N° 15,250 A.D. 1900

Date of Application, 27th Aug., 1900
Complete Specification Left, 15th May, 1901—Accepted, 22nd June, 1901

PROVISIONAL SPECIFICATION.

"Improvements in Explosion and Combustion-motors"

I, WILHELM MAYBACH, of Cannstatt, in the Kingdom of Württemberg, German Empire, Engineer, do hereby declare the nature of this invention to be as follows:—

The object of this invention is to provide explosion motors with a device by which the discharge gases may be rapidly cooled whilst totally shut off from the atmosphere in order that a vacuum may be produced which is utilised as is hereinafter described. The condenser or other device in which the gases are cooled is provided with non-return valves and is in open connection with the closed crank chamber of the motor.

The vacuum created is utilised in the first place for drawing in fresh air while the discharge valve is open, which air completely drives the burnt gases out of the cylinder, and in the second place for reducing the counter pressure during the working stroke after the discharge valve has been closed up.

In known construction of motors provided with cooling apparatus for cooling down the discharge gases the obtained vacuum is utilised for drawing into the cylinder the fresh charge of explosive mixture whereas in my arrangement the air drawn in by the vacuum clears the cylinder of all burnt gases.

Also in devices hitherto employed the cooling apparatus is not in open connection with the closed crank chamber, by which arrangement the vacuum is still further increased and the counter-pressure is reduced during the working stroke of the piston.

In order to make my invention more clear, I refer to the accompanying drawings, in which:

a is the cylinder of the motor, a^1 the piston. The cylinder *a* is connected to a condenser *d* by means of a discharge pipe *c* and a discharge valve *e*. Any known form of condenser and any known system of motor may be used.

The piston a^1, as illustrated on the drawing, is in the middle-position of its discharge stroke. The discharge valve *e* is opened so that the discharge-gases are forced through the latter and through the pipe *c* into the condenser *d*. The latter is shut off from the atmosphere by means of non-return valves *f* of known construction which only open when an overpressure arises in the condenser. The hot exhaust gases forced into the condenser expand and cool down, so that a vacuum is produced in the working space of the cylinder. When now the air inlet valve *g*, adapted to be regulated in any suitable manner, is opened during the further upward movement of the piston, fresh air drives the rest of the burnt gases out of the cylinder into the condenser, and thus flushes the cylinder.

At its lower end the condenser is connected to the closed crank chamber of the motor by a pipe *h* terminating in the wall *b* of the chamber. During the discharge stroke, that is to say, whilst the discharge valve is opened, the three spaces *viz*:—the working space of the cylinder, the space in the condenser and the crank chamber or space behind the piston, form one single space which being totally shut off from the atmosphere does not get altered in its volume during the upward or downward movement of the piston. Thus overpressure in the

[*Price* 8*d*.]

condenser can arise only at the very beginning of the discharge stroke, as long as the discharge gases are of a little higher pressure than the atmosphere.

When the discharge valve is opened at the beginning of the discharge-stroke the hot products of combustion contained in the cylinder pass, owing to their overpressure, into the condenser and expel the remains contained in the same through the non-return valves *f* into the atmosphere. As soon as the pressure has been equalised the non-return valves close again and while the piston continues its back stroke, the gases are cooled and a vacuum is produced.

The production of the vacuum is accelerated by the pressing action of the piston during its return stroke, as the gases are pressed from the top part of the cylinder through the condenser into the space behind the piston, so that fresh quantities of hot gases are continually forced through the cooling apparatus. The inlet valve might be opened earlier or later as required.

In four stroke cycle motors the fresh air is sucked into the cylinder by the vacuum during the whole return-stroke of the piston, whereas in two stroke cycle motors the discharge-valve is closed up in about the middle of the piston stroke, immediately after air and gas or a mixture has been drawn into the cylinder, in order to obtain the charge to be compressed during the rest of the stroke.

Dated this 27th day of August 1900.

BOULT WADE & KILBURN
Agents for the Applicant.

COMPLETE SPECIFICATION.

"Improvements in Explosion and Combustion-motors."

I, WILHELM MAYBACH, of Cannstatt, in the Kingdom of Württemberg, German Empire, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The object of this invention is to provide explosion motors with a device by which the discharge gases may be rapidly cooled whilst totally shut off from the atmosphere in order that a vacuum may be produced which is utilised as is hereinafter described. The condenser or other device in which the gases are cooled is provided with non-return valves and is in open connection with the closed crank chamber of the motor.

The vacuum created is utilised in the first place for drawing in fresh air while the discharge valve is open, which air completely drives the burnt gases out of the cylinder, and in the second place for reducing the counter pressure during the working stroke after the discharge valve has been closed.

In known constructions of motors provided with cooling apparatus for cooling down the discharge gases the obtained vacuum is utilised for drawing into the cylinder the fresh charge of explosive mixture whereas in my arrangement the air drawn in by the vacuum clears the cylinder of all burnt gases.

Also in devices hitherto employed the cooling apparatus is not in open connection with the closed crank chamber, by which arrangement the vacuum is still further increased and the counterpressure is reduced during the working stroke of the piston.

Referring to the drawings filed with the Provisional Specification:—

The working or combustion space *a* of the cylinder of the motor is in communication with the cooling apparatus *d* by means of the exhaust pipe *c*. The

general construction of the last named as also of the whole motor does not form part of this invention as any construction of motor may be used. The piston a^1 is shown in the position it occupies when it has thrown about half of the exhaust out. The exhaust valve *e* is open and the exhaust gases can pass by means of the exhaust pipe *c* into the cooling apparatus or condenser *d*. The condenser is cut off from the outside air by means of non-return valves *f* so constructed that they only open when the pressure in the condenser rises unduly.

A vacuum is formed in the working space of the cylinder through the cooling of the hot gases in the condenser during the exit of the exhaust gases and during the time that the exhaust valve remains open, which is used to draw fresh air into the working space *a* of the cylinder through a valve *g* so that when the piston moves further forward all the products of combustion will be driven out by the double action of the piston and the incoming air.

The condenser *d* communicates at its lower end through the pipe *h* with the space at the forward end of the piston which is entirely closed in with a crank chamber *b*. During the exhaust (*i.e.* so long as the exhaust valve is open) the three spaces namely the working space of the cylinder, the cooling space, or interior of the condenser, and the crank chamber, form a single closed space the capacity of which is not altered by the play of the piston. It will be seen therefore that over pressure can only occur at the beginning of the exhaust stroke, whilst the exhaust gases are above atmospheric pressure, during which time the air valve *g* is kept closed.

When the exhaust valve *e* is first opened at the beginning of the exhaust stroke, the hot products of combustion that are contained in the cylinder being under considerable pressure force the remaining gases of the former exhaust from the condenser through the non-return valves *f*. So soon as the pressure has become equalised these valves close automatically and while the cylinder completes its return stroke a vacuum is formed in the condenser by the cooling of the gases. The formation of this vacuum is accelerated by the piston during its return stroke pressing the gases from the upper part of the cylinder through the condenser to the other side of the piston so that fresh charges of hot gas are continually made to pass through the condenser.

The air valve *g* is opened earlier or later for the admission of air according to the particular requirements of the motor used.

In four stroke cycle motors fresh air is sucked in by means of the vacuum during the whole of the back or exhaust stroke of the piston, whereas, in two stroke cycle motors the exhaust valve closes at about the middle of the stroke, but shortly before it closes air and gas or mixture is permitted to enter the cylinder which mixture helps to drive out the exhaust gases and forms the fresh charge to be compressed.

The above described apparatus has the advantage over other construction of motors in that at the beginning of the out stroke no hot gases remain in the cylinder which contains only the fresh charge, or air to form the charge. The result of this is a low burning temperature and therefore a smaller loss of heat through the walls of the cylinder. Also it is found possible by this means to compress the charge in the cylinder to a greater extent without its being necessary to advance the sparking.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is:—

1. In an explosion engine the combination with the cylinder of a condenser whereby fresh air is made to enter the cylinder during the in stroke of the piston substantially as and for the purpose described.

2. In an explosion engine the combination with the cylinder of an air inlet

valve *g* and exhaust valve *e* communicating with a condenser such as *d* having one or more non-return valves *f* substantially as and for the purpose described.

3. In an explosion engine the combination with the cylinder of a condenser the inlet of which communicates with the combustion space or end of the cylinder and the outlet with the other or front end of the cylinder or closed crank chamber *b* substantially as and for the purpose described.

4. A four-stroke cycle explosion engine in which air is drawn into the cylinder during the exhaust stroke of the piston whereby the exploded gases are discharged substantially as described.

5. A two-stroke cycle explosion engine in which during the return stroke of the piston air is drawn into the cylinder and the exploded gases partially driven out after which and during the same stroke a fresh charge is drawn in and the exhaust gases further expelled the exhaust valve being then closed and the charge compressed substantially as described.

6. An explosion motor having an inlet valve for admitting the explosive charge to the cylinder an air inlet valve such as *g* communicating with the cylinder a passage way *c* controlled by an exhaust valve *e* and communicating with one end of the condenser such as *d* one or more non-return valves such as *f* communicating with the lower end of the condenser and a passage way such as *h* connecting the lower end of the condenser with the enclosed crank chamber *b* of the motor substantially as described and illustrated in the accompanying drawings.

Dated this 15th day of May 1901.

BOULT WADE & KILBURN
Agents for the Applicant.

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MAYBACH'S COMPLETE SPECIFICATION.

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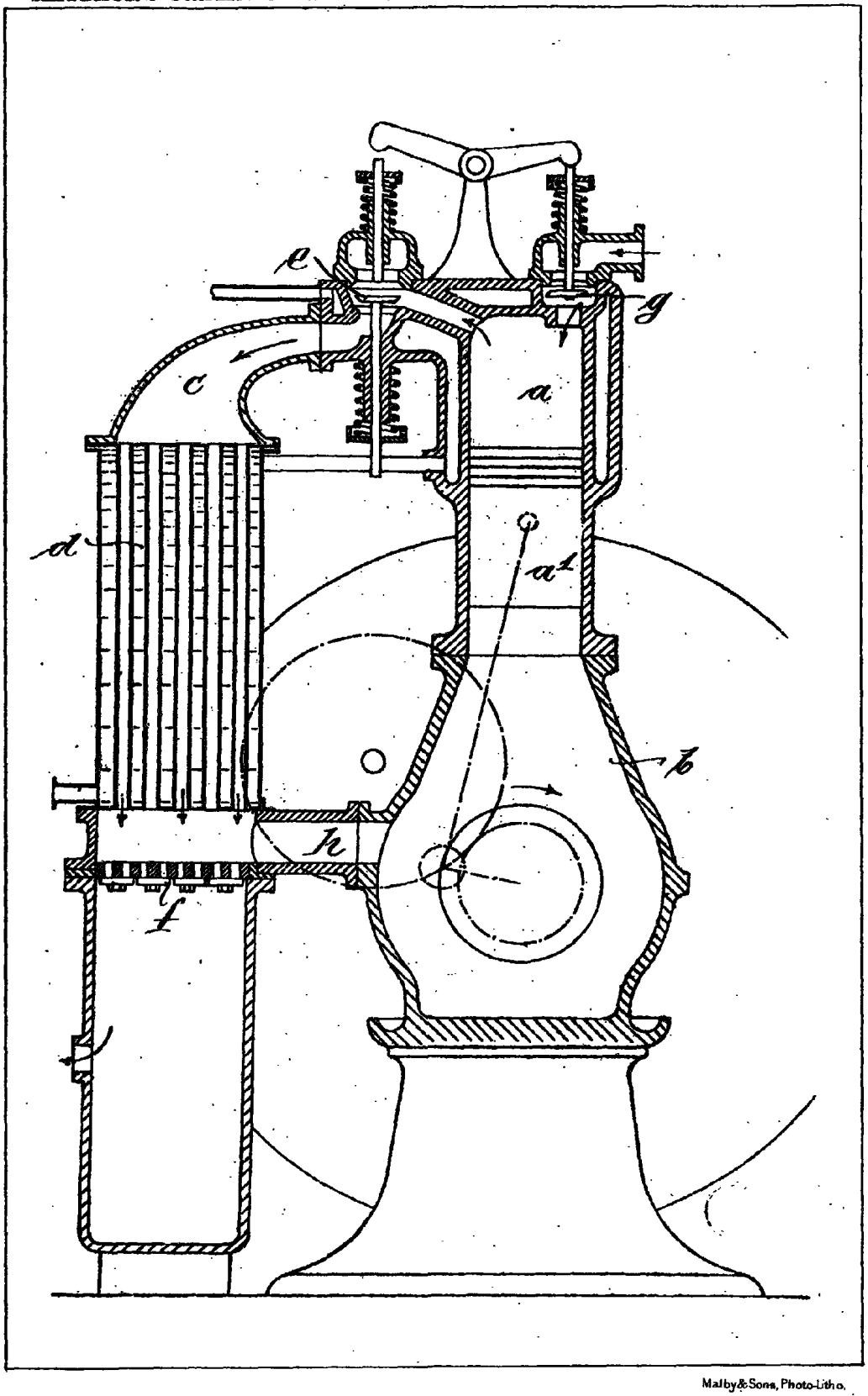

[This Drawing is a reproduction of the Original on a reduced scale.]

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