

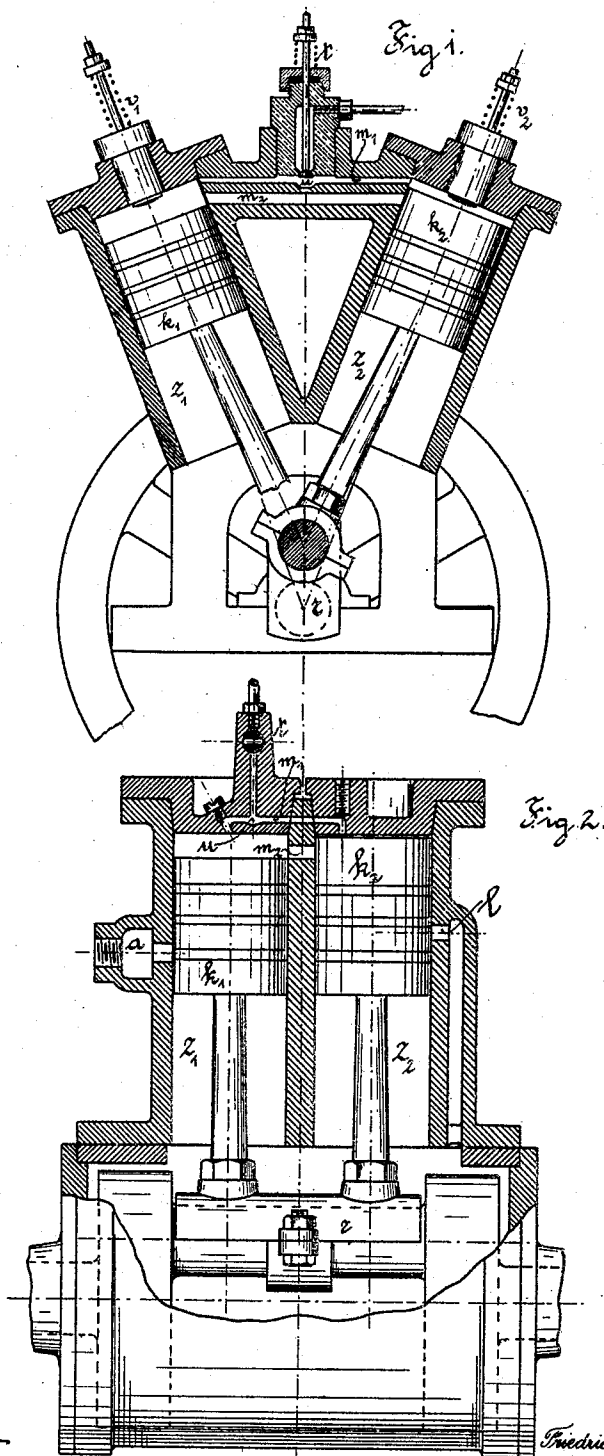
No. 788,402.

PATENTED APR. 25, 1905.

F. A. HASELWANDER.
INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAY 23, 1901.

3 SHEETS—SHEET 1.



Witnesses

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Fig. 3.

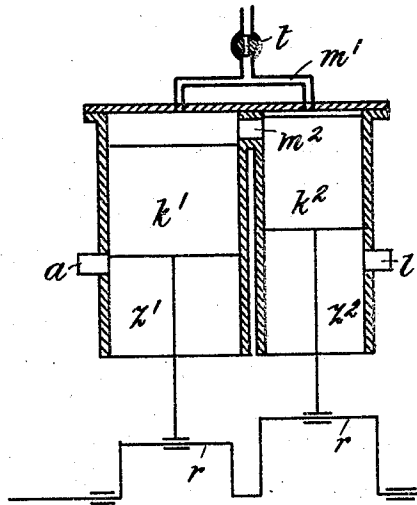
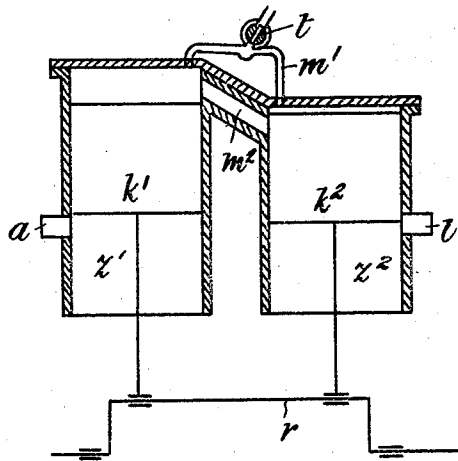


Fig. 4.

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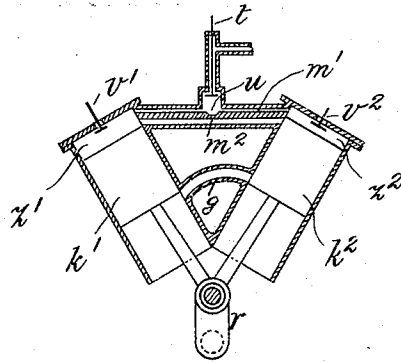


Fig. 5.

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UNITED STATES PATENT OFFICE.

FRIEDRICH AUGUST HASELWANDER, OF MANNHEIM, GERMANY.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 788,402, dated April 25, 1905.

Application filed May 23, 1901. Serial No. 61,585.

To all whom it may concern:

Be it known that I, FRIEDRICH AUGUST HASELWANDER, a subject of the Emperor of Germany, residing at 1 Käferthalerstrasse, Mannheim, in the German Empire, have invented a new and useful Improved Internal-Combustion Engine, of which the following is a specification.

The improvement in internal-combustion engines which forms the object of the present application is based substantially on what is known as the "displacement" principle first set forth by me in German Patent No. 101,453, applied for October 20, 1897, and granted December 27, 1898.

This invention consists in replacing the differential piston therein described by two pistons working side by side in different cylinders and so coupled by gearing or by cross-heads that one of these pistons fulfils the function of the working piston proper, while the other operates as the displacer toward the end of the stroke, or it may be carried into effect by providing at the combustion-chamber a second working cylinder with single piston which is coupled to the first piston, as mentioned above.

In the accompanying drawings, Figure 1 illustrates a four-stroke engine, and Fig. 2 shows a modification of the same, while Figs. 3, 4, and 5 are diagrammatic representations of further modifications.

In Fig. 1, ε' ε'' are two working cylinders which are inclined toward each other and are connected by two ports m' m'' in such a manner that the piston k'' , which acts as the displacing device, closes the port m'' toward the end of the stroke and further compresses the charge inclosed above it in the cylinder ε'' and forces it through m' to ε' above the piston k' . The two pistons k' and k'' operate on the common crank-shaft r . The working cycle is as follows: During the suction-stroke fresh air is drawn in through the automatic or controlled air-inlet valve v' , which may be of any desired type, into ε' and through m'' into ε'' . At the same time the combustible is injected by any known means through the feed-valve t (also of any suitable type either automatic or mechanically controlled) to the connecting-

port m' , said combustible being deposited in the hollow u , for instance. After the valves are closed the compression-stroke follows in the two cylinders, and toward the end of the stroke k' produces the excess pressure and drives air from ε'' to ε' through m' . Hereby the combustible is forced along, sprayed, and injected into the combustion-chamber into ε' above k' and is there exploded by means of self-ignition or by external ignition, preferably electric. The two pistons now make the expansion-stroke. The exhaust-stroke then follows, during which the valve v'' is opened and allows the exhaust-gases to escape. It is worthy of note in this arrangement that according to the direction of revolution of the crank-shaft the displacement-piston k'' runs before or after the piston k' . Consequently the combustion begins either with constant volume or with constant pressure.

Certain detail modifications will now be set forth.

The cylinders may be of unequal heights, as illustrated diagrammatically in Fig. 3, and they may also be placed in two different planes of motion of the connecting-rods, which then act on the crank-shaft side by side. This arrangement is shown in Fig. 2, hereinafter described. The respective diameters of the cylinders may be different and the cranks have different throws, as shown in Fig. 4. In other respects the arrangements shown in Figs. 3 and 4 correspond with the engine shown in Fig. 2 and hereinafter described. They will therefore require no further description. Further, the forms and arrangements of the valves or feeding and exhausting means may be varied in any desired manner without departing from the scope of this invention. Moreover, a plurality of valves may replace any one valve, if preferred. Such devices, as also the means, if required, for heating or cooling any of the parts for feeding fuel or air under pressure to any of the valves and for distributing or spraying the injected fluids, will be readily constructed or applied by any engineer, and they form no essential part of this invention. Any known means or method may be employed for effecting the ignition.

The combustible can be admitted at different periods of the working cycle—for instance, during the compression or else just before the injection or during the latter, in this case, of course, under pressure from any suitable source.

The new arrangement can also be utilized for the two-stroke cycle. In this cycle, as is well known, by means of previously-compressed air from any suitable source the cylinder is purified by the combustion-gases toward the end of the expansion-stroke and at the same time provided with fresh working air. Then to the construction shown in Fig. 1 is added a connecting-port g , as indicated in Fig. 5, the discharge-openings of which port are placed in the cylinders z' z'' , so that they will be left open by the pistons toward the end of the stroke, so that the previously-compressed air flowing in toward the end of the stroke from the air-inlet valve sweeps through from one cylinder through g to the other and can drive out the exhaust-gases through the outlet-valve. The combustible is then supplied before or after the end of the expansion-stroke or during the compression or the injection.

The exhaust-valve and air-inlet valve can in the well-known manner be replaced by the pistons acting as piston-slides, the exhaust-openings being free in the cylinder-wall. Such an arrangement is shown in Fig. 2, which illustrates a simpler form of the engine. This figure also serves to show an example of a different arrangement of the cylinders with regard to each other and to the shaft. In this case the piston of one cylinder—say k' in z' —uncovers the exhaust-apertures a toward the end of the stroke, and the other piston, k'' in z'' , uncovers the air-inlets l . The air previously compressed in the crank-chamber flows through l into z'' through the port m'' into z' and drives out the exhaust-gases through the exhaust-port a . The combustible which has been introduced in the port m' by one of the methods already described is injected into z' toward the end of the compression-stroke in the manner explained above. Combustible in the gas or fluid state as used for the four-stroke engine is also applicable in this case.

As regards the regulation of these engines, it can be effected by altering the quantity of combustible, by means of throttling, by altering the time or length of the stroke of the combustible-valve, or else by misfiring or any other suitable known means. The starting of the engine can also be effected in any manner preferred.

In conclusion it may be mentioned that this engine may be arranged to work in any plane—vertical, horizontal, or at an angle—and that the valves, overflow-ports, nozzles, and cylinders can be carried out in other forms and positions to suit particular circumstances as long as they fulfil their appointed purposes.

What I claim is—

1. In an internal-combustion engine two cylinders, a working piston in one of said cylinders and a displacing-piston in the other cylinder, a main port connecting said cylinders so that both pistons are driven during the expansion-stroke, a secondary port connecting said cylinders, and means for admitting combustible fluid into said secondary port, the main port being adapted to be closed by the displacing-piston toward the end of the compression-stroke, and the secondary port being adapted to inject the air or gas compressed above said displacing-piston in its cylinder into the other cylinder for the purpose of injecting and mixing the combustible, while the main port connecting the cylinders is not closed by the working piston, substantially as described.

2. In an internal-combustion engine two cylinders a working piston in one of said cylinders and a displacing-piston in the other cylinder a main port connecting said cylinders so that both pistons are driven during the expansion-stroke, a secondary port connecting said cylinders and means for admitting combustible fluid into said secondary port, the main port being adapted to be closed by the displacing-piston toward the end of the compression-stroke and the secondary port being adapted to inject the air or gas compressed above said displacing-piston in its cylinder into the other cylinder for the purpose of injecting and mixing the combustible, while the main port connecting the cylinders is not closed by the working piston, and a passage connecting the two cylinders said passage being arranged to be opened by the two pistons toward the end of the expansion-stroke substantially as and for the purposes described.

3. In an internal-combustion engine two cylinders a working piston in one of said cylinders and a displacing-piston in the other cylinder a main port connecting said cylinders so that both pistons are driven during the expansion-stroke, a secondary port connecting said cylinders, and means for admitting combustible fluid into said secondary port, the main port being adapted to be closed by the displacing-piston toward the end of the compression-stroke and the secondary port being adapted to inject the air or gas compressed above said displacing-piston in its cylinder into the other cylinder for the purpose of injecting and mixing the combustible while the main port connecting the cylinders is not closed by the working piston substantially as described.

4. In an internal-combustion engine two cylinders a working piston in one of said cylinders and a displacing-piston in the other cylinder a main port connecting said cylinders so that both pistons are driven during the expansion-stroke, a secondary port connecting said cylinders, and means for admitting com-

bustible fluid into said secondary port, the main port being adapted to be closed by the displacing-piston toward the end of the compression-stroke and the secondary port being
5 adapted to inject the air or gas compressed above said displacing-piston in its cylinder into the other cylinder for the purpose of injecting and mixing the combustible while the main port connecting the cylinders is not
10 closed by the working piston a port opening in one of the cylinder-walls for the admission of compressed air adapted to be unclosed near

the end of the working stroke and an exhaust-port opening in the other cylinder-wall, adapted to be unclosed when the air-admission port is unclosed substantially as described.

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

FRIEDRICH AUGUST HASELWANDER.

Witnesses:

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CONRAD ZIMMER.