E. E. GRAY.

POWER STORAGE DEVICE.

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1,167,555.

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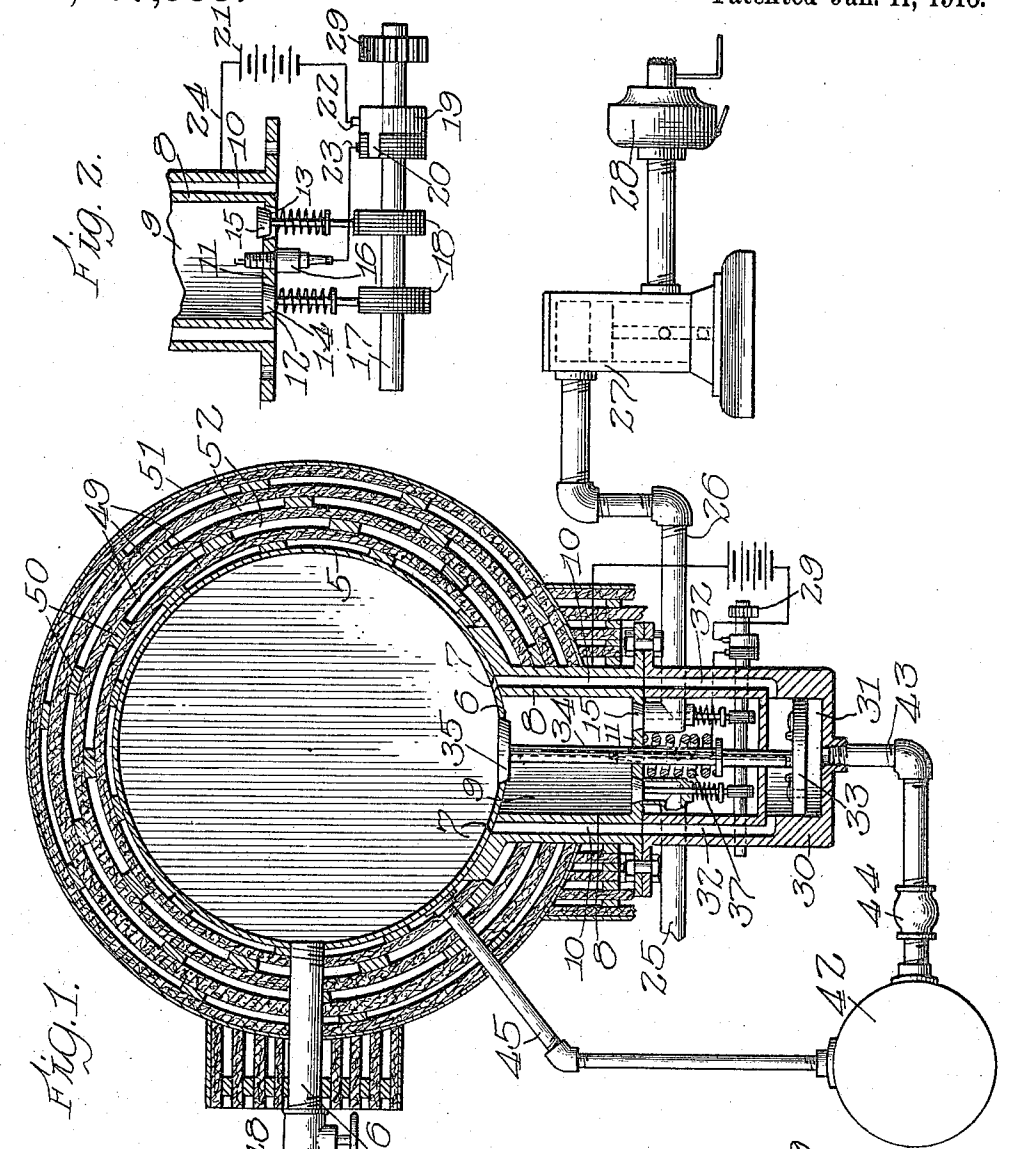


Fig. 1.

Fig. 2.

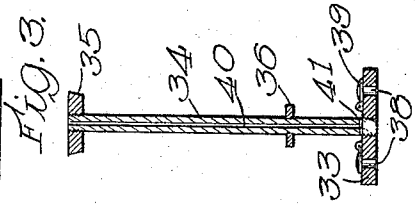


Fig. 3.

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POWER-STORAGE DEVICE.

1,167,555. Specification of Letters Patent. Patented Jan. 11, 1916.

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To all whom it may concern:

Be it known that I, EDWARD E. GRAY, a citizen of the United States, residing at Plano, in the county of Kendall and State of Illinois, have invented certain new and useful Improvements in Power-Storage Devices, of which the following is a specification.

This invention relates to means for employing the power developed by the explosion of a gas and, at the same time, for utilizing the heat generated by such explosion for vaporizing a liquid and for storing the gases produced thereby in an insulated receptacle so that the heat of the gases may be maintained with the greatest possible efficiency, and supplied from the storage chamber to an engine of any suitable class which is actuated by a fluid under pressure.

The principal object of the invention is to provide a device of the class described which is easily operated and maintained, and is effective and efficient in operation.

For the attainment of these ends and the accomplishment of other new and useful objects, as will appear, the invention consists in the features of novelty in the construction, combination and arrangement of the several parts generally shown in the accompanying drawing and described in the specification, but more particularly pointed out in the appended claims.

In the drawing, Figure 1 is a view partly in section of an apparatus constructed in accordance with the principles of my invention. Fig. 2 is a detail view of the valve and ignition operating mechanism; and Fig. 3 is a sectional view of a piston valve of the preferred form of construction.

In obtaining power or storing kinetic energy by the explosion of a gas in a reciprocating engine, much of the force of each explosion and expansion is lost. Another objection to an engine of this type is that the repeated explosion of a gas within a cylinder heats and burns the cylinder and the piston, as well as the packing for the piston, thereby necessitating frequent repairs and adjustment, and preventing proper lubrication. The present invention is designed to overcome these objections by exploding a gaseous mixture and discharging the same into a storage chamber which is insulated to retain the heat of the exploded gas and, at the same time, to utilize the heat generated by the explosion for vaporizing a liquid which is also expanded in the insulated chamber, and from which chamber the gases under pressure may be fed continuously to an engine of suitable kind with substantially constant pressure.

Referring now more particularly to the drawing, a storage receptacle 5 constructed of any suitable material and preferably tubular or cylindrical in shape is provided with one or more valve openings 6, about which are a plurality of inwardly inclined openings 7. These openings 7 are arranged adjacent to the valve openings 6 and are directed inwardly adjacent the valve opening. Surrounding the valve opening 6 on the outside thereof, and suitably secured to the receptacle 5, in any well-known manner, is a cylindrical member 8 and comprising an explosion chamber 9 communicating with the interior of the receptacle 5 through the valve opening 6. The walls of the tubular member 8 are preferably sectional or hollow in construction, forming a space 10 which communicates with the interior of the receptacle 5 through the inclined openings 7 in the wall thereof, and in the outer end of the member 8 is a wall 11 (see Fig. 2) provided with valve openings 12 and 13 for inwardly opening valves 14 and 15, respectively. A spark plug 16 is also inserted in the head or partition 11.

The valves 14 and 15 are operated in any suitable manner, as for example, by means of a rotatable shaft 17 upon which are mounted cams 18, and this shaft may also be employed for positively closing an ignition circuit for the spark plug 16. A contact ring 19, having a projecting finger 20, is mounted upon the shaft 17 for rotation therewith, and a source of electric energy 21 is provided with a brush terminal 22 which is constantly in engagement with the contact ring 19. The spark plug is provided with a brush terminal 23 which makes periodic connections with the projecting finger 20 as the shaft 17 rotates. The other terminal 24 of the source of electric energy 21 is connected in the well-known manner with a ground or with the cylindrical member 8 in which the spark plug is inserted. Stems of the valves 14 and 15 preferably extend through elbows of tubular members 25 and 26, which constitute passages for leading the gaseous mixture into the explo-

sion chamber 9. These tubes 25 and 26 may be connected to a compressor 27 which leads from a carbureter 28. The shaft 17, of course, is rotated in any suitable manner, as for example, by means of a mechanical connection with a gear 29 secured thereto. Secured to the tubular member 8 is another tubular member 30, having a chamber 31 and passages 32 forming a connection from the chamber 31 with the space 10 of the tubular member 8. Mounted for free movement in the chamber 31 is a piston 33, and secured thereto is a hollow piston rod 34, which also constitutes a valve stem for a valve 35 disposed in the valve opening 6 of the receptacle 5 and adapted to open inwardly into said receptacle. Secured to the piston rod 34 is a collar 36, and disposed between the collar and the partition 11 of the tubular member 8 is a spring 37 which tends to keep the valve 35 normally seated in the valve opening 6. The piston 33 is provided with valve openings 38 therethrough, and with pivoted valve disks 39 to permit the passage of fluid through the piston in one direction. Extending through the piston rod from the end adjacent the valve 35 is a passage 40, which extends to a point adjacent the piston 33, and from which the lateral passages 41 extend to form direct communication with the inside of the receptacle 5.

A secured closed fluid receptacle 42 is provided with a tubular connection 43 which forms communication between it and the chamber 31, and a check valve 44 is disposed in the tubular connection 43, to permit fluid to flow from the receptacle 42 into the chamber 31, but not in the opposite direction. The receptacle 42 is also provided with a tubular connection 45 which forms connection between it and the receptacle 5, so that the pressure within the receptacle 5 is communicated directly to the receptacle 42.

Extending from the receptacle 5 are any number of service pipes 46 (only one being shown in Fig. 1) for conveying the gases under pressure to any suitable engine or engines 47, and a valve 48 is commonly provided to control the supply of gas. It is to be understood, of course, that the gas may be utilized for propelling an engine of the reciprocating type or of the turbine type, which, however, forms no part of the present invention.

In order to maintain the gases in the receptacle 5 and in the explosion chambers at a proper temperature, and, in order to prevent the waste of any heat generated by the explosion of the gas, these parts are provided with a heat insulating casing preferably comprising a plurality of heat insulating casings 49, one within the other, and spaced apart by suitable blocks 50. In order to hold the heat insulating casings in position, a metal band or casing 51 is commonly provided on the outside of the other casings 49. This construction provides insulating air spaces 52 between the several casings, which, although they need not be air-tight, are preferably as nearly air-tight as possible. Any number of insulating casings as desired may be employed, and it is understood, of course, that they are designed to cover any of the parts in which it is desired to retain heat.

In operation, the action of this apparatus is substantially as follows: The receptacle 42 is filled with some substance which is readily vaporized, such for example as water, and an explosive gaseous mixture is fed to the explosion chamber 9, through one of the valves, by means of the compressor 27, so that an explosive mixture under sufficient pressure will be contained in the explosion chamber 9. The object of having the two valves 14 and 15 is to provide means for scavenging the chamber after an explosion, if desired, it being necessary only to arrange the cams 18 upon the shaft 17 in the well-known manner to accomplish this result. Assuming that this device has been in operation, and that a gas under pressure has been stored in the chamber 5, it will be evident that the pressure upon the liquid in the receptacle 42 will be the same at both ends, even with the check valve 44 open, for the tubular connection 45 communicates the pressure in the receptacle 5 directly to the receptacle 42; and, when the valve disks 39 are open, a direct connection will be formed through the tubular member 43, through the chamber 31, the passages 32, spaces 10 and the openings 7, with the interior of the receptacle 5; thus it will be seen that the spring 37 maintains the valve 35 in closed position. When an explosive mixture has been admitted to the explosion chamber 9 and is expanded by means of the spark plug 16, the valve 35 will be forced open by the explosion, carrying with it the valve stem or piston rod 34 and the piston 33. This action will force the fluid contained in the chamber 31 on the side opposite from the tubular connection 43 through the passages 41 and 40 of the piston rod and through the passages 32 and the spaces 10 outwardly through the openings 7 into the receptacle 5. The fluid which is thus ejected into the receptacle 5 is either in a very highly heated state or is already vaporized, due to its contact with the wall of the explosion chamber, so that when it is forced into the receptacle 5 adjacent the valve 35, by reason of the explosion, the highly heated expanding gases of explosion coming in contact with the water will instantly vaporize it and cause its pressure to be correspondingly increased. It will be seen, therefore, that not only will the exploded gases be contained in

the receptacle 5, but also the heat of the explosion will be utilized to vaporize another substance, which will also be stored in the receptacle.

Although but a single explosion device is shown, it is obvious that any number of such devices might be employed in connection with a single power storage receptacle, and that the pressure generated by such devices could be controlled at will within certain limits. Furthermore, the pressure obtained from such a storage receptacle would be practically constant, so that it is suitable for use in connection with any kind of reciprocating or rotary engines. The efficiency of such an apparatus is dependent upon the heat insulation thereof, and the more nearly perfect the insulation is, the greater is the efficiency of the apparatus.

What I claim is:

1. The combination with a storage chamber for expanded gases, of an explosion chamber connected therewith and means for discharging an expansive fluid into the storage chamber when an explosion occurs in the explosion chamber.

2. The combination with a storage chamber for expanded gases, of a receptacle connected therewith forming an explosion chamber, a fluid containing means for communicating with the storage chamber, and means operated by an explosion in the explosion chamber for feeding fluid into the storage chamber.

3. In a device of the class described, the combination with a receptacle forming a storage chamber for expanded gases, of a receptacle connected therewith forming an explosion chamber, means for containing a liquid for communication with the storage receptacle about the explosion chamber, and a valve between the explosion chamber and the storage chamber having means connected therewith for feeding fluid into the storage chamber when an explosion occurs.

4. In a device of the class described, the combination with a receptacle forming a storage chamber for expanded gases, of a receptacle connected therewith forming an explosion chamber, means for containing a liquid for communication with the storage receptacle about the explosion chamber, and a valve between the explosion chamber and the storage chamber having means connected therewith for feeding fluid into the storage chamber simultaneously with the opening of the valve whereby the fluid is vaporized by the heat of the explosion.

5. A device of the class described, the combination with a receptacle forming an explosion chamber, another receptacle forming a fluid containing chamber, an outwardly opening valve in the explosion chamber having a piston connected therewith in the fluid containing receptacle, fluid discharging openings adjacent the said valve, and means for exploding a gaseous mixture in the explosion chamber whereby the valve is opened outwardly causing the piston to eject the fluid from the fluid receptacle adjacent the valve, the heat generated by the explosion vaporizing the fluid discharged adjacent the valve.

6. In a device of the class described, the combination with a receptacle forming an explosion chamber, of another receptacle forming a fluid containing chamber, the first named receptacle having a fluid receiving space in its walls, and means for connecting the said space with the fluid containing chamber, a valve for the explosion chamber, a piston for the fluid chamber and means forming a common connection between the valve and the piston whereby the movement of one will cause the movement of the other.

7. In a device of the class described, the combination with a receptacle forming an explosion chamber, of another receptacle forming a fluid containing chamber, the first named receptacle having a fluid receiving space in its walls, and means for connecting the said space with the fluid containing chamber, a valve for the explosion chamber, a piston for the fluid chamber and means forming a common connection between the valve, and resilient means tending to maintain the valve normally in closed position.

8. In a device of the class described, the combination with a receptacle forming an explosion chamber, of another receptacle forming a fluid containing chamber, a valve for the said explosion chamber, a piston for the fluid containing chamber, and a common connecting member for the valve and the piston having a passage extending therethrough from the fluid containing chamber outwardly through the end adjacent the valve.

9. In a device of the class described, the combination with a receptacle forming an explosion chamber, of another receptacle forming a fluid containing chamber and concentric with the other chamber, a valve for the explosion receptacle, a piston for the fluid chamber, means forming communication from the fluid receptacle to discharge adjacent the valve, and means forming a common connection between the valve and the piston and additional valves through said piston to permit the movement of fluid therethrough in a single direction.

10. The combination with a storage receptacle for expanded gases, of another receptacle forming an explosion chamber, a receptacle forming a fluid containing chamber, means forming a fluid containing passage from the fluid chamber around the storage receptacle, the said storage receptacle being provided with a valve opening communicating with the explosion chamber and

with openings inclined toward the valve opening, a valve disposed in the valve opening and movable inwardly in the storage chamber, a piston movable in the fluid chamber and a hollow rod connecting the piston and the valve and forming a passage from the fluid chamber into the storage chamber through the valve, a spring tending to keep the valve seated in the valve opening, and means to explode a charge in the explosion chamber whereby the valve will be opened against the spring and fluid will be forced through the inclined openings and said passages from the fluid chamber in the direction of the valve so that heat of the exploded gases may be utilized to vaporize the fluid.

11. In a device of the class described, the combination with a receptacle forming an explosion chamber, another receptacle forming a fluid chamber, a valve for the explosion chamber, a piston for the fluid chamber, means connecting the valve and the piston, fluid containing means extending from one end of the fluid chamber in the direction of the valve, means to supply fluid to the fluid chamber at the other end thereof on the opposite side of the piston and valves in the piston to permit fluid to pass therethrough in one direction only.

12. In a device of the class described, the combination with a receptacle forming a storage chamber for expanded gases, of a receptacle comprising an explosion chamber having communication therewith, a receptacle comprising a fluid chamber, means forming communication from the fluid chamber with the storage receptacle, and a fluid containing receptacle having communication with the storage chamber and with the fluid containing chamber.

13. In a device of the class described, the combination with a receptacle forming a storage chamber, another receptacle comprising an explosion chamber having communication therewith, a fluid containing receptacle having direct communication with the storage chamber adjacent the opening between the other chambers, a fluid containing receptacle, tubular connecting means between the fluid receptacle and the fluid chamber, a valve between the storage chamber and the explosion chamber, a piston movable in the fluid chamber, valves in said piston to permit fluid to pass therethrough, means forming direct connection between the valve and the piston, a spring tending to hold the valve in closed position, means to supply an explosive mixture to the explosion chamber, and an ignition device to explode the charge in the explosion chamber whereby the valve is opened against the tension of the spring and the piston is moved to cause the fluid to be injected into the storage chamber adjacent the valve where it is vaporized by the heat of the explosion.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 17th day of January A. D. 1913.

EDWARD E. GRAY.

Witnesses:
CHARLES H. SEEM,
K. W. WONNELL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."