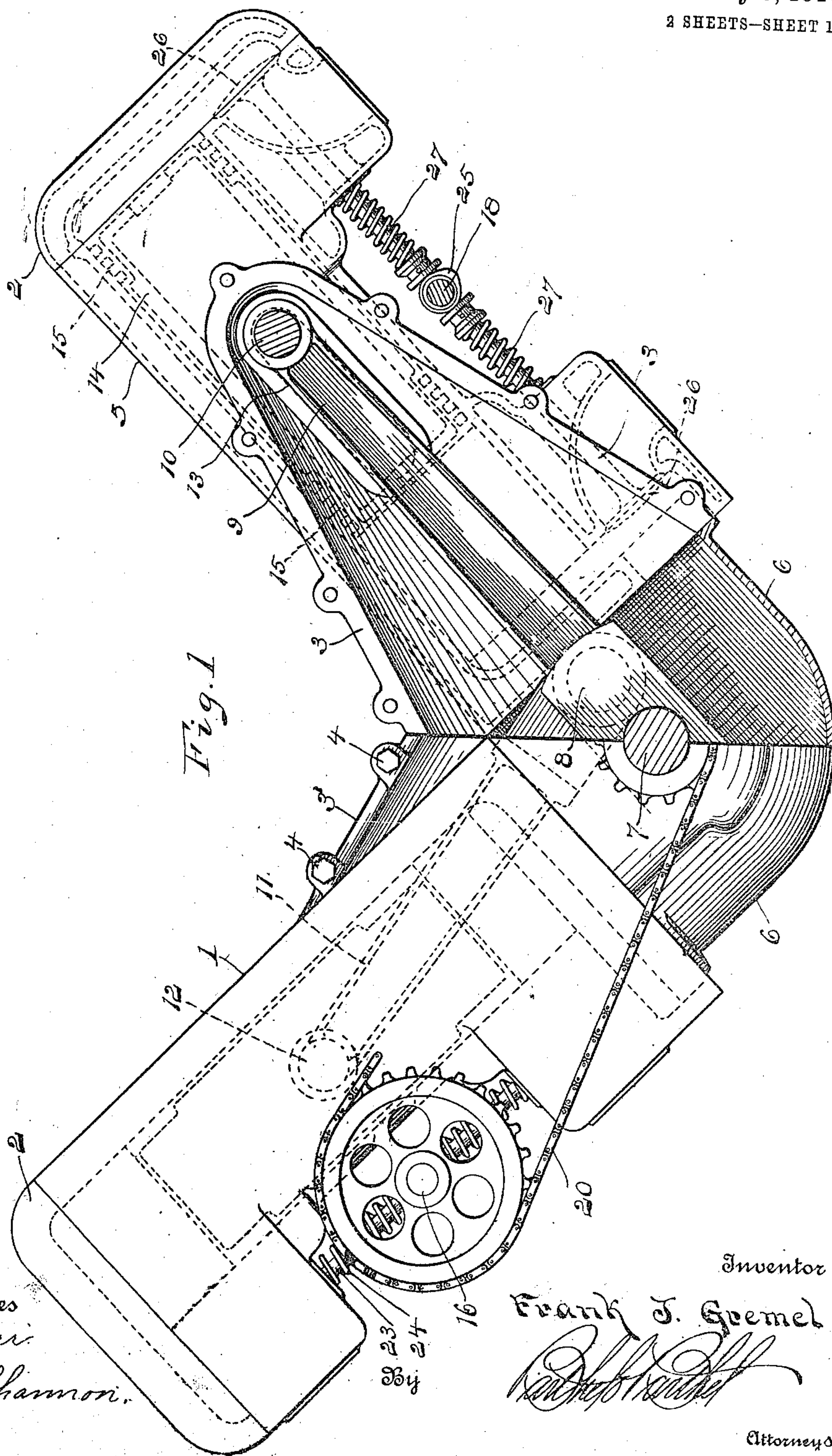


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F. J. GREMEL.
EXPLOSIVE ENGINE.
APPLICATION FILED OCT. 9, 1909.

Patented July 5, 1910.
2 SHEETS—SHEET 1.



Witnesses
A. M. Dorr
A. M. Shannon.

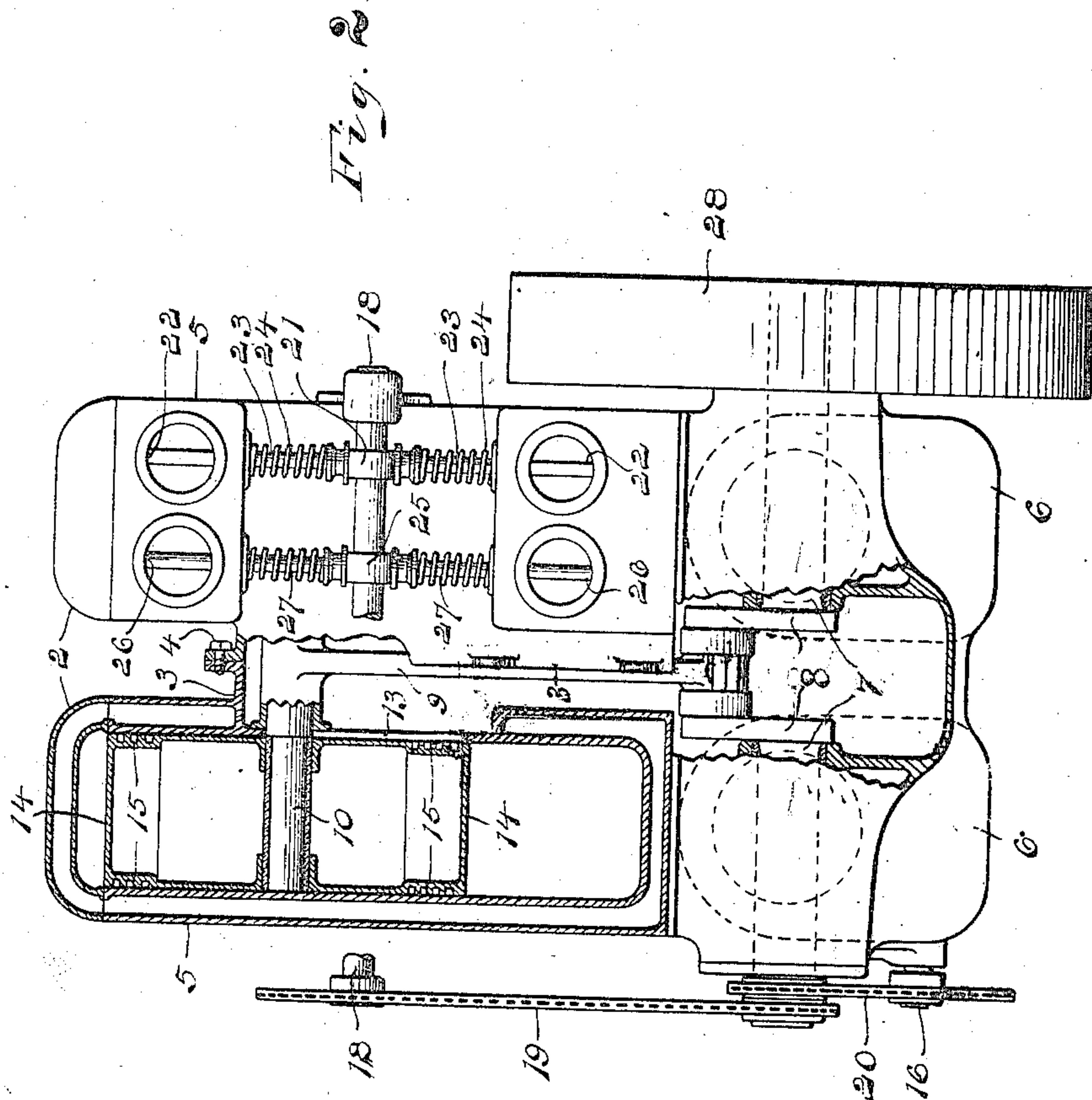
Inventor
Frank J. Gremel
[Signature]

Attorneys

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By *[Signature]*
Attorneys

UNITED STATES PATENT OFFICE.

FRANK J. GREMEL, OF DETROIT, MICHIGAN

EXPLOSIVE-ENGINE.

963,043.

Specification of Letters Patent.

Patented July 5, 1910.

Application filed October 9, 1909. Serial No. 521,842.

To all whom it may concern:

Be it known that I, FRANK J. GREMEL, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

10 This invention relates to explosive multi-cylinder four-cycle engines and more particularly to an arrangement thereof whereby a power plant is obtained of great strength and compactness, together with the simplicity of construction that particularly fits it for use on trucks and for commercial service.

15 The invention consists in the matters hereinafter set forth, and more particularly pointed out in the appended claims.

20 Referring to the drawings, Figure 1 is a view in end elevation with one pair of cylinders removed, of an engine embodying features of the invention; and Fig. 2 is a view in side elevation looking squarely at one pair of cylinders with one of the cylinders in longitudinal section and the casing partly broken away.

25 As herein indicated, a pair of parallel cylinders 1 are permanently closed at their lower ends and provided at their upper ends with detachable heads 2, both wall and heads being water jacketed or arranged with radiating surface for air cooling. The cylinders are connected by a central crank case whose sections 3 formed integral with or on the inner adjacent sides of the cylinders are secured together at their margins as by bolts 4. A second pair of cylinders 5 corresponding in arrangement to the first pair are disposed at substantially right angles thereto, the adjoining lower ends of each pair being mounted on a suitably shaped base 6. A crank shaft 7 is journaled in any preferred manner in the crank casing and has a single pair of cranks and wrist pin 8 central between the cylinders that are coupled by an inner connecting rod 9 to a cross pin 10 of the cylinders 5 and by a second connecting rod 11 to a cross pin 12 of the cylinders 1. Each cross pin travels in a pair of aligned, longitudinal guide slots 13 in the cylinder walls and is journaled at each end in tubular pistons 14. The latter are closed at each end and provided with double sets of piston rings 15. The pistons

are sufficiently long to always cut off or cover the cross pin guide slots. A cam shaft 16 is journaled in suitable bearings on the exterior of the pair of cylinders 1, and a similar shaft 18 is likewise secured on the corresponding side of the cylinders 5. Each cam shaft is operated in proper timed relation to the main shaft by chain and sprocket connections 19 and 20, gearing or the like. A cam 21 adjacent each cylinder alternately opens intake valves indicated at 22 on the cylinder ends by means of tappets 23 held against the cam by springs 24 while another cam 25 likewise opens exhaust valves 26 through push-rods or stems 27. Or other means for operating the valves of standard suitable construction may be used, if desired. A properly arranged ignition system, not shown, together with a fly-wheel 28 and the other usual adjuncts and accessories complete the engine.

30 In operation the cams and ignition systems are arranged so that the cylinder of each pair are fired alternately from one end in order, as in the ordinary multi-cylinder arrangement. By this arrangement one crank and a pair of connecting rods transmit the impulses from eight cylinders to the crank shaft, and this greatly lessens the cost of machining and the labor of assembling the parts and also reduces the weight per horse power. Furthermore the compactness of the engine makes it especially desirable for use in automobile trucks or commercial wagons wherein it is desirable to economize space and weight. It is also clear that this same arrangement of cylinders and pistons with single crank may be used for two-cycle engine, one end of each cylinder being for ignition and the other for compression, the valves being disposed accordingly.

Obviously, changes in details of construction may be made without departing from the spirit of the invention and I do not care to limit myself to any particular form or arrangement of parts.

What I claim as my invention is:—

1. In an explosive engine, a base, oppositely inclined pairs of parallel cylinders on the base, each cylinder being closed at each end, an inlet and an exhaust valve at each end of each cylinder, a single piston in each cylinder, a main crank shaft, a single connecting rod operatively coupling both pistons of each pair of cylinders to the crank,

and means adapted to operate the valves in series in timed relation.

2. In an explosive engine, a base, oppositely inclined pairs of parallel cylinders on the base, each cylinder being closed at each end, an inlet and an exhaust valve at each end of each cylinder, a single piston in each cylinder, a main crank shaft, a single connecting rod operatively coupling both pistons of each pair of cylinders to the crank, a crank case between each pair of cylinders housing the connecting rod, and means adapted to operate the valves in series in timed relation.

3. In an explosive engine, a base, oppositely inclined pairs of parallel cylinders thereon, each adapted to compress at each end, and provided with a piston, a crank shaft in the base having a single wrist pin, a cross pin connecting the pistons of each pair of cylinders, and a connecting rod connecting each cross pin with the wrist pin.

4. In an explosive engine, a base, oppositely inclined pairs of cylinders thereon in parallel, spaced relation, closed at each end and provided with an inlet valve and an exhaust valve at each end, a single piston in each cylinder, a cross-pin connecting the piston of each pair and traveling in slots in the cylinder walls, a main crank-shaft journaled in the base, a connecting rod coupling each pin and crank-shaft, and means adapted to operate the valves in series in timed relation.

5. In an explosive engine, a base, oppositely inclined pairs of cylinders thereon in parallel spaced relation, closed at each end and provided with an inlet valve and an exhaust valve at each end, a single piston in each cylinder, a cross-pin connecting the pistons and traveling in slots in the cylinder walls, a main crank-shaft journaled in the base, a connecting rod coupling each pin and crank-shaft, a crank case connecting the cylinders of each pair and housing the adjacent connecting rod, and means adapted to operate the valves in series in timed relation.

6. In an explosive engine, oppositely in-

clined pairs of parallel cylinders closed at each end, an inlet and an exhaust valve at each end of each cylinder, a single piston in each cylinder, a main crank shaft, a single connecting rod operatively coupling both pistons of each pair to the crank-shaft, a cam shaft for each pair, a pair of cams thereon, each adapted to operate both inlet valves of a cylinder, a second pair of cams thereon each adapted to operate both exhaust valves of a cylinder, and means operatively connecting the cam and crank shafts.

7. In an explosive engine, oppositely inclined pairs of parallel cylinders closed at each end and provided with an inlet valve and an exhaust valve at each end, a single piston in each cylinder, a cross-pin connecting the pistons of each pair and traveling in guide slots in the cylinder sides covered by the pistons, a main crank-shaft, a connecting rod coupling each pin and crank-shaft, a cam shaft, a pair of cams thereon, each adapted to operate both inlet valves of a cylinder, a second pair of cams thereon each adapted to operate both exhaust valves of a cylinder, and means operatively connecting the cam and crank shafts.

8. In an explosive engine, a base, oppositely inclined pairs of parallel cylinders thereon each provided with a piston, a crank shaft in the base having a single wrist pin, a cross pin connecting the pistons of each pair of cylinders, a connecting rod connecting each cross pin with the wrist pin and means adapted to control the intake and exhausts of the cylinders.

9. In an explosive engine, pairs of cylinders secured in oppositely inclined positions, a piston for each cylinder, a cross-pin connecting the pistons of each pair of cylinders, and a connecting rod coupling each cross-pin with the wrist pin.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK J. GREMEL.

Witnesses:

OTTO F. BARTHEL,
C. R. STICKNEY.