No. 745,578. PATENTED DEC. 1, 1903.

C. G. DEAN.

APPARATUS FOR SUPPLYING EXPLOSIVE ENGINES WITH EXPLOSIVE MIXTURE.

APPLICATION FILED APR. 10, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

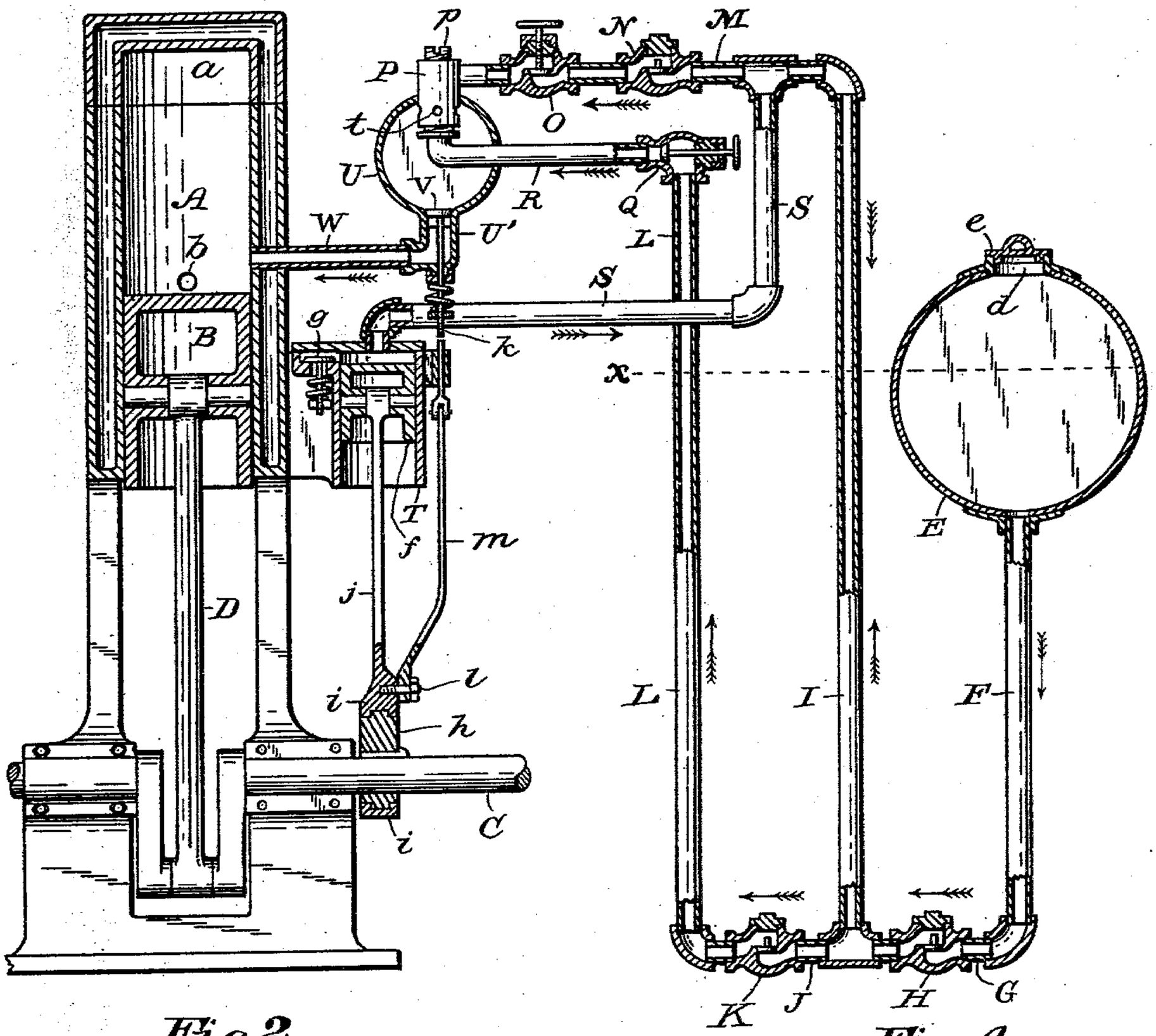


Fig. 2.

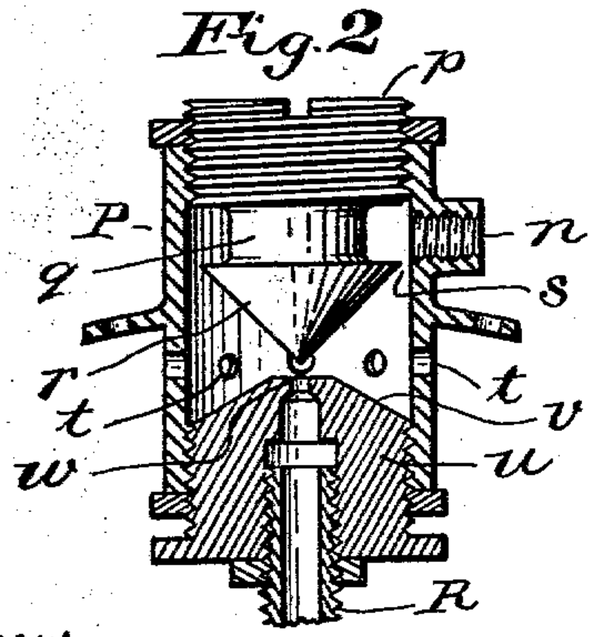


Fig. 3.

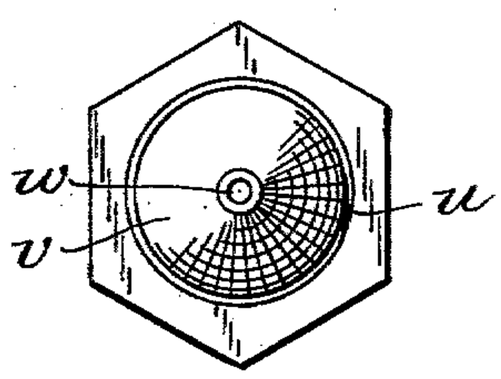
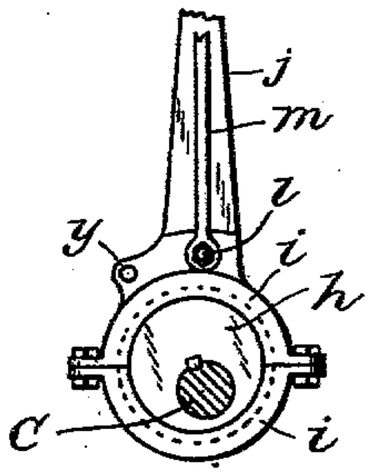


Fig. 4.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 5.

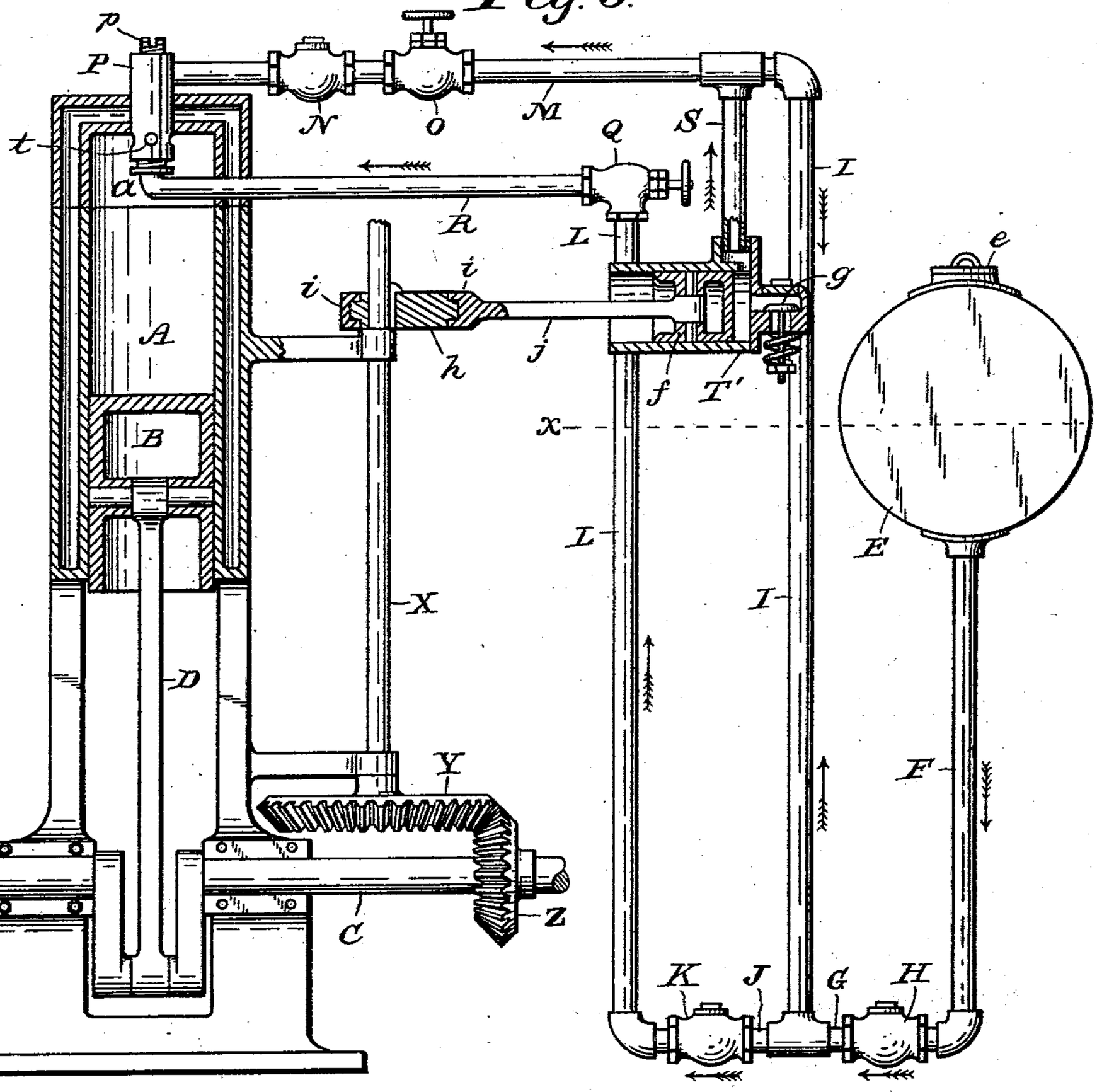
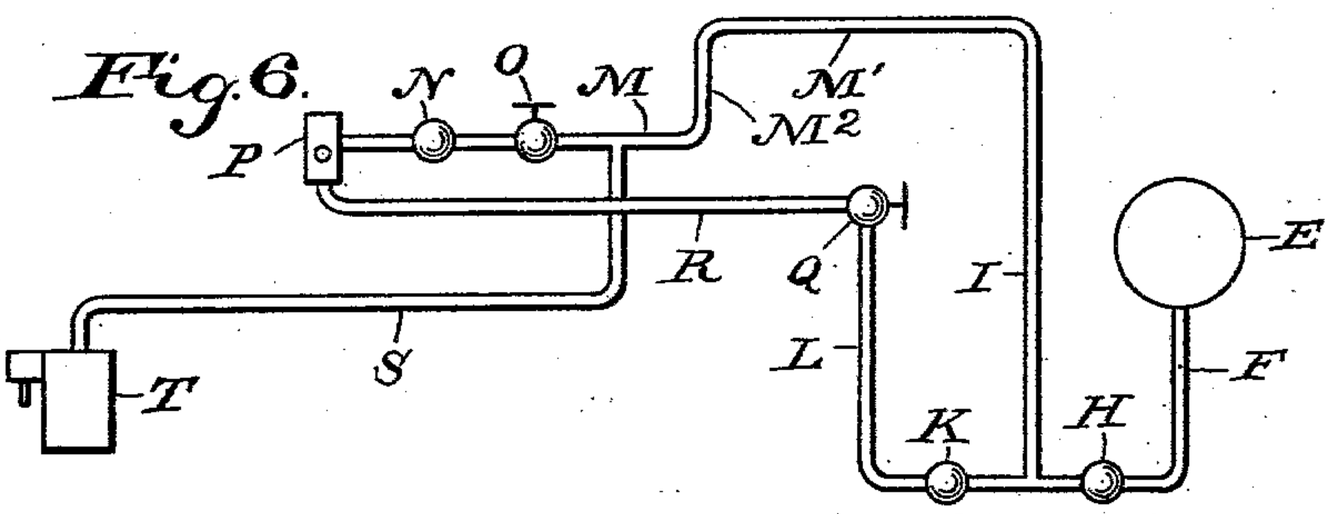


Fig. 6.



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UNITED STATES PATENT OFFICE.

CHARLES G. DEAN, OF INDIANAPOLIS, INDIANA.

APPARATUS FOR SUPPLYING EXPLOSIVE-ENGINES WITH EXPLOSIVE MIXTURE.

SPECIFICATION forming part of Letters Patent No. 745,578, dated December 1, 1903.

Application filed April 10, 1903. Serial No. 151,975. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. DEAN, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented new and useful Improvements in Apparatus for Supplying Explosive-Engines with Explosive Mixture; and I do hereby declare the following to be a full, clear, and exact description of the invention, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to means and appliances for conveying and feeding oil or the like liquid and converting the same into explosive mixture or vapor near to or in cylinders of explosive-engines, the invention having particular reference to a series of conduits, a pump and pump-barrel, and a vaporizer comprised in a mechanical system.

The object of the invention is to improve the features of construction of apparatus for supplying explosive-engines with explosive mixture, to the end that such engines may be operated safely, economically, and conveniently.

My invention consists, broadly, in a novel application of an air-pump to a vaporizer and also to the oil-supplying conduit for the vaporizer, whereby the oil and the air required in producing the explosive mixture or vapor may be supplied to the vaporizer simultaneously in impulses.

The invention consists, specifically, in a novel vaporizer, a novel arrangement of valves in the oil-supplying conduit, and an air-pump having novel forms of connections with the engine and also with the oil-supplying conduit and the vaporizer.

The invention consists, further, in the parts and the combination and arrangement of parts, as hereinafter particularly described and claimed.

Referring to the drawings, Figure 1 illustrates my invention as when applied to a two-cycle upright engine, only so much of the latter being shown as will give a comprehensive understanding of the invention, the engine cylinder and piston and other parts being shown in central vertical section, while the conduits and pump-barrel are in elevation, partially in section, and are rather diagrammatic than arbitrary in arrangement; Fig. 2, a vertical central sectional view of the vaporizer, showing the internal construction thereof; Fig. 3, a top plan view of the lower portion of the vaporizer from which the oil issues; Fig. 4, a side elevation of an eccentric and strap, showing means whereby the strap may operate the valve for admitting charges of the explosive mixture into the cylinder; Fig. 5, an elevation of the series of conduits and pump-barrel and vaporizer as arranged for four-cycle engines, the pump being connected to a geared shaft having half as many revolutions as the crank-shaft of the engine, the arrangement of the pump being for illustrative purposes rather than arbitrarily, the vaporizer being shown in the explosion-chamber of the cylinder; and Fig. 6, a diagrammatic elevation illustrating modifications in the arrangement of the oil and air conduits and apparatus.

Similar reference characters in the several figures of the drawings designate like parts or features.

In practically carrying out the purpose of my invention I may supply a separate vaporizing-chamber, in which the hydrocarbon vapor may be made, and connect the chamber with the cylinder of the engine, as in Fig. 1, or I may arrange the vaporizer in the head of the cylinder, as in Fig. 5, or in a suitable explosion-chamber connected to the cylinder. Also the air-pump may either be adapted to operate vertically or be modified so as to operate horizontally. When horizontal, the pump-cylinder will obviously be arranged near the engine and not isolated, as indicated in Fig. 5. The air-pump proper is provided with a pump-barrel of more or less length, which is connected to the cylinder of the pump, the barrel being connected to the oil-supplying conduit, and an air-supplying conduit is connected either to the barrel or directly to the cylinder in which the piston works and to the vaporizer. The pump-barrel is of suitable length and height to permit oil to rise therein from the oil-supplying conduit without flowing into the pump-cylinder, and it is designed that the air forced by the pump-piston shall act as a piston on the oil in the barrel to expel the oil therefrom, so

that at each impulse caused by the piston a portion of the oil may be forced into the oil-supplying conduit, and thus cause a charge of oil to be forced from the conduit into the vaporizer at the same time that a jet of air will be expelled from the air-conduit into the vaporizer.

In the drawings, A designates the cylinder of an explosive-engine, which may have an exhaust-port *b*; *a*, the cylinder-head, B the piston, C the crank-shaft, and D the pitman, thereof. The engine may be either a vertical or a horizontal type.

An oil-tank E is suitably supported in a convenient position and has a top opening *d*, provided with a cover *e*, which may fit loosely, so as to afford a vent without providing one specially. The tank and the connecting ducts or conduits may all be arranged in an engine-frame on new engines; but in applying my apparatus to old engines conduits formed of pipes and separate tanks are employed, and this plan is herein shown as being the most convenient form for illustration of the invention. An oil-supplying conduit is connected to the tank and also to the vaporizer, and for descriptive purposes the conduit will be referred to as being composed of connected upright and horizontal sections, an upright section F being connected to the lower portion of the tank E and extending preferably to a lower plane than that of the tank. A horizontal section G joins the section F and is provided with a check-valve H, designed to permit a free flow through the conduit from the tank and to prevent a return-flow toward the tank. The check-valve, however, may be situated in the section F, if desired. A horizontal section J is suitably joined to the section G and is provided with a check-valve K, also designed to permit a flow through the conduit from the tank toward the vaporizer and to prevent return-flow. A vertical section L joins the section J and is in connection with a section R, which is connected with the vaporizer P. A regulating-valve Q is provided in the oil-supplying conduit and is preferably situated, as shown, between the sections L and R thereof, although it may be arranged elsewhere in the conduit, and in some cases it may be dispensed with. If desired, the check-valve K may obviously be situated in the section L. A pump-barrel I, which is preferably vertical, or nearly so, is connected to the oil-supplying conduit at a suitable point thereof between the two check-valves H and K and rises to a greater elevation than the top of the tank E, the barrel being connected by means of a branch S to the cylinder of an air-pump T or T′, which will be further described, the barrel being for practical purposes a part of the cylinder and designed to receive oil in the lower portion thereof and to prevent the oil from passing into the cylinder. An air-supplying conduit M for the vaporizer P is connected thereto and also to the branch S of the pump-barrel, or it may be connected either to the barrel proper or to the cylinder of the pump, as will be obvious, and it is provided with a check-valve N and a regulating-valve O, the check-valve being designed to prevent a flow from the vaporizer and to permit a flow thereto. The valves N and O, however, are of minor importance and may in some cases be dispensed with.

It is designed that the upper portion of the barrel I and connecting branch S shall perform the function of an arch rising above the oil-tank, and in some cases, as illustrated in Fig. 6, a section M′ may be arranged in a higher plane than that of the conduit M, and a section M^2 (or branch) will then connect the conduit M and section M′, the barrel I rising to the section M, and being connected therewith. Obviously in this case the branch S may be connected with either the section M′ or the upper portion of the barrel I.

The air-pump comprises a hollow cylinder having a head at one end thereof and open at its opposite end, a piston *f* and an inlet-valve *g* lightly spring-pressed at the closed end of the cylinder, the same end being connected with the branch S of the pump-barrel. The piston may suitably be operated by means of an eccentric *h*, which may be secured to the crank-shaft C of a two-cycle engine, as in Fig. 1, an eccentric-strap *i*, and a connecting-rod *j*.

In case a vaporizing-chamber is provided, it will include a shell U, having a valve-chamber U′, and a valve V, having a stem *k*, a suitable spring normally holding the valve to its seat. The chamber U′ is provided with a conduit W, connected with the cylinder A of a two-cycle engine near the exhaust-port *b*, between the same and the cylinder-head *a*. The conduit W may, however, be connected with the head end of the cylinder in other types, as in four-cycle. In the two-cycle type the valve V is operated by means of a wrist-pin *l*, attached to one side of the strap *i*, and a push-rod *m*, connected to the pin, or the rod *m* or a similar one may be connected at a pin-hole *y* in the front or the rear of the strap *i*.

The vaporizer P comprises a shell adapted to be set with its outlet-openings within the vaporizing-chamber or within the cylinder or its explosion-chamber, while a portion of the shell extends beyond, to which the conduit M is connected, an aperture *n* being provided for admitting the air from the conduit. The upper end of the vaporizer has an adjustable plug *p* inserted therein, the plug having a neck *q* and a conical head *r*, the base of the head being attached to the neck and of greater diameter than the neck, but less than the internal diameter of the shell, so that an annular passage *s* is provided between the base of the head and the shell, the latter having the outlet-openings *t* within the chamber U or the explosive-chamber of the cylinder and about the apex of the head *r*, the latter being below the base. The neck *q* is opposite

to the opening *n*. Below the head *r* is a plug *u*, adjustably inserted in the shell of the vaporizer, and this has a duct therein and a conical top *v*, in the apex of which is an orifice *w*, opposite to the apex of the head *r*, the orifice being the end of the duct in the plug with which the section R is connected.

In four-cycle engines usually a shaft X is found that is driven by a suitable gear Y, attached thereto, in connection with a suitable gear Z, secured to the crank-shaft C, for operating various valve mechanism, and in this case the eccentric *h* is secured to the shaft X, this having the proper ratio of speed. Other suitable means, however, may be employed for operating the air-pump.

It will be understood that in practice suitable provision is made for heating the vaporizer or its connections artificially before starting the engine, and when the chamber U is employed it may be inclosed in a casing, through which the exhaust-vapors from the engine may be conducted in the usual manner for heating the vaporizer while in operation.

In practical use the tank or reservoir E may be supplied in any suitable manner with liquid hydrocarbon, which may be replenished at any time while operating the engine. The hydrocarbon will flow through the conduit-sections F and J and the check-valves H and K, rising in the barrel I and the section L to its level in the tank, as to the broken line *x*. The engine, and consequently the air-pump connected thereto, may then be started in the usual manner. Atmospheric air will be drawn into the pump through the valve *g* and discharged into the branch S, flowing impulsively under pressure into the conduit M and the barrel I and to the top of the oil in the latter and also to the vaporizer P. By means of the check-valves K and N the air will be prevented from being drawn from the branch S into the cylinder during the outstrokes of the pump-piston. The regulating-valve O may be manipulated to control the amount of flow of air to the vaporizer, while the air-pressure acting on top of the oil in the barrel I in the direction of the upper arrow thereat will cause pulsations of the oil and force the oil in the section L through the valve Q and the section R into the vaporizer from the orifice *w*, the check-valve H resisting the pressure. The valve Q may be manipulated in governing the amount of oil passing into the vaporizer, in which the air and oil will meet, the air being forced through the annular opening *s* and breaking up and vaporizing the oil will mix therewith as vapor and pass through the apertures *t* into the chamber U or the cylinder-chamber, as may be designed. After the operation becomes complete the oil will stand in the sections R and L, being retained by the valve K, and in the plug *u* ready to be ejected by each air impulse, and thus only the required amount of the explosive mixture may be produced for each charge as it is needed by the engine, the pump working in harmony with the engine-piston. During the instroke of the pump-piston, as in Fig. 1, the explosive mixture will be produced while exhaust takes place through the opening *b*. After the piston B closes the opening *b* the rod *m* will engage the stem *k* and open the valve V, admitting a charge of explosive into the cylinder A to be compressed and exploded by the usual means. With a reverse movement of the rod *m* the valve V will be permitted to close. It will be understood that the air-pump should be properly designed as to capacity in order to avoid excess pressure in the air-supplying conduit and in the pump-barrel, and in case the pump has too great capacity it is obvious that suitable vents should be provided which may be adapted to be regulated whereby to prevent excess pressure.

Having thus described my invention, what I claim as new is—

1. Apparatus, for supplying explosive-engines with explosive mixture, including a vaporizer, means whereby the vaporizer may be fed with oil and air simultaneously in impulses, comprising an oil-reservoir, an oil-supplying conduit having connection with the oil-reservoir and also with the vaporizer, an air-supplying conduit having connection with the vaporizer, a pump-barrel having connection with the oil-supplying conduit, and means whereby air may be forced impulsively in the air-supplying conduit and in the pump-barrel and simultaneously into the vaporizer and also upon oil that may rise in the pump-barrel from the oil-supplying conduit.

2. Apparatus, for supplying explosive-engines with explosive mixture, including a vaporizer, an oil-reservoir, an oil-supplying conduit extending from the oil-reservoir to the vaporizer and connected therewith and having two check-valves therein adapted to prevent currents therein toward the oil-reservoir, an air-supplying conduit extending from the vaporizer and connected therewith, a pump-barrel operatively connected with the air-supplying conduit and also connected to the oil-supplying conduit between the two check-valves, and an air-pump in operative connection with the air-supplying conduit, and also with the pump-barrel, whereby air and oil may be simultaneously forced impulsively into the vaporizer.

3. Apparatus, for supplying explosive-engines with explosive mixture, including a vaporizer, an oil-reservoir, an oil-supplying conduit extending from the oil-reservoir to the vaporizer and connected therewith and having two check-valves therein adapted to prevent currents therein toward the oil-reservoir, a regulating-valve in the oil-supplying conduit, an air-supplying conduit extending from the vaporizer and connected therewith, a pump-barrel adapted to receive oil and air and connected operatively with the air-supplying conduit and also connected to the oil-supplying conduit between the two check-

valves, and an air-pump in operative connection with the air-supplying conduit and also with the pump-barrel, whereby air and oil may be simultaneously forced impulsively into the vaporizer.

4. Apparatus, for supplying explosive-engines with explosive mixture, including a vaporizer, an oil-reservoir, an oil-supplying conduit extending from the oil-reservoir to the vaporizer and connected therewith and having two check-valves therein adapted to prevent currents therein toward the oil-reservoir, an air-supplying conduit extending from the vaporizer and connected therewith and having a check-valve therein adapted to prevent currents from the vaporizer, a pump-barrel adapted to receive oil and air and connected with the air-supplying conduit and also connected to the oil-supplying conduit between the two check-valves, and an air-pump in operative connection with the air-supplying conduit and also with the pump-barrel, whereby air and oil may be simultaneously forced impulsively into the vaporizer.

5. Apparatus, for supplying explosive-engines with explosive mixture, including a vaporizer, an oil-reservoir, an oil-supplying conduit extending from the oil-reservoir to the vaporizer and connected therewith and having two check-valves therein adapted to prevent currents therein toward the oil-reservoir, an air-supplying conduit extending from the vaporizer and connected therewith and having a regulating-valve therein, a pump-barrel adapted to receive oil and air and connected to the air-supplying conduit and also connected to the oil-supplying conduit between the two check-valves, and an air-pump in operative connection with the air-supplying conduit and also with the pump-barrel, whereby air and oil may be simultaneously forced impulsively into the vaporizer.

6. In an explosive-engine, the combination with the explosion-chamber and with a movable element of the engine, of a vaporizer having communication with the explosion-chamber, an oil-reservoir, an oil-supplying conduit communicating with the oil-reservoir and also with the vaporizer and having two check-valves therein, a regulating-valve having operative connection with the oil-supplying conduit controlling the supply of oil to the vaporizer, an air-pump having operative connection with the movable element of the engine, a pump-barrel communicating with the pump and rising to a higher plane than that of the oil-reservoir and communicating with the oil-supplying conduit between the two check-valves and also having operative connection with the vaporizer, whereby air may be supplied to the vaporizer and also applied to oil in the pump-barrel simultaneously forcing oil to the vaporizer in impulses coinciding with the air-supply by means of a single air-pump operated in harmony with the piston of the engine.

7. In an explosive-engine, the combination with the explosion-chamber and with a movable element of the engine, of a vaporizer having communication with the explosion-chamber, an oil-reservoir having a vent, a conduit connected with the oil-reservoir and extending above the plane of the top of the oil-reservoir and communicating with the vaporizer, a pump-barrel connected to the conduit and extending above the plane of the top of the reservoir, and a pumping device having operative connection with the movable element of the engine and having communication with the pump-barrel and also with the vaporizer.

8. In an explosive-engine, the combination with the explosion-chamber and with a movable element of the engine, of a vaporizer having communication with the explosion-chamber, an air-pumping device having operative connection with the movable element of the engine, an air and an oil conduit section communicating with opposite ends of the vaporizer, an oil-reservoir, an oil-supplying conduit connected to the oil-reservoir and also to the said oil-section that is connected to the vaporizer, a pump-barrel connected to the oil-supplying conduit and also in communication with the said air-section, a check-valve in the oil-supplying conduit whereby oil may be prevented from returning to the oil-reservoir, a check-valve in the oil-supplying conduit whereby oil may be prevented from flowing from the vaporizer, and an air-supplying conduit having communication with the air-pumping device and with the pump-barrel and also with the said air-section that is connected with the vaporizer, whereby the vaporizer may be supplied with air and also air forced impulsively upon oil in the pump-barrel.

9. In an explosive-engine, the combination with the explosion-chamber of the engine, of a vaporizer having communication with the explosion-chamber, an air-pump having operative connection with the rotative shaft of the engine, an oil-reservoir, an oil-supplying conduit communicating with the reservoir and also with the vaporizer and having a regulating-valve and also two check-valves connected therewith, a pump-barrel communicating with the air-pump and extending to a higher plane than that of the reservoir and communicating with the oil-supplying conduit between the two check-valves, and an air-supplying conduit communicating with the vaporizer and also with the air-pump and having a regulating-valve and also a check-valve connected therewith between the vaporizer and the pump.

10. In an explosive-engine, the combination with the explosion-chamber of the engine, of a vaporizer having communication with the explosion-chamber and comprising a shell

having outlet-apertures in the body portion thereof, a plug in the shell and having a conical top and a central aperture, an oil-supplying duct connected with the aperture in the plug, a plug in the shell and having a conical head with its apex opposite the aperture in the first-described plug, the base of the head being less in the diameter than that of the shell thereat, and an air-supplying duct having communication with the interior of the shell beyond the base of the head oppositely to the apex thereof.

11. In an explosive-engine, the combination with the explosion-chamber and with a movable element of the engine, of a vaporizing-chamber, a conduit communicating with the vaporizing-chamber and also with the explosion-chamber and having a spring-pressed valve therein, a vaporizer connected to the vaporizing-chamber shell and having outlet-openings in the vaporizing-chamber, an oil-supplying conduit communicating with the vaporizer, an air-supplying conduit communicating with the vaporizer, an oil-reservoir in communication with the oil-supplying conduit, an air-pump in communication with the air-supplying conduit and having operative connection with the movable element of the engine, and means operated by the engine cooperating with the spring-pressed valve.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES G. DEAN.

Witnesses:

OSBORNE BOWLES,

E. T. SILVIUS.