H. SAURER.

STARTING DEVICE FOR EXPLOSION ENGINES WITH FOUR CYLINDERS.

APPLICATION FILED APR. 24, 1906.

906,663.

Patented Dec. 15, 1908.

2 SHEETS—SHEET 1.

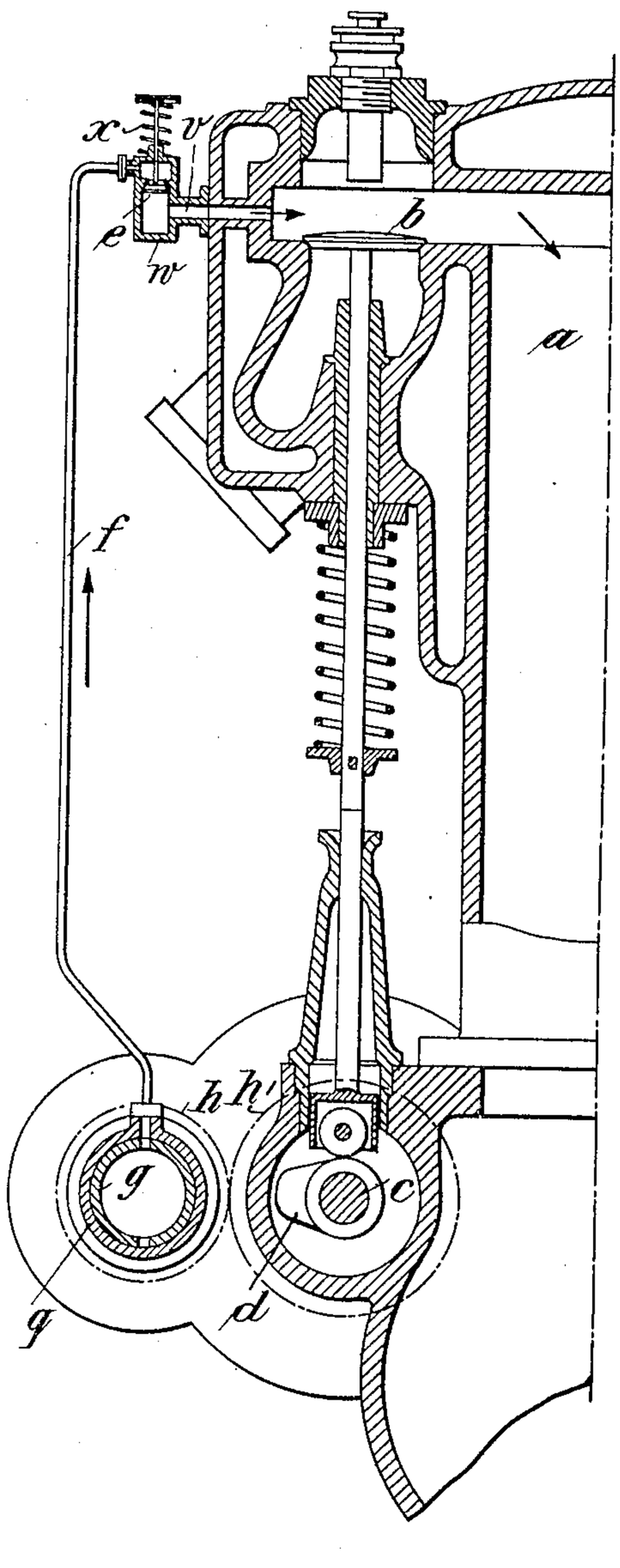

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 3.

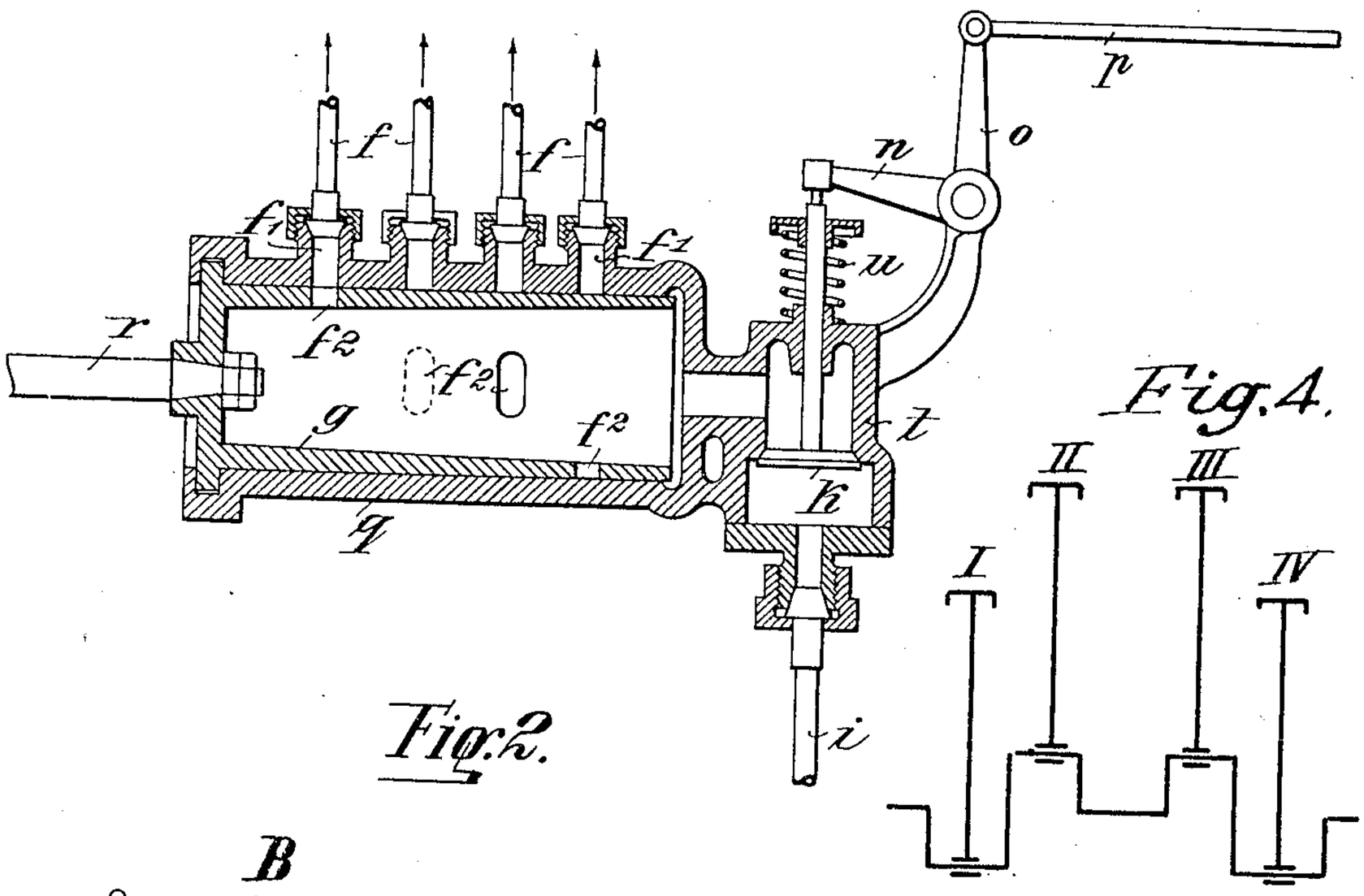

Fig. 4.

Fig. 2.

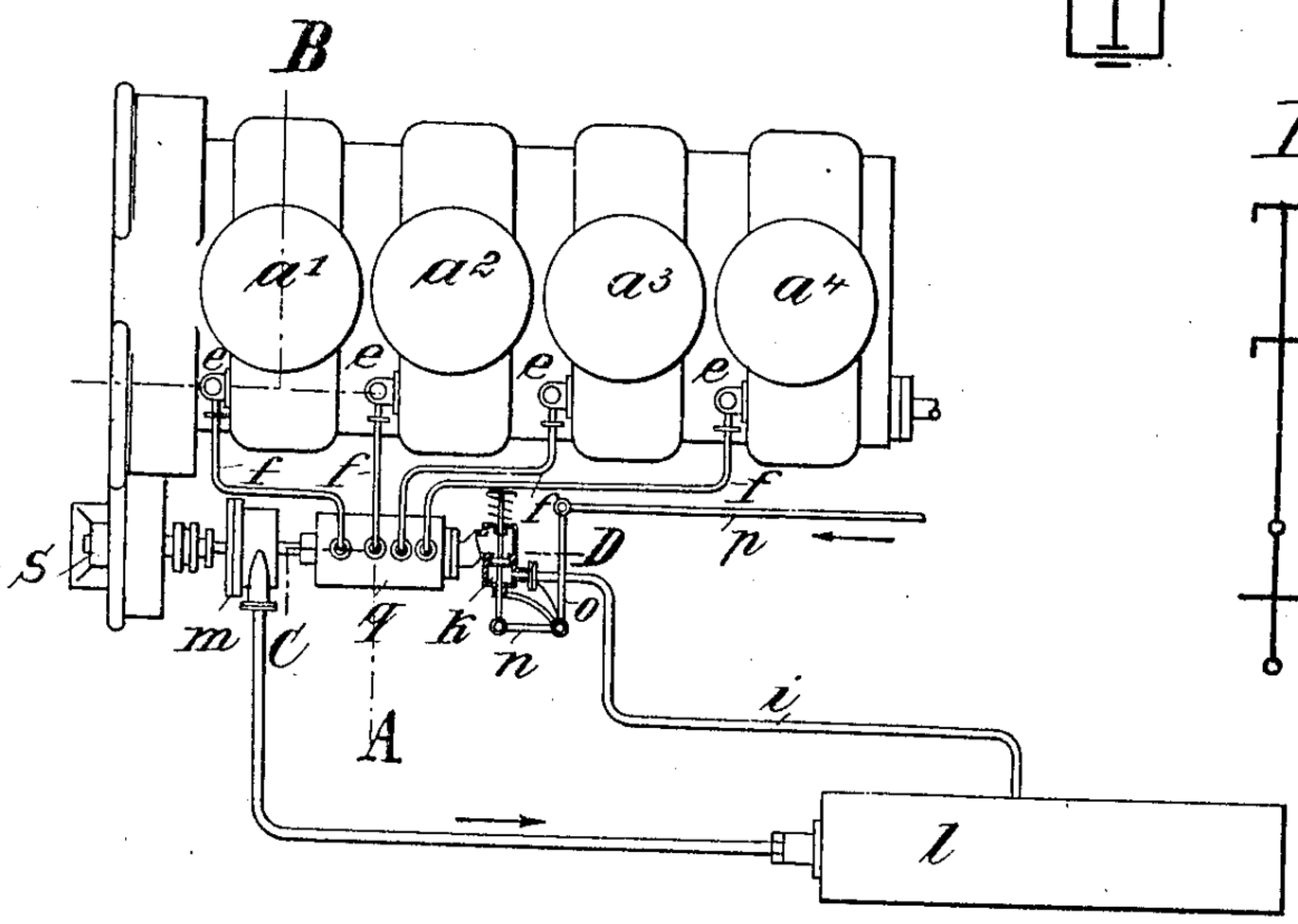

Fig. 5.

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HIPPOLYT SAURER, OF ARBON, SWITZERLAND.

STARTING DEVICE FOR EXPLOSION-ENGINES WITH FOUR CYLINDERS.

No. 906,663. Specification of Letters Patent. Patented Dec. 15, 1908.

Application filed April 24, 1906. Serial No. 313,437.

To all whom it may concern:

Be it known that I, HIPPOLYT SAURER, a citizen of the Confederation of Switzerland, residing at Arbon, in Switzerland, have invented a new and useful Starting Device for Explosion-Engines with Four Cylinders, of which the following is a specification.

My invention relates to improvements in starting devices for explosion-engines with four cylinders, and a crank-shaft having its four cranks set in one and the same plane, whereby the advantage is obtained, that compressed air can be at once admitted to either of the four cylinders alone for starting the engine, while the other cylinders are left in their usual state, in other words, they are enabled to at once work in the usual four stroke cycle. Thereby the starting of the engine is simplified and the consumption of compressed air is considerably reduced, since this compressed air is required only for a single cylinder.

The objects of my improvement are, first, to provide a rotary distributing valve, which is driven from the engine; and is arranged to supply the compressed air to each of the four cylinders consecutively only during the expansion stroke of its piston; and, second, to provide a stop-valve under the control of the driver for admitting the compressed air to the rotary distributing valve only when this is required. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal section through half a vertical cylinder of the engine and through the starting device on the broken line A—B in Fig. 2, Fig. 2 is a plan on a reduced scale of the explosion-engine as used with an automobile and provided with the starting device, Fig. 3 is a vertical section on an enlarged scale through the starting device on the line C—D in Fig. 2, the stop-valve controlling the supply of compressed air being slightly modified, Fig. 4 illustrates diagrammatically the four cylinders with their pistons, connecting rods and the crank-shaft and Fig. 5 is a side view of Fig. 4 so as to show that the four cranks of the crank-shaft are all in one and the same plane.

Similar letters of reference refer to similar parts throughout the several views.

My invention is founded upon the observation, that after the disengagement of its igniting device an explosion-engine with four cylinders and a crank-shaft having its four cranks set in one and the same plane (see Fig. 4) will stop at such a moment, at which the cranks occupy a horizontal position or very nearly so. When assuming the engine to be provided with a standard valve-gear, the piston in one of the four cylinders will invariably stop in the middle of its stroke, during which the expansion of the exploded gases takes place. It is this cylinder, into which according to my invention the compressed air is admitted for starting the engine. For the position of its piston is so favorable, that the compressed air acting upon the piston will be able to at once overcome the resistance of the engine during the start of the latter, so that during the following stroke of the piston in the same cylinder the exhaust of the air (corresponding to that of the wasted gases during the usual work) can take place, whereupon the usual cycle commences.

A casing q is disposed near the engine and a rotary distributing valve g of any known construction is mounted in this casing to turn. It is rigidly connected with a shaft r, which is mounted in a suitable bracket s to turn and may be driven from the cam shaft c by means of two gear wheels h and h^1 respectively. On the cam shaft c are fastened the several cams d, which serve for actuating in the usual manner the several inlet-valves b (see Fig. 1) of the four cylinders a^1, a^2, a^3 and a^4. The casing q is provided with four tubular connection pieces f^1 f^1, which can register at different moments with suitable holes f^2 f^2 in the hollow rotary distributing valve g. The latter is open at the right end in Fig. 3 and its cavity communicates with a valve-box t, in which a stop-valve k is disposed. This stop-valve k is normally pressed on its seat by means of a helical spring u and can be opened from the driver's seat (not shown) in any known manner, for example by means of a bell-crank lever n o and a rod p. The chamber beneath the stop-valve k is put in communication with a convenient storage vessel l for compressed air by means of a suitable tube i. An air-pump m is disposed for supplying the vessel l with compressed air under a pressure of say 8 or 9 atmospheres. The construction of the air-pump m is immaterial and it should be arranged to be coupled at will in any known manner with the shaft r from the driver's

seat during the motion of the vehicle, so as to keep the vessel *l* well filled with compressed air. Each cylinder *a* is at its upper end put in communication with a valve-box *w* through a convenient channel *v* and this valve-box *w* is connected with the respective tubular connection piece f^1 on the casing *q* by means of a tube *f*. A safety-valve *e* is preferably disposed in the valve-box *w* and is normally pressed on its seat by a helical spring *x*. This safety-valve *e* is to prevent the exploded gases in the cylinder *a* from passing over to the storage-vessel *l* through the tube *f*, through any opening f^2 in the rotary distributing valve, which may happen to register with the channel f^1, further through the opened stop-valve *k* and the tube *i*. As already mentioned, the openings f^2 f^2 are differently arranged in the rotary distributing valve *g* and the ratio of the two gear wheels *h* and h^1 should be so proportioned, that only one of the four tubular connection pieces f^1 f^1 may register with the respective opening f^2 for the horizontal position of that crank, which is driven downwards during the stroke of expansion from the piston in the respective cylinder *a*.

The starting device is operated as follows: The vehicle and therewith the engine may be assumed to be at rest, so that one of the four cranks will occupy a horizontal position or nearly so according to the above statement. When the driver is desirous of starting the engine, he actuates by the respective lever or other part the rod *p* for opening the stop-valve *k*, so that compressed air will be admitted from the storage vessel *l* to the respective cylinder *a* through the corresponding opening f^2 in the rotary distributing valve *g*, which opening f^2 at this moment registers with its tubular connection piece f^1, and through the tube *f*. The compressed air will open the safety-valve *e*, enter the cylinder *a* and act upon its piston. The valve gears for all the four cylinders a^1, a^2, a^3 and a^4 however remain, as they are, so that the driver can at once open the respective stop-valve for admitting the explosive agent to the engine and he can also at once allow the respective igniting devices to operate. The consequence of this will be, that the compressed air in the respective cylinder will not only force the piston downwards, but also compress the air or mixture contained in one of the other three cylinders by means of the connecting rods and the crank shaft. Trials have proved, that the pressure of the compressed air from the storage vessel *l* on the piston in about the middle of its stroke will be ample for doing this double work, since the maximum pressure due to the compression of the air or mixture in the other cylinder is only attained at the end of the respective piston stroke, that is at a moment, at which the engine has already been put into motion. Therefore the driver can release the rod *p* and thereby permit the stop-valve *k* to close and thus to stop the supply of compressed air, the moment the piston in the first cylinder has reached its lowermost position. At this moment the explosive mixture in the second cylinder is ignited, so that an explosion will take place and the engine can continue its usual work in the four stroke cycle.

It will be seen, that the new starting device is very simple and merely serves for introducing compressed air into either of the four cylinders at the proper moment and for half a piston stroke only, and that otherwise the engine is at once ready for starting and for working in the four stroke cycle.

The starting device may be varied without departing from the spirit of my invention.

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

1. In a four stroke cycle explosion-engine, the combination with four juxtaposed vertical cylinders each provided with an inlet-valve and a channel at its top, of a crank-shaft having all four cranks placed in the same plane and connected with the pistons in said four cylinders, a cam shaft driven from said crank-shaft for actuating said four inlet-valves, a cylindrical casing parallel to said cam shaft and provided with four tubular connections in a row parallel to its axis, four tubes between the channels of said four cylinders and the four tubular connections of said cylindrical casing, means under the control of the driver for supplying compressed air to said cylindrical casing, and a rotatory distributing valve mounted in said cylindrical casing to turn and driven from said cam shaft by gearing, it being adapted to supply the compressed air through the tubular connections to each of said four cylinders consecutively only during the expansion stroke of its piston for starting the engine.

2. In a four stroke cycle explosion-engine, the combination with four juxtaposed vertical cylinders each provided with an inlet-valve and a channel at its top, of a crank-shaft having all four cranks placed in the same plane and connected with the pistons in said four cylinders, a cam shaft driven from said crank-shaft for actuating said four inlet-valves, four valve-boxes communicating with the four channels of said four cylinders, a cylindrical casing parallel to said cam shaft and provided with four tubular connections in a row parallel to its axis, four tubes between said four valve-boxes and the four tubular connections of said casing, four spring-pressed valves in said four valve-boxes and adapted to open under a pressure in the tubes and to close under a pressure in the cylinders, means under the control of the driver for supplying compressed air to said cylindrical easing, and a rotary distributing

valve mounted in said cylindrical casing to turn and driven from said cam shaft by gearing, it being adapted to supply the compressed air through the tubular connections to each of said four cylinders consecutively only during the expansion stroke of its piston for starting the engine.

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

HIPPOLYT SAURER.

Witnesses:
MARY FALCONER,
CARL KAUFMANN.