniter to which it is connected, so that when current is passed from the generator through the firing switch to the junction of leads 44 and 45, a sufficient current to fire an igniter will pass through the rotary selector switch, but the current which passes through the solenoid will not be enough to actuate it so long as the igniter circuit is in shunt with it. However, firing the igniter destroys the shunt circuit, and all of the current then flows through the solenoid, which is enough to actuate it and step the selector switch by one step to the next igniter contact. The resistances of the various components are designed to achieve this aim.

FIG. 5 shows aspirator means 60, whereby cooling the gasses, together with an increase in the mass discharged by this device are attained. End plate 61 is intended to be substituted for the right hand end plate of the accumulator, and has connected thereto a nozzle 62 which serves as a conduit discharging from the chamber. It discharges into an aspiration chamber 63, the aspiration chamber having an inlet port 64 at one side of the stream discharged from the nozzle which provides an aspiration effect. The aspiration means includes a nozzle 65 which discharges the combined fluids. The aspirator means is substituted for the heat transfer unit by changing the end plates.

FIG. 6 illustrates the substitution of still another end plate 66 in the end of the accumulator, this including a discharge nozzle 67, which substitutes for the conduit in FIG. 1, and which discharges a jet stream of gaseous products for the purpose of providing a jet force reaction.

The operation of the device of FIG. 1 will now be briefly described, inasmuch as its operation in general should be understandable from the above. The charges are all in place, and the rotary selector has its rotary contactor on one of the contacts, such as between 50 and 51 in FIG. 4. Also, the pressure in the accumulator will be assumed to be below a pre-selected value, for example, less than 100 p.s.i.g., so that pressure-sensitive switch 24 will be closed. Button 28 will not be pressed, so that the override switch will also be closed. Then firing switch 30 is closed or some other means is provided for supplying current to lead 43. It passes to the junction between leads 44 and 45, and because of the resistance relations between them, sufficient current flows through contact 51 to fire the igniter to which the rotary selector switch directs the current, but not enough to step the selector switch. However, as soon as the igniter fires, this particular shunt circuit is destroyed and sufficient current flows to the solenoid to step the switch to the next contact, such as contact 63. Should the firing switch still be held closed, the next igniter will be fired unless pressure in the accumulator is high enough to open pressure-sensitive switch 24, in which case all circuits will be broken. The firing switch could be held closed until the pressure drops sufficiently to close the pressure-sensitive switch, at which time the next charge will be automatically fired. This sequence will continue in operation until the trigger is released.

Assume a misfire, such that one of the igniters does not fire a propellant, and the shunt action through the rotary

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selector switch continues. In this case, the device would tend to "hang up." This is overcome by pressing button 28 to open override switch 29. This cuts off the shunt circuit and permits sufficient current to go through the solenoid (assuming switch 30 to be closed) to step the selector switch to the next charge and the firing will proceed as aforesaid.

The gases produced by the charges will, of course, be discharged into the accumulator and pass out through whatever conduit discharges from the accumulator. In the case of a heat exchanger, such as in FIG. 1, the temperature of the gases produced is, of course, a function of their initial temperature plus the efficacy of the heat exchange device. The safety valve operates to provide a secondary escape pass for gases in the event that pressure exceeds safe values.

The device of FIG. 5 receives gases from the accumulator and discharges them through nozzle 62 and, in accordance with well understood aspiration principles, draws an additional mass to discharge it out nozzle 65. The mixing of the hot gases with colder gases will make unnecessary the use of heat transfer means and they are, therefore, not shown in this embodiment. It has been found that the mass of the gases delivered can be increased as much as four to five times by the aspiration principle.

The operation of FIG. 6 is evident, the purpose being to produce a jet of gases to the right therein to give a force reaction to the left.

It has been determined that a device which could conveniently produce 100 cubic feet of gases at 70° F. at a pressure from 2-7 p.s.i.g., would require an accumulator having a volume of about 340 cubic inches and would require a propellant of the type disclosed above, approximately 1.5 inches in diameter by 11 inches in length, ten of these cartridges being used to provide this volume of gas. The combined length of the housing and accumulator is about 10 inches, and the diameter would be about 4 inches. Larger and smaller quantities can be delivered at various pressures, and more or fewer propellant charges could be provided. Furthermore, propellants other than that given can be utilized which may provide more or less gases, depending on their nature.

This device thereby provides a quick, safe, easy to use device for delivering gas at desired temperatures and pressures in volume which very much exceed the volume of the device itself.

This invention is not to be limited by the embodiments shown in the drawings and described in the description which are given by way of example and not of limitation, but only in accordance with the scope of the appended claims.

I claim:

1. A gas-generating power source comprising: an accumulator including an accumulator chamber; a conduit discharging from said accumulator chamber; a casing having a cavity in fluid connection with said accumulator chamber; a solid charge in said cavity so disposed and arranged as to discharge gaseous products of its burning into said accumulator chamber; igniter means for causing the charge to burn; actuator means connected to the igniter means for actuating the igniter means; and heat transfer means connected to the conduit to receive gases therefrom and adapted to accomplish heat transfer for said gases without dilution of said gases, whereby upon igniting the igniter, the solid charge is caused to burn and discharge gaseous products of combustion into the accumulator from which they are discharged through the conduit and the heat transfer means, and whereby cooler gases are delivered by the heat transfer means than by the conduit from the accumulator chamber.

2. A gas-generating power source comprising: an accumulator including an accumulator chamber; a conduit discharging from said accumulator chamber; a plurality of casings, each having a cavity in fluid communication with said accumulator chamber; a solid charge in each of

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said cavities so disposed and arranged as to discharge gaseous products of their burning into said accumulator chamber; an igniter means for each of said charges for causing the charge to burn; actuator means connected to each igniter means for sequentially actuating the individual igniter means; heat transfer means in connection with the conduit and adapted to receive hot gases therefrom and to cool the same without dilution, whereby upon actuating the igniter, the solid charges are sequentially caused to burn and discharge their gaseous products of combustion into the accumulator from which they are discharged through the conduit, and whereby cooler gases are delivered by the heat transfer means and by the conduit from the accumulator chamber.

3. A gas-generating power source comprising: an accumulator including an accumulator chamber; a conduit discharging from said accumulator chamber; a plurality of casings, each having a cavity in fluid communication with said accumulator chamber; a solid charge in each of said cavities so disposed and arranged as to discharge gaseous products of their burning into said accumulator chamber; an igniter means for each of said charges for causing the charge to burn; actuator means connected to each igniter means for sequentially actuating the individual igniter means; heat transfer means in connection with the conduit and adapted to receive hot gases therefrom and to cool the same without dilution; and pressure-sensitive means disposed in the accumulator chamber and connected to the actuator means so disposed and arranged as to prevent actuation of igniter means when fluid pressure in the chamber is above a pre-selected level, and whereby cooler gases are delivered by the heat trans-

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fer means and by the conduit from the accumulator chamber.

4. A gas-generating power source comprising: an accumulator including an accumulator chamber; a conduit discharging from said accumulator chamber; a plurality of casings, each having a cavity in fluid communication with said accumulator chamber; a solid charge in each of said cavities so disposed and arranged as to discharge gaseous products of their burning into said accumulator chamber; an igniter means for each of said charges for causing the charge to burn; actuator means connected to each igniter means for sequentially actuating the individual igniter means; an aspiration member having an aspirator chamber connected to the conduit from the accumulator chamber to receive fluid from the conduit, said conduit discharging fluid in a stream into said aspiration chamber, said aspiration chamber having an inlet port and outlet nozzle, whereby fluid is withdrawn into the aspiration chamber through the inlet port by virtue of flow of fluid from the accumulator chamber into the aspiration chamber, and said combined fluids are discharged through the nozzle, and whereby upon actuating the igniter, the solid charges are sequentially caused to burn and discharge their gaseous products of combustion into the accumulator from which they are discharged through the conduit.

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