No. 754,929. PATENTED MAR. 15, 1904.

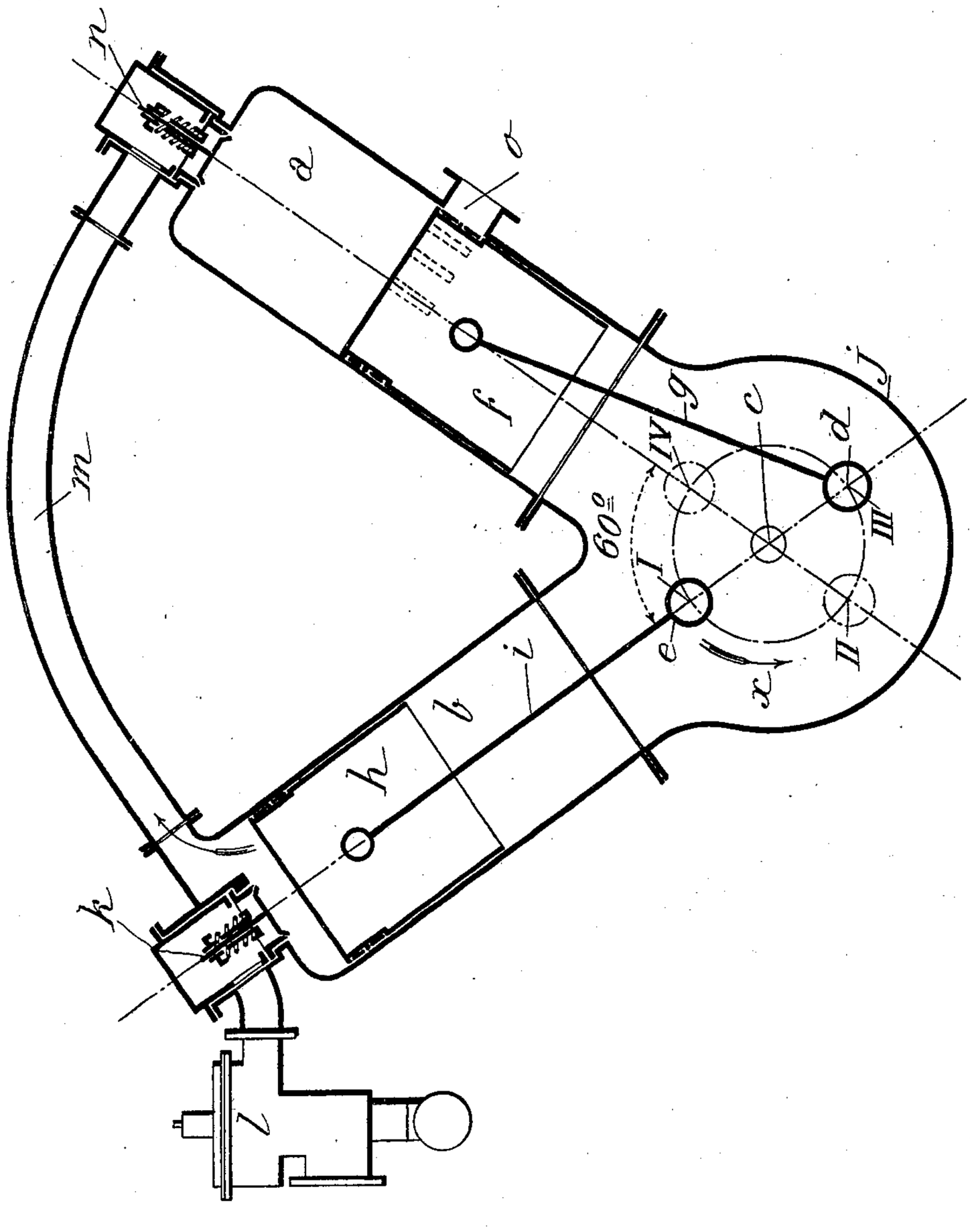
H. LEPAPE.

INTERNAL COMBUSTION ENGINE FOR CYCLES.

APPLICATION FILED JULY 13, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
J. Stephen Kinsella.
Fred'k W. Dunglas.

Inventor.
H. Lepape
by Wilkinson & Fisher
his Attorneys.

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NO MODEL. 2 SHEETS—SHEET 2.

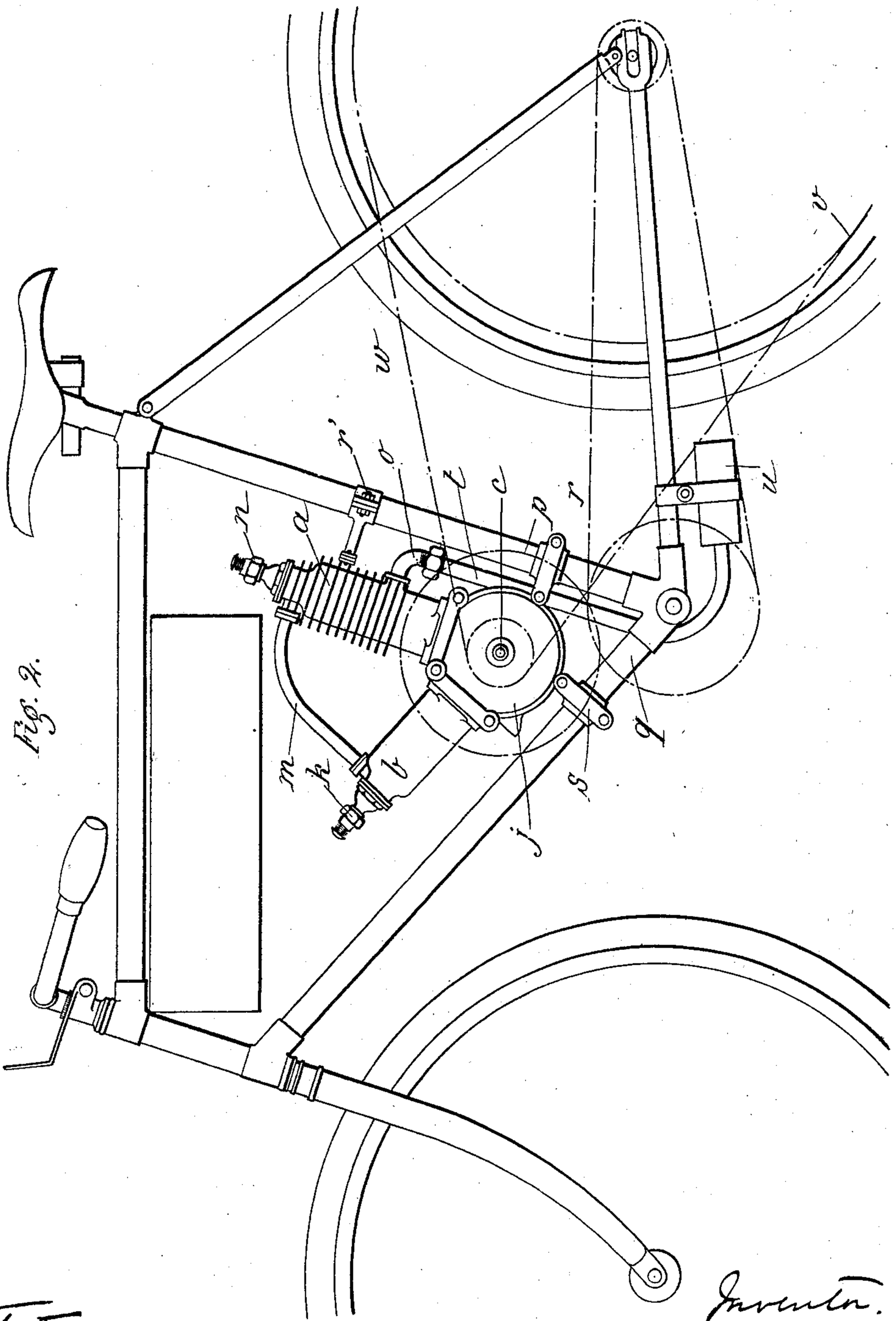

Fig. 2.

Witnesses,
J. Stephen Kinsler.
Fredk. Englert.

Inventor.
H. Lepape,
by Wilkinson & Fisher
his attorneys.

No. 754,929. Patented March 15, 1904.

UNITED STATES PATENT OFFICE.

HIPPOLYTE LEPAPE, OF PARIS, FRANCE.

INTERNAL-COMBUSTION ENGINE FOR CYCLES.

SPECIFICATION forming part of Letters Patent No. 754,929, dated March 15, 1904.

Application filed July 13, 1903. Serial No. 165,373. (No model.)

To all whom it may concern:

Be it known that I, HIPPOLYTE LEPAPE, engineer, a citizen of the Republic of France, residing at 23 Rue Montaigne, Paris, France, (postal address,) have invented a new and useful Improvement in Internal-Combustion Engines for Cycles, (for which I have obtained Letters Patent in France under date of December 26, 1902, No. 327,714, and in England under date of December 24, 1902, No. 28,558, and for which I have applied for Letters Patent in Germany under date of December 31, 1902, and for which Letters Patent have been obtained in my name jointly with that of Paul Leopold Goldschmidt in Belgium under date of March 30, 1903, No. 169,586, and have been applied for in the same joint names in Switzerland under date of March 30, 1903,) of which the following is a specification.

The present invention consists of a novel arrangement of explosion-engine, so-called "one-impulse-per-revolution" engine, intended to be applied in a rational, practical, and advantageous manner to cycles and autocars. It has for its objects, first, to facilitate the fitting of engines of that kind to a cycle-frame or in the minimum of disposable space upon an autocar-frame, and, second, to simplify the construction of the engine crank-shaft and considerably reduce its cost of manufacture, while at the same time producing a simple and perfect regulation of the motion of the pump-piston and engine-piston, causing the engine to produce a maximum yield under the most economical conditions.

In a so-called "one-impulse-per-revolution" engine comprising a pump and a working cylinder to which the pump supplies the combustible mixture, the explosion of which produces an impulse or power-stroke for every revolution of the engine-shaft, the pump draws from the carbureter while the power-piston receives the impulse due to the explosion. Before reaching the end of its stroke the said piston uncovers the exhaust-orifices of the cylinder, (which corresponds to an advance on exhaust in four-phase engines,) and as soon as the pressure has sufficiently decreased in the cylinder the inlet-valve of the latter opens under the pressure of the charge of fresh gas which the pump is at the time forcing away and which drives or blows away the spent gases of the cylinder until the moment when the piston after reaching the end of its power-stroke returns and on continuing its motion closes the exhaust-orifices. From that time on and during the remainder of its return stroke the piston compresses the charge which has just been admitted into the cylinder, and as it reaches the end of its stroke the charge is ignited and the explosion causes the piston to be impelled forward while the pump draws from the carbureter, and so on, the same cycle being thus repeated and an impulse being produced for every revolution of the shaft. If now it be supposed, as has hitherto always been the case, that the pump be placed side by side with the power-cylinder in a plane passing through the axis of the power-shaft, it is necessary, in order to produce the above-named phenomena regularly, that the angle of displacement between the two cranks of the double-crank shaft, one of which actuates the piston while the other is connected to the power-piston, shall be about one hundred and twenty degrees; but a double-crank shaft the cranks of which are at one hundred and twenty degrees to each other cannot be readily manufactured and is very expensive to make, and this therefore constitutes from an economical point of view a serious drawback. On the other hand, the idea of placing in a bicycle the two cylinders side by side in a transverse plane to the frame cannot be entertained, because they would take up too much space widthwise for the free play of the cyclist's legs. It thus became necessary to devise an advantageous arrangement whereby the said cylinders could be so located as not to interfere with the legs, while at the same time affording the maximum of simplicity, the best yield, and the most perfect action. That is precisely the object of the present invention, which while obviating the hereinbefore-mentioned drawbacks enables, under very advantageous conditions as to cost of manufacture, an engine of the class set forth to be produced, it being reduced to its most simple expression, perfect as to operation, and capable of being readily installed in a bicycle-frame with the

two cylinders in a plane at right angles to the engine-shaft, so as not to interfere any more than one-cylinder engines operating according to the four-phase principle, while at the same time affording the marked advantage over such engines of producing one impulse per revolution.

In the accompanying drawings, Figure 1 is a diagrammatic longitudinal section along the axis of the cylinders of a one-impulse-per-revolution engine of the class set forth. Fig. 2 shows the engine fitted on a bicycle.

The arrangement essentially consists in placing the power-cylinder *a* and the pump-cylinder *b* in such a manner that their axes shall be in the same plane at right angles to the crank-shaft axis *c* and be at an angle of, say, sixty degrees, the pump-cylinder being ahead of the power-cylinder in respect of the direction of rotation. Under these conditions a crank-shaft may be employed having its cranks *d* and *e* at an angle of one hundred and eighty degrees to each other, since the difference between one hundred and eighty degrees and sixty degrees just corresponds to the displacement of one hundred and twenty degrees necessary for insuring a perfect regulation of the operation of the engine. It is obvious that this is a marked advantage from a point of view of the saving in cost. Moreover, the fitting of the engine in the lower angle of a bicycle-frame is thereby rendered easy, (see Fig. 2,) each cylinder being about parallel to one of the tubes, and the whole only thus taking up a width in the frame corresponding to that of the power-cylinder.

The piston *f* of the power-cylinder *a* actuates the crank *d* of shaft *c*, while the crank *e* is connected to the pump-piston *h* by connecting-rod *i*. The connecting-rod heads and cranks dip into an oil-bath *j*, contained in the carrier-case.

k is the automatic pump-valve, the valve-box of which is connected to the carbureter *l*, in which the pump draws. The pump forces through tube *m* into the box of the automatic inlet-valve *n* of the power-cylinder, the latter being also provided with exhaust-orifice *o*, which is uncovered by the power-piston *f* at the end of its power-stroke.

The operation is as follows: In Fig. 1 the parts are shown in the position in which the drawing of the pump into the carbureter commences, the pump-piston *h* being at the top of its stroke and the power-piston *f* having already accomplished part of its return stroke (corresponding to the angular displacement of sixty degrees) and being on the point after closing the exhaust *o* of commencing to compress the charge of gas in the cylinder *a*. As the motion takes place in the direction of arrow *x* during the revolution of the crank *e* from position I to position II, the piston *h* commences to draw gas from the carbureter *l*. While this is taking place the crank *d* revolves from position III to position IV. The piston *f* compresses the gas, reaches the end of its compressing-stroke, and the charge is ignited. During the revolution of crank *e* from position II to position III the piston *h* completes its drawing stroke at the same time as crank *d* revolves from position IV to position I, and the expansion of the explosion-gases commences to take place in the power-cylinder *a*. The crank *e* then revolving from position III to position IV, the piston *h* commences to force the charge of gas drawn from the carbureter *l* during the preceding stroke into the power-cylinder through tube *m*, which first of all produces a slight compression, while the crank *d* then passing from position I to position II, the piston *f* continues its power-stroke and the gases attain their full expansion in *a*. Then as soon as toward the end of this stroke piston *f* uncovers exhaust-orifices *o* the spent gases are blown out by the charge of fresh gas forced in by the pump. Finally, while the crank *e* revolves from position IV to position I piston *h* completes the forcing of fresh gas into cylinder *a*, driving out the spent gases. At the same time crank *d* revolves from position II to position III, and the piston *f* reaches the end of its power-stroke and commences its return stroke, during the first stage of which it closes the exhaust *o*. The cycle of movements just described is then repeated in the same manner, a power impulse being given for every revolution.

The engine may be fitted to the tubes *p q* of the cycle-frame by means of clamps *r r' s*, respectively attached to the carrier-case *j''* and cylinder *a*. The exhaust *o* may be connected by a tube *t* to a muffler *u*, and the motion is transmitted from shaft *c* to driving-wheel *v* by means of a belt *w* in the usual way. It will be understood, moreover, that the application of an engine of this class is not exclusively limited to cycles. On the contrary, it may also be advantageously employed on all autocars when only a limited space on the frame can be disposed of or whenever circumstances only admit of a minimum bulk.

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

1. An internal-combustion engine comprising a power-cylinder and a pump-cylinder arranged in a V shape with their axes at an angle of about sixty degrees to each other, a piston in each cylinder, piston-rods and a common crank-shaft formed with two cranks at one hundred and eighty degrees to each other, connected to the respective piston-rods, substantially as described and shown and for the purpose set forth.

2. An internal-combustion engine comprising a power-cylinder and a pump-cylinder arranged in a V shape, with their axes at an angle of about sixty degrees to each other, a piston in each cylinder, piston-rods, a common

crank-shaft formed with two cranks at one hundred and eighty degrees to each other, connected to the respective piston-rods, and a pipe connecting the force end of the pump-cylinder to the inlet end of the power-cylinder, substantially as described and shown and for the purpose set forth.

3. An internal-combustion engine comprising a power-cylinder and a pump-cylinder arranged in a V shape, with their axes at an angle of about sixty degrees to each other, a piston in each cylinder, piston-rods, a common crank-shaft formed with two cranks at one hundred and eighty degrees to each other, connected to the respective piston-rods, a pipe connecting the force end of the pump-cylinder to the inlet end of the power-cylinder and a carbureter connected to the pump-cylinder, substantially as described and shown and for the purpose set forth.

4. The combination of the wheels and diamond frame of a motor-cycle with an internal-combustion engine fastened to the interior of said frame, said engine comprising a power-cylinder and a pump-cylinder arranged in V shape with their axes at an angle of about sixty degrees to each other, a piston in each cylinder, piston-rods, a common crank-shaft formed with two cranks one hundred and eighty degrees apart, said cranks being connected to said piston-rods respectively, a pipe connecting the force end of the pump-cylinder to the inlet end of the power-cylinder, a carbureter connected with the pump-cylinder and suitable inlet and outlet ports, and valves, substantially as described.

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

H. LEPAPE.

Witnesses:
DOUGLAS HORACE BRANDON,
LOUIS RINNÉ.