J. McKECHNIE.

MEANS FOR SUPPLYING LIQUID FUEL TO INTERNAL COMBUSTION ENGINES.

APPLICATION FILED APR. 22, 1912.

1,066,936.

Patented July 8, 1913.

3 SHEETS—SHEET 1.

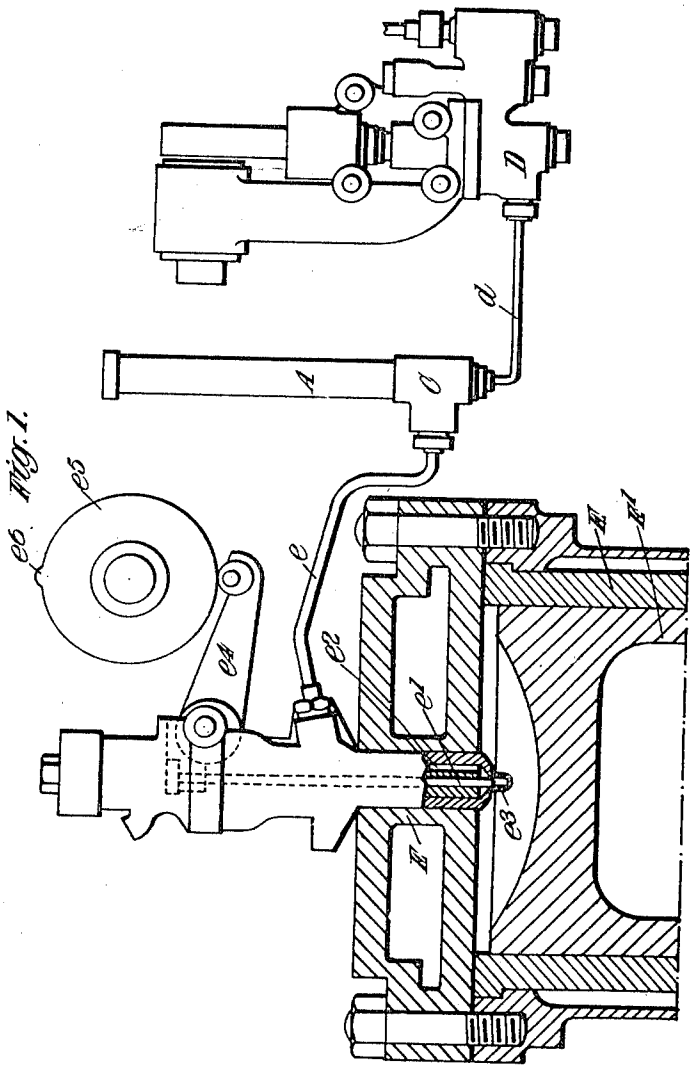

Fig. 1.

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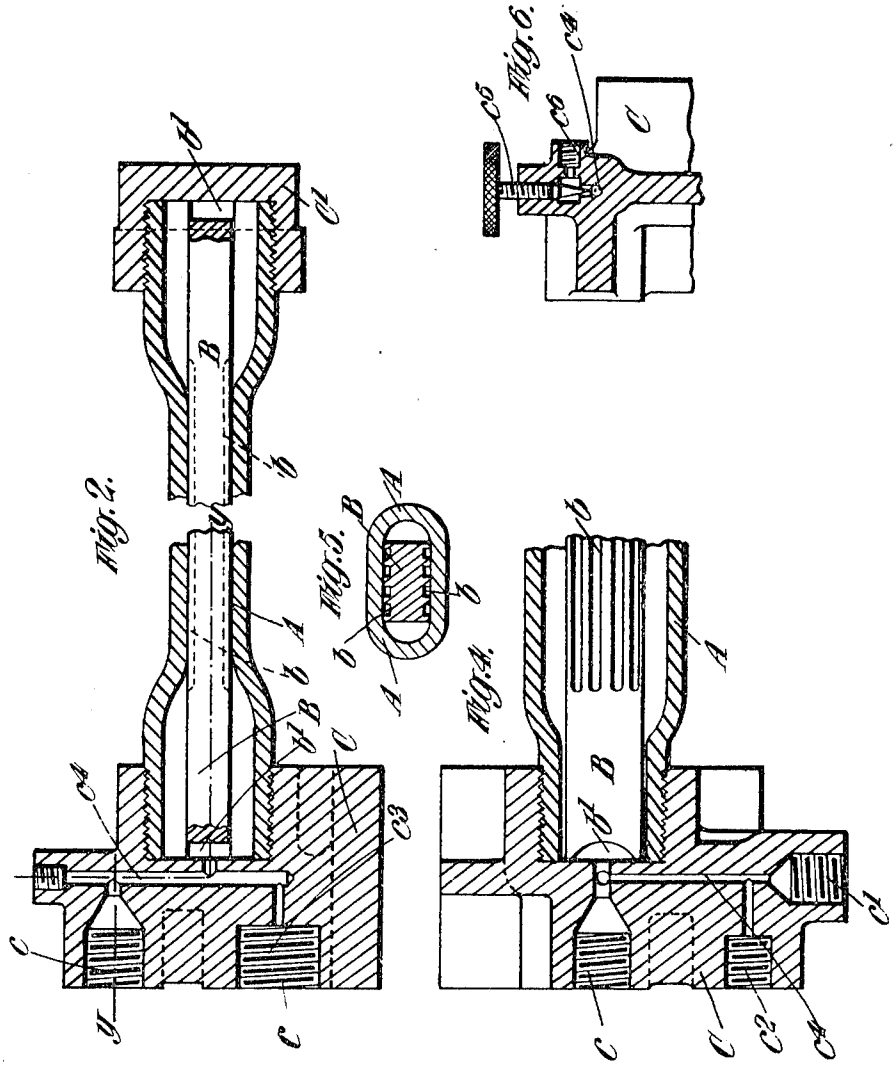

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Fig. 7.

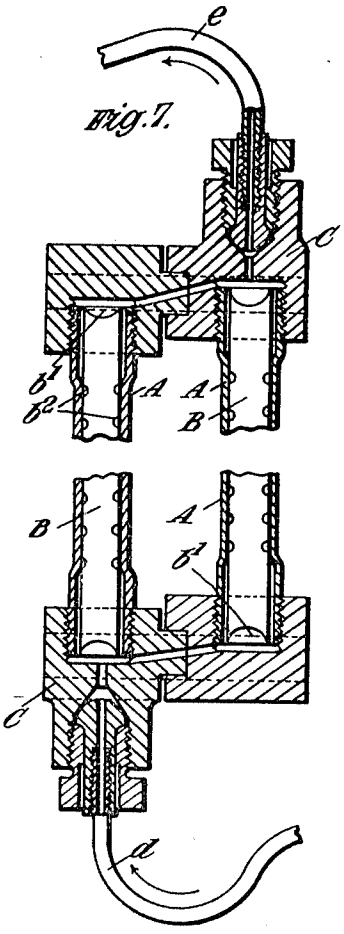


Fig. 3.

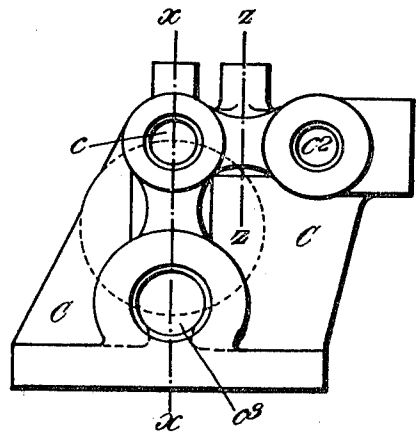
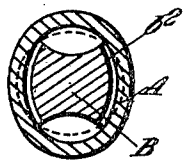


Fig. 8.



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UNITED STATES PATENT OFFICE.

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MEANS FOR SUPPLYING LIQUID FUEL TO INTERNAL-COMBUSTION ENGINES.

1,066,936. Specification of Letters Patent. Patented July 8, 1913.

Application filed April 22, 1912. Serial No. 692,231.

To all whom it may concern:

Be it known that I, JAMES McKECHNIE, a subject of the King of Great Britain, residing at Naval Construction Works, Barrow-in-Furness, in the county of Lancaster, England, have invented certain new and useful Improvements in Means for Supplying Liquid Fuel to Internal-Combustion Engines, of which the following is a specification.

This invention relates to means for supplying liquid fuel to internal combustion engines of the kind in which the fuel is injected suddenly under extremely high resilient pressure into a highly compressed charge of air in the cylinder.

According to this invention the apparatus employed for injecting the fuel comprises a tube or tubes the walls of which are made so as to yield slightly under high internal pressure, obtained by the action of a fuel delivery pump while the cylinder injection valve is held closed, and, on the opening of the said valve, to cause a contraction of the tubular volume and force a definite charge of fuel into the cylinder. For this purpose I propose to make the tube of elliptical or flattened cross section, so that, on subjecting it to the high internal liquid pressure, the walls tend to take a cylindrical form and the volume is thus increased to admit the charge, the amount of liquid admitted being determined by the pump. When the injection valve (preferably a needle valve at the cylinder end of the inlet passage) is opened, the tube walls return suddenly to their flattened form and force into the cylinder all the excess liquid admitted by the previous expansion of volume.

To prevent expansion of the tube until a predetermined high pressure has been reached a distance piece may be placed within the tube which prevents the full contraction of the walls to their free flattened form so that, on the relief of the internal pressure, they contract upon the distance piece with great force. When the internal pressure is sufficient to overcome this initial force the tube begins to expand. The distance piece may be in the shape of a rod bridging the shorter diameter of the tube throughout its length, but leaving space for the liquid at each side and having channels to allow the liquid to reach the flattened surface of the tube. By this device the injection of the full fuel charge is insured at each opening of the valve, as even at the end of the operation the contracting pressure of the tube walls is greatly in excess of the pressure inside the cylinder. Two or more such tubes may be employed, placed in parallel or series, according to the size of the engine and the amount of fuel to be passed through the tubes. The form of the tubes may also be varied as found desirable.

In order that the said invention may be clearly understood and readily carried into effect I will describe the same more fully with reference to the accompanying drawings in which:—

Figure 1 is a general view showing the application of the pressure tube to an engine. Fig. 2 is a longitudinal section of one construction of pressure tube device, taken on the line x—x of Fig. 3, which is an end elevation of the same. Fig. 4 is a longitudinal section taken on the broken line y—y of Fig. 2. Fig. 5 is a cross section of the tube. Fig. 6 is a detail section on the line z—z of Fig. 3. Fig. 7 shows in section a modification employing two tubes, and Fig. 8 is a cross section of one of these tubes.

A is the pressure tube.

B is the distance piece placed within the said tube to prevent its full contraction and produce an initial contracting pressure.

C is the tube fitting by which connection is made to the pump D and the engine cylinder E.

In the general arrangement shown in Fig. 1 the pressure tube A is placed between the pump D and the cylinder E, to which it is connected by the pipes d and e. The pump D is of a known type capable of producing an extremely high pressure. The liquid fuel is admitted to the cylinder under the extreme pressure due to the contraction of the tube walls, which have been expanded by the liquid forced in by the pump. The admission of the liquid fuel is controlled by the valve e' at the cylinder end of the inlet passage e^2, the liquid passing through fine holes in a spraying cap e^3 over the end of the passage. The valve is operated by the lever e^4 and cam e^5, the cam having a small projection e^6 on a circular periphery so that the opening of the valve is almost momentary and during the injection of the fuel the piston E′ has time to move only a short distance.

Referring to the special construction illustrated in Figs. 2 to 6, the tube A is shown of considerably flattened form except at its ends, which are left circular, and the distance piece B is made with longitudinal grooves b extending almost throughout its length and permitting the liquid readily to reach the flattened tube walls and to be expelled on the contraction of the tube. The ends of the grooves are exposed at the round ends of the tube so that free communication is established throughout the tube. The extremities of the distance piece are arched at b' to provide a cross passage at the ends.

One end of the tube is covered by the screwed cap C′, the fitting C being secured on the other end. The position of the fitting is however merely a matter of convenience and, as in the modification shown in Fig. 7, the liquid may be supplied from the pump at one end and expelled at the other; or supplied and expelled at any other convenient points. The connection to the pump is made through the inlet c and that to the engine through the outlet c'. A pressure gage may be fitted at c^2 and a relief valve at c^3. The tube and all the openings in the fitting C are inter-connected by the passages c^4. A needle stop valve c^5 shown in Fig. 6 is provided at the air vent c^6. This air vent should be placed at the highest point of the tubular pressure device in any construction which may be adopted. In the apparatus just described, the pressure tube is horizontal, so that the vent c^6 is situated well above it.

I prefer to construct the parts so that the initial pressure which must be exceeded before the tube A begins to expand is about 2000 lbs. per square inch and the maximum pressure, when the tube receives the full charge, may be from 4000 to 6000 lbs. per square inch. The tube must therefore be made of substantial thickness to provide for such high pressures by the distortion of its walls. At these pressures it is very desirable that there should be as few moving parts as possible, in order to avoid leakage, a small loss in the charge largely decreasing the efficiency of the engine. The tubular pressure device allows of ready application of the extremely high resilient pressure desired in order to provide for the sudden injection of the liquid fuel, without the use of a spring controlled plunger or other reciprocating or sliding member.

In the modification shown in Fig. 7 two pressure tubes A are provided, mounted in parallel on the fittings C which are placed at opposite ends, the pump pipe d being connected to one fitting and the cylinder pipe e to the other, so that the liquid passes through the tubes A on its way from the pump to the cylinder. The section of one of the tubes given in Fig. 8 shows it as of only slightly elliptical or flattened form, and the distance piece B is curved at its meeting faces to fit fairly closely against the inner surface of the tube across its reduced diameter. On charging the tube it is slightly expanded into the circular form, as shown by the dotted circle. The distance piece may be made with cross channels b^2 to permit ready access of the liquid between it and the contracted tube walls. The precise arrangement or number of tubes employed is immaterial and depends on the size and type of engine to which the device is fitted.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In an internal combustion engine, liquid fuel injecting means comprising a fuel pump, a tube adapted to expand slightly under high internal liquid pressure derived from the said pump, mechanical means for limiting the free contraction of the tube on release of pressure, and an inlet valve which on opening allows the tube to contract upon the liquid fuel and force it suddenly under high resilient pressure into the cylinder.

2. In an internal combustion engine, liquid fuel injecting means comprising a fuel pump, a flattened tube adapted to expand slightly by distortion of its walls under high internal liquid pressure derived from the said pump, an internal distance piece upon which the flattened walls of the tube collapse, and an inlet valve through which the liquid fuel is forced into the cylinder by the contracting pressure of the tube walls.

3. In an internal combustion engine, liquid fuel injecting means comprising a fuel pump, a flattened expanding pressure tube receiving the fuel, an internal distance piece on which the flattened tube walls contract, having fuel channels in its contacting faces, and an inlet valve through which the liquid fuel is forced into the cylinder by the contracting pressure of the tube walls.

4. In an internal combustion engine, liquid fuel injecting means comprising a fuel pump, an expanding pressure tube, a tube fitting through which the tube is connected to the said pump and to the engine cylinder, an air vent at the uppermost point of the said fitting, a stop valve controlling the said air vent and a fuel inlet valve through which the liquid fuel is forced into the cylinder by the contracting pressure of the tube walls.

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

JAMES McKECHNIE.

Witnesses:
CHARLES GEORGE ROBERTSON,
HENRY KING.