R. HENNIG.

MULTIPLE CYLINDER ENGINE.

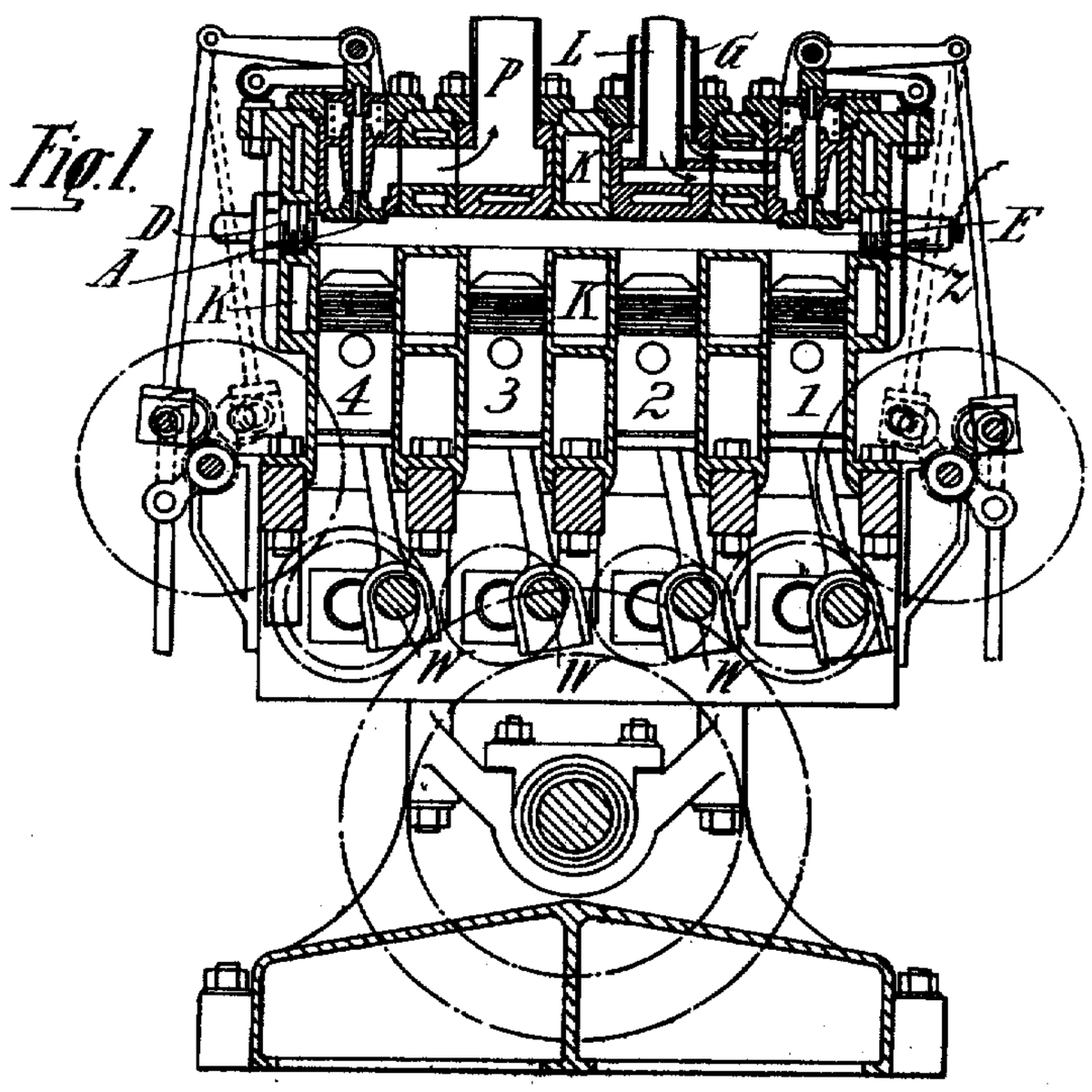
APPLICATION FILED APR. 27, 1908.

999,561.

Patented Aug. 1, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

C. D. Kesler.

Inventor

Rudolf Hennig

By

James L. Norris

Atty.

R. HENNIG.

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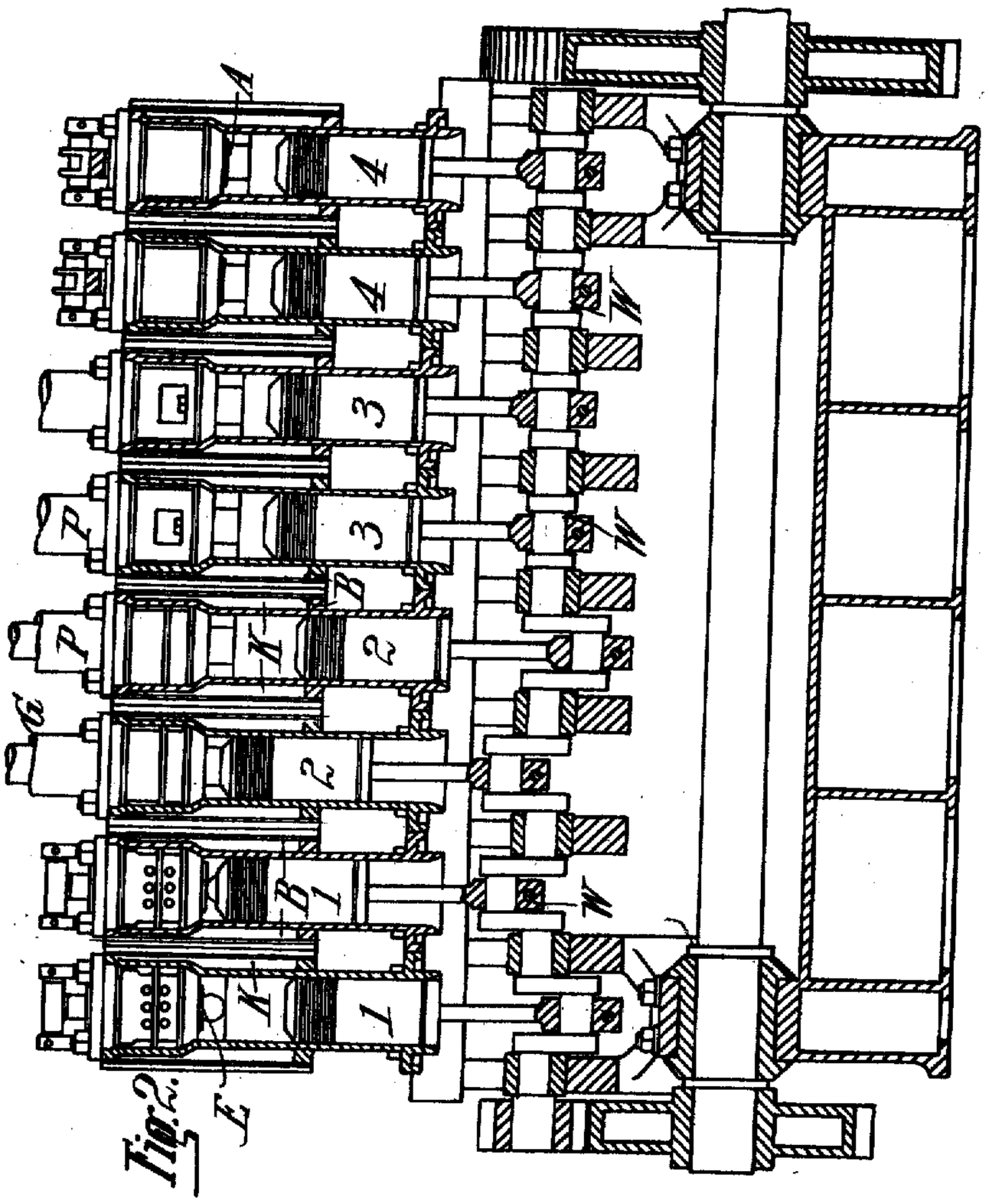

Fig. 2.

Witnesses:

Inventor
Rudolf Hennig

James L. Norris

Attys.

R. HENNIG.

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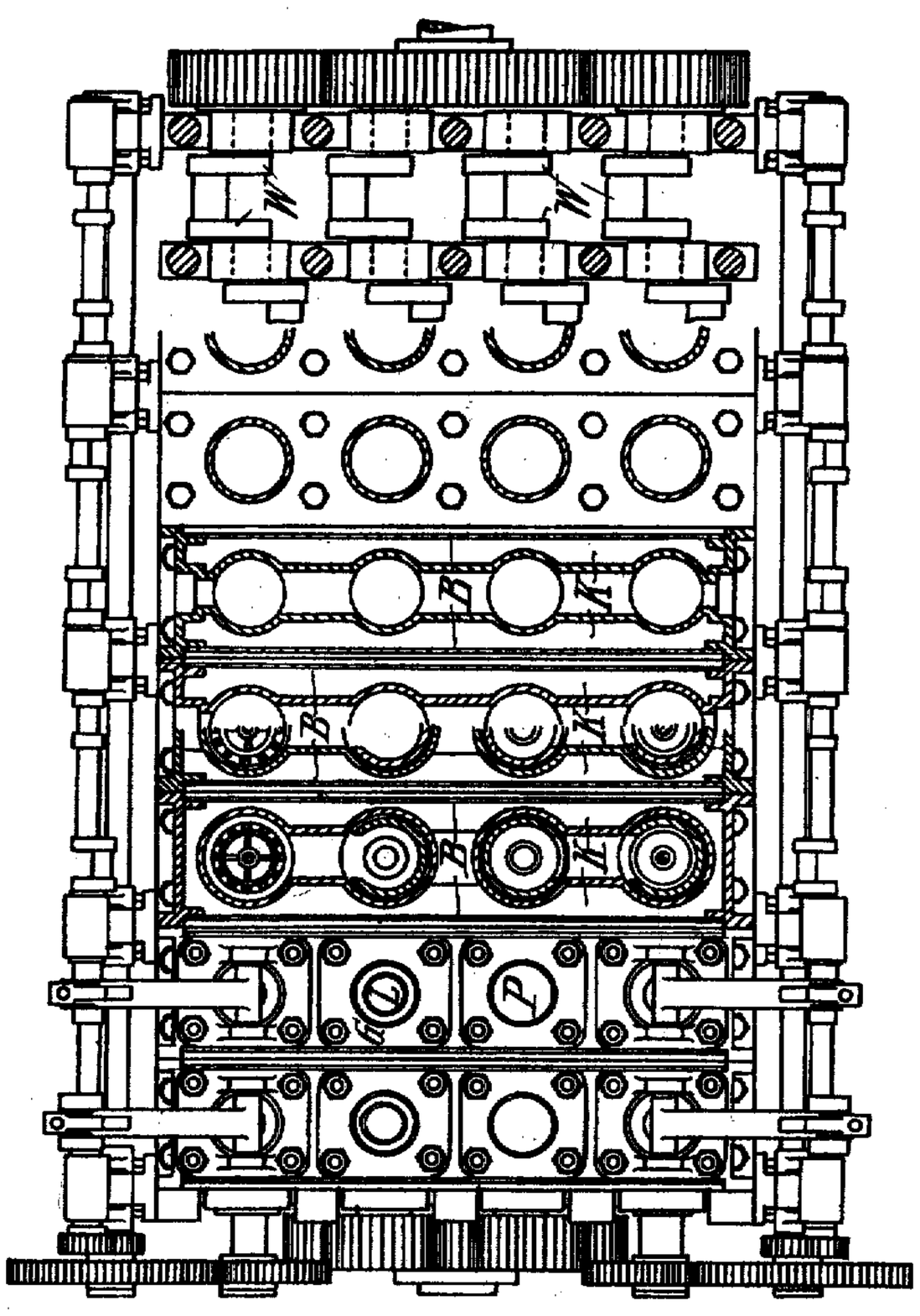

Fig. 3.

Witnesses:

W. B. Kesler

C. F. Kesler

Inventor

Rudolf Hennig

By

James L. Norris

Atty.

UNITED STATES PATENT OFFICE.

RUDOLF HENNIG, OF HAMBURG, GERMANY.

MULTIPLE-CYLINDER ENGINE.

999,561. Specification of Letters Patent. Patented Aug. 1, 1911.

Application filed April 27, 1908. Serial No. 429,426.

To all whom it may concern:

Be it known that I, RUDOLF HENNIG, a subject of the Emperor of Germany, residing at Hamburg, Germany, have invented certain new and useful Improvements in Multiple-Cylinder Engines, of which the following is a specification.

It is known that engines, which have a large number of cylinders and which have their cranks properly arranged relatively to each other, are of low weight in proportion to their power (that is to say, the value of the ratio—

$$\frac{\text{weight of the engine}}{\text{horse power}}$$

—is low) and do not require a fly-wheel. The value of the said ratio for engines without fly-wheels, of geometrically similar construction and made of the same materials, is proportional at the same piston-speed to the diameter of the cylinders; and it has also been found practically that the value of the said ratio rises and falls with the diameter of the cylinders. In order to produce as light engines as possible, a small cylinder-diameter and for large powers a large number of cylinders should therefore be employed.

In the subject of the present invention, in order to make internal combustion engines of high power and small weight in proportion to their power, the common diameter and the number of cylinders are chosen in accordance with the power required, whereupon the cylinders are arranged in more than two longitudinal rows with common combustion-chambers for the cylinders of the transverse rows, each of which rows forms a unit that can be secured directly to the adjacent unit or units. The pistons of each longitudinal row preferably drive on to a separate crank-shaft, and these shafts have their cranks so arranged that the pistons in each transverse row are in the same relative positions. By this means, a very light, efficient and easily overhauled engine is produced. A four-stroke-cycle internal combustion engine made in this manner with 32 single-acting cylinders is shown by way of example in the accompanying drawing, in which—

Figure 1 shows the engine in vertical transverse section, Fig. 2 in vertical longitudinal section and Fig. 3 in plan partly in section.

The 32 cylinders are arranged vertically in four longitudinal rows and eight transverse rows. Each transverse row consists of what may be termed a four-cylinder unit, which is cast in one piece.

The admission-valve E is arranged above the cylinder 1, the exhaust-valve A above the cylinder 4, the inlet of the gas and air pipes G, L above the cylinder 2 and the outlet of the exhaust-pipe P above the cylinder 3 of the transverse row (Fig. 1). The working fluid inlet chest is arranged between the pipes G, L, and the valve E, and the exhaust chest is arranged between the pipe P and the valve A. The valve- and pipe-connections, after removal leave free openings through which the four pistons together with their connecting rods can be dismounted from the top.

The mechanism for operating the valves A and E *per se*, forms no part of the present invention and may be of any desired construction. By way of example I have illustrated the valve operating mechanism which forms the subject of my prior U. S. Patent No. 935,500. This mechanism, in view of its full disclosure in my patent referred to, needs no detailed or general description in connection with the present improvement. The valve operating mechanism is connected by suitable gears to the adjacent crank shafts and the whole of the connections between said crank shafts and the valves may be comprehended under the general term "gearing," which term is used with this intent in the claims.

Close below the valves E and A, there is the combustion chamber extending transversely across over the four cylinders and common to them all. The right-hand opening Z, is designed to receive the ignition-device, while the left-hand opening D is designed to receive the compressed-air starting valve.

The rectangular cooling water jacket K common to the four cylinders of the unit is closed on the longer sides by detachable plates B (Figs. 2 and 3). By this means a cylinder casting is produced which can be easily molded and cleaning of the cooling water jacket is facilitated.

On the outside of the four-cylinder unit are flanges (Figs. 1 and 3) by means of which the several transverse rows can be screwed together.

The four-cylinder units are all screwed to

a frame which consists of upper longitudinal girders, lower transverse girders and connecting pillars. A frame of this kind can easily be made from iron of rectangular and round cross-section. The screwing of the four-cylinder units to the longitudinal girders is effected by means of screws from below.

The lower transverse girders receive the four-crank crank-shafts W each of which has eight cranks and which are built into the frame from above. These shafts either run all in the same direction, as shown, or alternately in opposite directions, accordingly as appears necessary from the method adopted of driving the countershaft or from the inertia-effects which are produced, or for like reasons. On account of the similar arrangement of the pistons of the four-cylinder unit, it is necessary that all the crank-shafts shall rotate at the same speed. For this purpose, the crank-shafts are coupled by spur-wheels and the like. They give up their power either directly or through a countershaft, as shown in Figs. 1 and 3. The smaller gear-wheel on the countershaft is driven by the inner crank-shafts and the larger gear-wheel by the outer crank-shafts W. The axes of the four cylinders of each unit can also be arranged on an incline, in order to permit of the crank-shafts being arranged at a greater distance apart without however being obliged to enlarge the combustion-chamber.

What I claim is:—

1. A multiple-cylinder internal-combustion engine, comprising a plurality of cylinders arranged in longitudinal and transverse rows, the transverse rows each consisting of more than two cylinders formed into a unit, a combustion-chamber common to the cylinders of each unit, said units being arranged directly against each other, pistons in said cylinders, crank shafts corresponding in position to said longitudinal rows of cylinders, connecting rods between said crank-shafts and said pistons, gearing connecting said crank-shafts, and gearing connecting said crank-shafts and said valves.

2. A multiple-cylinder internal-combustion engine comprising a plurality of cylinders arranged vertically in longitudinal and transverse rows, the transverse rows each consisting of more than two cylinders cast integrally together and forming a unit, a combustion-chamber common to the cylinders of each unit, an inlet- and an exhaust-valve to each of said combustion-chambers, said units being arranged directly against each other, pistons in said cylinders, crank-shafts corresponding in number and position to said longitudinal rows of cylinders, connecting rods between said crank-shafts and said pistons, gearing connecting said crank-shafts, and gearing connecting said crank-shafts and said valves.

3. A multiple-cylinder internal-combustion engine comprising a plurality of cylinders arranged vertically in longitudinal and transverse rows, the transverse rows each consisting of more than two cylinders cast integrally together and forming a unit, a combustion chamber common to the cylinders of each unit, an inlet- and an exhaust-valve to each of said combustion-chambers, a rectangular cooling-water jacket surrounding the cylinders of each unit and having its longer sides formed by detachable plates, said units being arranged directly against each other, pistons in said cylinders, crank-shafts corresponding in number and position to said longitudinal rows of cylinders, connecting rods between said crank-shafts and said pistons, gearing connecting said crank-shafts, and gearing connecting said crank-shafts and said valves.

4. A multiple-cylinder internal-combustion engine comprising a plurality of transverse rows of cylinders, the transverse rows each consisting of more than two cylinders, the cylinders of each row being made in the form of a single casting which has a combustion chamber common to all of the cylinders of said row, the casting also having a working fluid inlet chest and a working fluid exhaust chest, an admission valve controlling the communication of the inlet chest with the combustion chamber and an exhaust valve controlling the communication of the exhaust chest with the combustion chamber, a series of crank-shafts each having its cranks connected to one of the cylinders of each transverse row, and gearing connecting said valves and said crank-shafts.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

RUDOLF HENNIG.

Witnesses:
ERNEST H. L. MUMMENHOFF,
IDA CHR. HAFERMANN.