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M. J. KLEIN.

EXPLOSIVE ENGINE.

(Application filed Jan. 17, 1901.)

(No Model.)

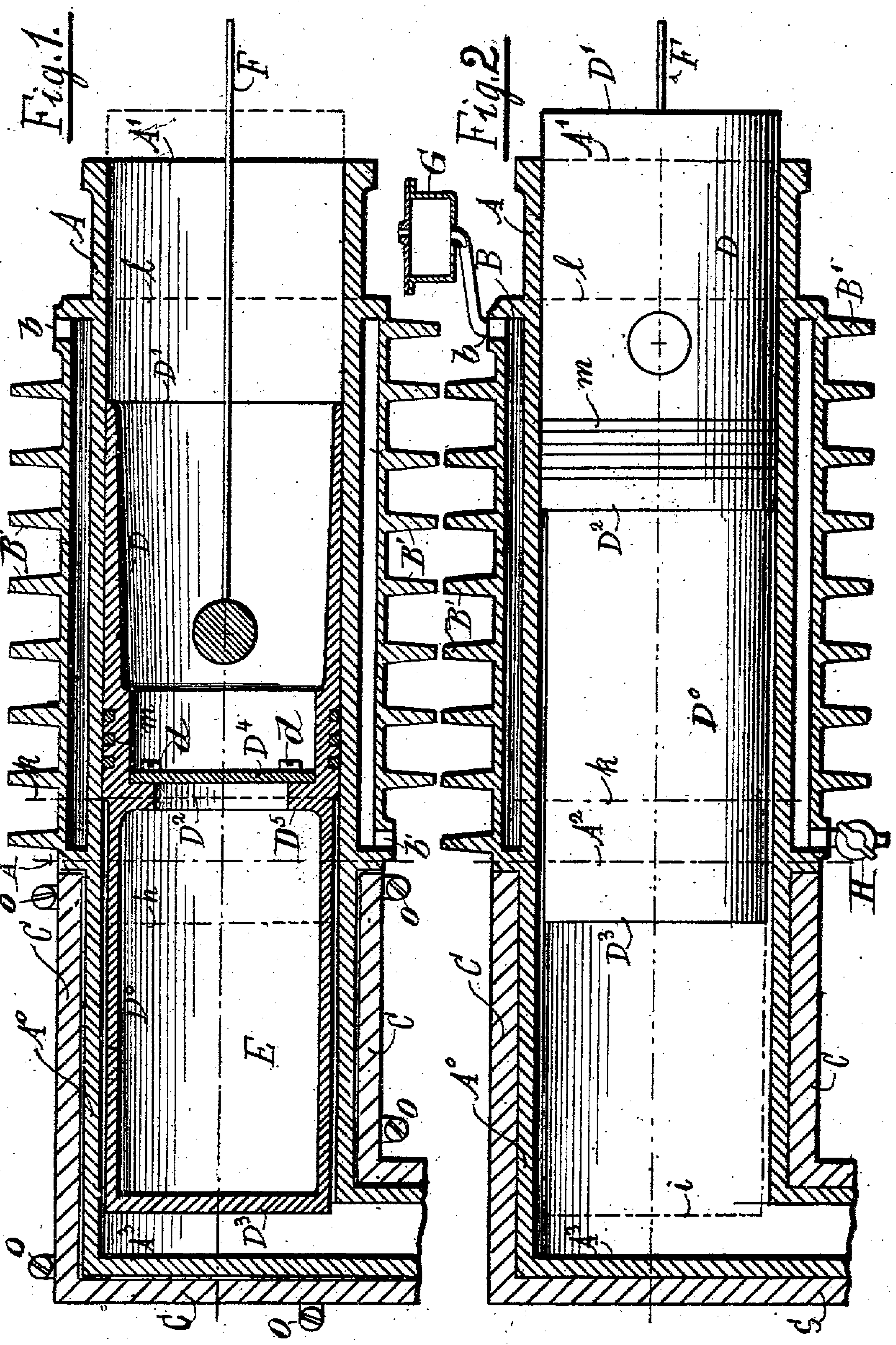

Fig. 1. Fig. 2.

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EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 704,713, dated July 15, 1902.

Application filed January 17, 1901. Serial No. 43,659. (No model.)

To all whom it may concern:

Be it known that I, MATHIAS J. KLEIN, a citizen of the United States, residing in the city of Baltimore, State of Maryland, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

This invention relates to gas, oil, and other explosive-engines of the four-cycle type. In such engines as they are usually constructed the cylinder needs artificial cooling in order to prevent the overheating of the cylinder and to avoid trouble with the piston lubrication. The amount of heat transmitted through the cylinder-walls is very high and is usually lost.

The object of this invention is to improve the long-known arrangement of cylinder and piston extension on the compression side of the cylinder and also to add other improvements regarding cylinder-cooling. I reduce thereby not only the loss of heat transmitted through the cylinder-walls, but also simplify the cooling of the cylinder, and the engine will properly work under much varied conditions—for instance, high speed or low speed of the engine, use of different kinds of oil or gas, high or low compression of the explosive gas and air mixture before ignition. In order to accomplish this, the cylinder and piston are increased in their lengths on the compression side of the piston. The increase in length is equal to the length of the piston-stroke or more. Said increases are called in the following "cylinder extension" and "piston extension." The former has the same diameter as the cylinder; but the piston extension is slightly smaller in diameter than the piston. That part of the cylinder which guides the piston is lubricated on the inside and cooled on the outside by a water-jacket. Air-ribs on the outside of the water-jacket cool the water inside of the jacket. The cylinder extension which incloses the compression-space has a removable insulation on the outside. The dry air in the hollow space of the piston extension represents an insulation on the inside of the latter.

This invention is fully illustrated in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of a single-acting cylinder of an explosive-engine of the four-cycle type provided with my improvement. The position of the piston is to the extreme left. Fig. 2 shows the same section of the cylinder with the piston in side view and in the position to the extreme right.

The same parts are marked with the same letters in both figures.

Those parts of the explosive-engine not shown may be of any suitable construction. The valves (not shown) are cooled in the usual way by air-ribs or a water-jacket.

Referring to Fig. 1, A is the cylinder which guides the piston D. The latter is connected by the connecting-rod F to the crank-shaft of the engine. (Not shown.) A^0, from A^2 to A^3, represents the cylinder extension. It has the same diameter as A, and its insulation C must be fireproof. The latter consists of two or more parts which are connected together by means of the screws *o o*. The whole insulation C can therefore quickly and easily be removed from the cylinder extension A^0 and put again around the same when required. The cylinder A, from A' to *k*, comes in touch with piston D and must be lubricated, which is done in some suitable way. (Not shown.) Cylinder A is cooled from A^2 to *l* by the water-jacket B. *l* may come more or less near to A'.

The air-ribs B' around the water-jacket B cool the water inside of the jacket, and this water cools the cylinder in a more uniform way than air-ribs alone could do it. The openings *b* and *b'* on the highest and lowest point of the water-jacket may be connected on the outside of the cylinder by a circulating-pipe open on its highest point to the atmosphere, or *b'* may be closed by the small water-cock H, Fig. 2, and *b* connected by a pipe to the small water-tank G, open on its top to the atmosphere and having a higher position than the water-jacket B, or *b* may be open to the atmosphere, as shown in Fig. 1, (*b'* being closed,) or to the opening *b* may be connected a check-valve opening to the outside and its valve pressing only lightly on its seat. In either of these cases there will be practically only atmospheric pressure (or a lower pressure) inside of the water-jacket B, and therefore the water in the jacket will not have a higher temperature than 212° Fahrenheit. The water-jacket cooling the valves of the engine may have connection with jacket B. All the water in the latter and in tank G may be taken out by means of water-cock H, Fig. 2.

The piston D, from D′ to D^2, with its piston-rings *m* near D^2, is guided and cooled by cylinder A. The piston extension D^0, from D^2 to D^3, is a little smaller in diameter than piston D. Its smaller diameter may be uniform, or it may decrease slightly from D^2 to D^3. This piston extension D^0 comes, therefore, never in touch with cylinder A or its extension A^0. It removes the compression-space with its very hot walls away from the water-jacket B.

i D^3, equal to *k* D^2, Fig. 2, represents the length of the piston-stroke, which is something shorter than the length of the piston extension D^2 D^3. D^2 moves between *k* and D^2, and D^3 between *i* and D^3 or D^3 and *h*, Fig. 1. The limit A^2 between water-jacket B and insulation C is placed about midway between D^2 and *h* or between *k* and D^3, Fig. 2. The plate D^4 (consisting of one or more parts and connected by means of the screws *d d* to ring D^5 inside of the piston) closes the hollow space E of the piston extension. The inclosed dry air or gas in E serves as an insulation, so that not much heat can escape through the open piston end D′.

The thin cylindrical ring of gas around the piston extension D^0 moves with the piston forward and backward. It takes up heat from the hot walls of the cylinder extension A^0 when the piston is moving to the left and gives this heat off to the cooling-water when the piston moves to the right. The amount of heat, however, transmitted in this way to the cooling-water is very small, because the said gas ring is very thin. (The diameter of the piston extension from D^2 to D^3 is only one or two per cent. smaller than the diameter of the cylinder.) Another small amount of heat will travel from the hot compression-space through the metals of A^0 and D^0 to the cool places A^2 and D^2 and will also be taken up by the cooling-water in the water-jacket, and some heat will go through the insulation C to the surrounding atmosphere; but all these losses of heat represent only a small part of the quantity of heat which goes through the cylinder-walls when the compression-space is directly cooled by a water-jacket or air-ribs. Usually the amount of heat transmitted to the water in jacket B will be so small that the air-ribs B′ will be able to take off all this heat, and consequently no evaporation of the water in jacket B takes place, and therefore said water will last for a long while. Should by a high speed of the engine the air-ribs B′ not be able to take off all the heat transmitted to the water in jacket B, then of course some water in the latter would evaporate and escape through the opening *b* as steam to the atmosphere, and therefore the water-tank G has to be filled up with water from time to time, so that the water-jacket B is always full of water when the machine is in operation. There, however, is no need for an extra water-cooler, and no water-circulating pump is required. The cooling of the cylinder is therefore a simple matter, and as the temperature of the water in jacket B does not go over 212° Fahrenheit there will be no trouble in regard to piston lubrication.

When the engine is used as a gas-engine or the engine using an oil having a low boiling-point—for instance, gasolene—and the compression of the explosive-gas mixture before its ignition is low, in such cases the average temperature of the walls of the compression-space will be moderately high and the engine having a construction as before described will work well; but in case an oil having a high boiling-point is used in the engine—for instance, ordinary kerosene, as used in lamps—and the compression of the explosive-gas mixture is very high before ignition of the same in such cases the average temperature of the walls of the compression-space will be much higher, as before, the explosive-gas mixture may be ignited too early by these hot walls, and consequently the engine will not work properly or may not work at all under such conditions. In such cases the removing of the insulation C and of piston-plate D^4 will restore the proper working of the engine. By taking out the screws (marked *c* and *d*) the insulation C and plate E^4 can both easily be removed. Now more heat will go through the walls A^0 and D^0 to the surrounding atmosphere. The engine does not work quite so economical as before; but the temperature of the walls of the compression-space will be kept sufficiently low for a proper working of the engine.

The shape of the air-ribs around the water-jacket B may be different from the shape shown in the drawings. The larger the surface of these ribs the better is their cooling effect. Whatever the position of the explosive-cylinder may be, *b* is always the highest and *b′* the lowest point of the water-jacket B, and the latter is so constructed that any steam produced inside of the jacket can escape at *b*. Usually, however, such steam is condensed inside of the jacket by the cooling effect of the air-ribs B′.

The cylinder and its extension are shown in the drawings as one piece of metal. They may, however, be constructed of several parts connected together. So, for instance, the cylinder from A′ to A^2 may be of brass, and the cylinder extension from A^2 to A^3 may be of steel, both connected at A^2. In the same way the piston and its extension (shown as one piece in the drawings) may be from D′ to D^2, for instance, of bronze and from D^2 to D^3 of steel or iron and both connected at D^2. Instead of different metals the same metal may be used.

In case the explosive-engine has more than one cylinder, in such case every cylinder is constructed as before described.

I am aware that cylinders of explosive-engines having on the compression side of the cylinder a piston extension entering into an insulated cylinder extension, while the other part of the cylinder is cooled by a water-jacket, have been constructed many years before. The present invention is an improvement of such an arrangement.

What I claim, and desire to secure by Letters Patent, is—

1. In an explosive-engine of the four-cycle type, the combination, of a single-acting cylinder, having on the compression side of the same an insulated cylinder extension, and on the other side of the cylinder a water-jacket, the highest point of the latter having communication with the atmosphere as described, said water-jacket being surrounded by air-ribs for cooling the water in the jacket, of a piston, having a hollow piston extension slightly smaller in diameter than the piston, in length equal to the piston-stroke or longer, and extending into the cylinder extension, the hollow space of the piston extension being closed to the atmosphere, for the purpose and substantially as shown and described.

2. In an explosive-engine of the four-cycle type, the combination, of the single-acting cylinder A, having the cylinder extension A^0, the latter being surrounded by the removable insulation C, the other side of the cylinder having the water-jacket B, the latter, by means of opening *b*, being in communication with the atmosphere as described, and having the air-ribs B′ for cooling the water in the jacket, of a piston D, having the hollow piston extension D^0, slightly smaller in diameter than piston D, its length D^2 D^3 being equal to the piston-stroke or longer and extending into the cylinder extension, the hollow space E of the piston extension being closed by the removable plate D^4, the whole constructed, to be operated and to work in the manner and for the purpose, substantially as described.

3. In an explosive-engine of the four-cycle type, the combination, of a single-acting cylinder, having on the compression side of the same a cylinder extension, and on the other side of the cylinder a water-jacket, the highest point of the latter having communication with the atmosphere as described, said water-jacket being surrounded by air-ribs for cooling the water in the jacket, of a piston, having a hollow piston extension slightly smaller in diameter than the piston, in length equal to the piston-stroke or longer, and extending into the cylinder extension, the hollow space of the piston extension being open to the atmosphere, for the purpose and substantially as shown and described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MATHIAS J. KLEIN.

Witnesses:

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F. LE GRAND CARLIN.