No. 790,374. PATENTED MAY 23, 1905.

J. D. MAXWELL.

EXPLOSIVE ENGINE.

APPLICATION FILED JULY 13, 1903.

2 SHEETS—SHEET 1.

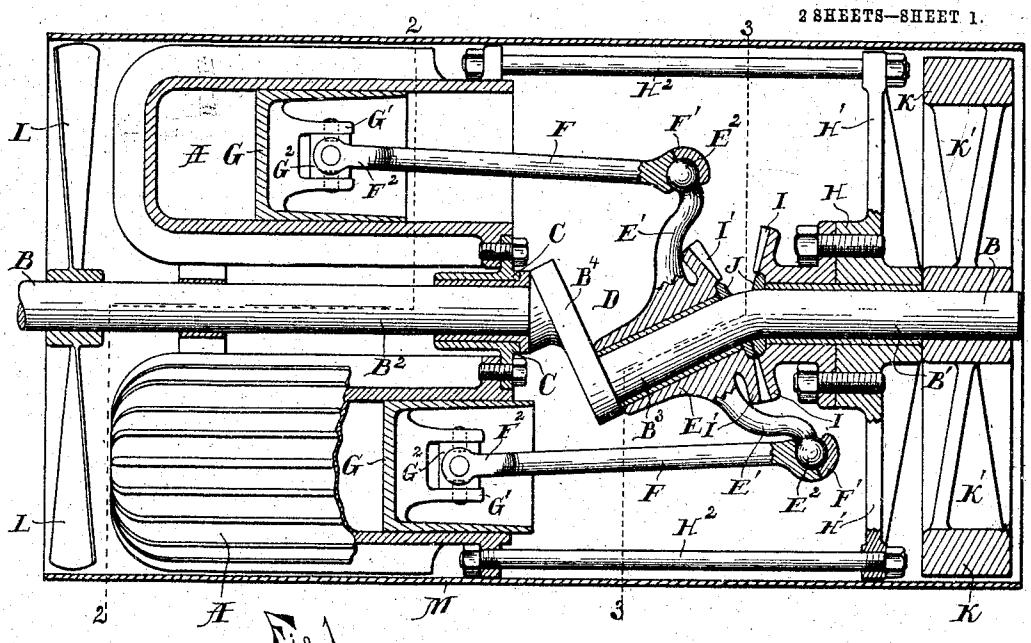

Fig. 1.

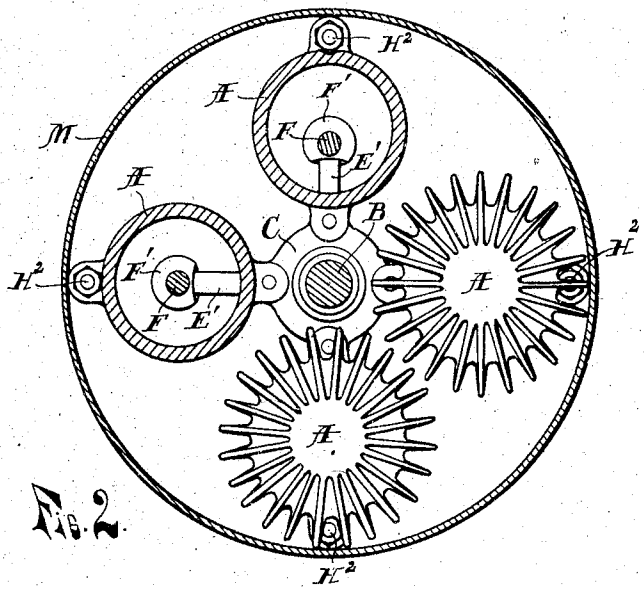

Fig. 2.

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2 SHEETS—SHEET 2.

Fig. 2.

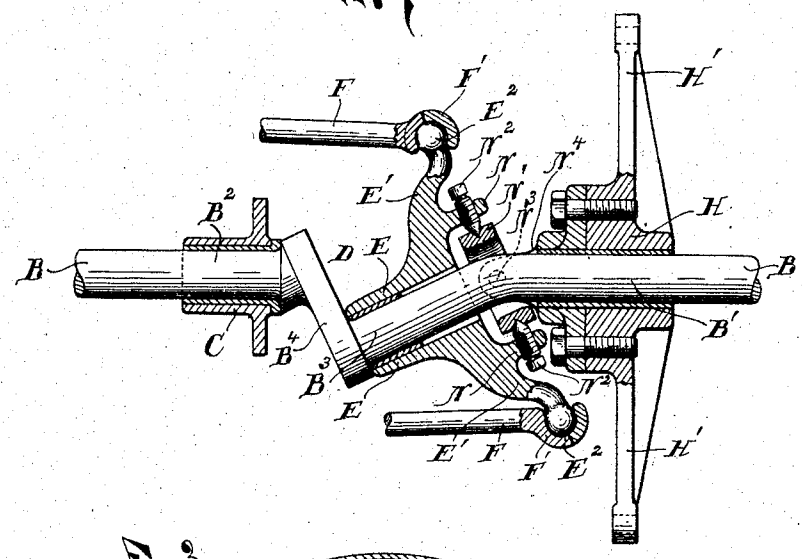
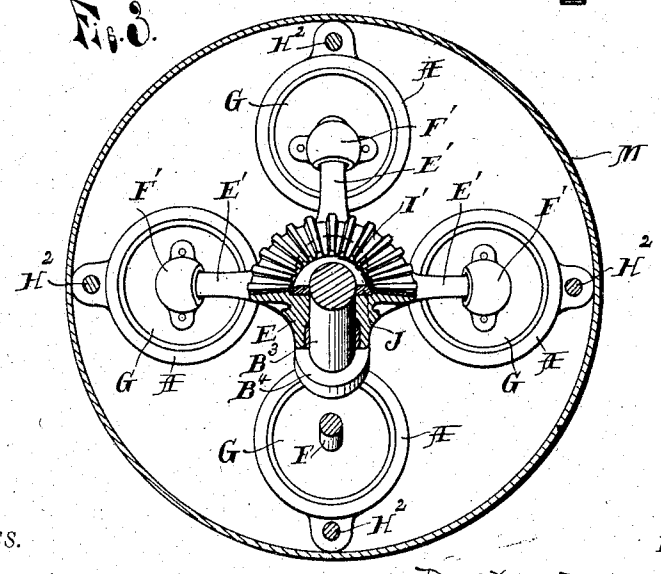


Fig. 3.



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UNITED STATES PATENT OFFICE.

JONATHAN D. MAXWELL, OF DETROIT, MICHIGAN.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 790,374, dated May 23, 1905.

Application filed July 13, 1903. Serial No. 165,256.

To all whom it may concern:

Be it known that I, JONATHAN D. MAXWELL, 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.

This invention relates to improvements in explosive-engines; and its object is to provide a multiple-cylinder engine which is particularly adapted for automobile propulsion, the cylinders being so arranged that they may be all inclosed within a single casing, through which a current of air to cool the cylinders is forced by fans on the engine-shaft and also so arranged as to take up the least possible room.

It is also an object of the invention to reduce the vibration to the minimum and to provide a cheap, efficient, and convenient construction for automobile use.

To this end the invention consists in arranging the cylinders around the engine-shaft with their longitudinal axes extending parallel with the longitudinal axis of said shaft and in so constructing the shaft and connecting the pistons therewith that a rotary motion is imparted to the shaft by the pistons acting consecutively thereon, such arrangement bringing the thrust of the pistons longitudinally of the shaft, thereby reducing vibration and also bringing the cylinders close to the shaft, so that they may be inclosed in a casing, and a fan secured to the engine-shaft at the end of the casing to cause a cooling current of air to pass therethrough.

The invention also consists in the novel construction and arrangement of parts and in certain other new and useful features, all as hereinafter more fully described, reference being had to the accompanying drawings, in which—

Figure 1 is a central longitudinal section of a device embodying the invention; Fig. 2, a section on the line 2 2 of Fig. 1; Fig. 3, a section on the line 3 3 of Fig. 1, and Fig. 4 a detail showing a modified construction.

As shown in the drawings, A represents the four cylinders arranged at equal distances apart around the engine-shaft B, each cylinder extending longitudinally of the shaft with its axis parallel with the axis of the shaft, and a bearing C, within which said shaft turns, is provided with ears to which the cylinders are bolted. The shaft B is formed with two straight portions B' B^2, with a crank D forming the connection between the two parts, said crank being formed by bending the end B^3 of the part B' laterally at an angle of less than forty-five degrees to the shaft and forming a crank member B^4 integral with the end of the part B^2 and with the end of the bent portion B^3. On the laterally-bent end B^3 of the shaft is a sleeve E, provided with four laterally-projecting arms E', one for each cylinder, each arm provided at its outer end with a ball E^2 to engage a socket F' on the end of each of the connecting-rods F, said bolts and sockets forming universal connections between the ends of the arms and the outer ends of the connecting-rods. The upper ends of said rods are also secured to the pistons G by universal connections formed by providing each of said pistons with downwardly-extending lugs G', between which is pivotally secured a block G^2, and to these blocks the forked ends F^2 of the rods are pivotally secured. The part B' of the shaft is mounted in a bearing H, which is provided with laterally-extending arms H', provided with openings at their ends to receive tie-bolts H^2, which also engage openings in ears on the cylinders, said tie-bolts, cylinders, and bearing together forming a frame, which is secured in any suitable manner to a base or frame (not shown) to prevent the same from turning. To prevent the sleeve E from turning around the shaft, a miter-gear I is securely bolted to the bearing H, and the sleeve is formed with an integral miter-gear I' to engage the stationary gear. The gears are mitered relative to the

bend in the shaft, so that as the shaft is turned, changing the direction of the bent end, and consequently that of the sleeve, the teeth of the gear I′ will be brought successively into mesh with those of the gear I, and as said gear I is stationary the sleeve is prevented from turning by the intermeshing of the gear-teeth, but at the same time is free to move as the bent end turns and, as it were, to rock on the stationary gear. Within a recess in the face of each gear is a hardened ring J to take the thrust of the pistons and prevent the gears from wearing, and when a piston receives its impulse force is exerted, through its connecting-rod, upon the end of the arm E′, and as the sleeve carrying said arm is prevented from rotating the tendency of such force is to turn the laterally-bent portion B^3 of the crank within the sleeve, thus rocking the sleeve on the stationary gear and moving the end of said arm away from the cylinder, permitting the piston to move to the outer end of its stroke. On the part B′ of the shaft adjacent to the bearing H is secured the fly-wheel K, which is provided with flat spokes K′, set at an angle to form fan-blades, the opposite end of the shaft adjacent to the cylinder-heads being provided with a fan-wheel L, and inclosing the whole structure is a cylindrical casing M, the fan being located at one end of this casing to force air into the same, and at the opposite end of the casing is the fly-wheel, operating to draw the air from the casing. The cylinders are provided with longitudinal radiating ribs, and as the air is forced through the casing longitudinally of the cylinders they will be effectually cooled, as will also the crank and other parts. The cylinders are provided with suitable intake and exhaust valves, (not shown,) preferably arranged to operate the engine upon the four-cycle plan, and in the drawings four cylinders are shown; but two or more may be used, and, if desired, two opposing sets, one at each side of the crank, may be provided, operating in opposite directions thereon and set to receive their impulses in rapid succession. Where but one set of four-cycle cylinders is used, operating in but one direction upon the crank, it is preferable to use an odd number of cylinders and to explode a charge in every other cylinder in succession, so as to synchronize the impulses; but if opposing sets are used they may be so arranged as to synchronize the explosions when an even number of cylinders are used.

As shown in Fig. 4, instead of employing the miter-gears to hold the sleeve E from turning said sleeve may be provided with the ears N and a ring N′, surrounding the shaft and pivotally secured between said ears by pivot-pins N^2, which ring is in turn pivotally secured by the pins N^3 to the ears N^4 on the stationary bearing H. The sleeve is thus held from turning with the shaft by the ears N^4 and allowed to rock on the pivot-pins N^2 in one direction and on the pins N^3 in the other direction.

Having thus fully described my invention, what I claim is—

1. In an explosive-engine, the combination of a crank-shaft and a plurality of cylinders arranged around said shaft, connecting means for rotating said shaft, an open-ended cylindrical casing surrounding the cylinders and crank and a fan-wheel on the crank-shaft at each end of the casing.

2. In an explosive-engine, the combination of a crank-shaft having a laterally-bent portion extending at an angle of less than forty-five degrees to the axis of the shaft and forming a crank, a plurality of cylinders extending longitudinally of the shaft, pistons in said cylinders, a sleeve on the laterally-extending portion, arms on said sleeve, connecting-rods connected at their ends by universal connections to the pistons and the ends of said arms, a miter-gear on said sleeve, a stationary bearing and a miter-gear secured to said bearing and meshing with the gear on the sleeves.

3. In an explosive-engine, the combination of a crank-shaft provided with a lateral bend intermediate its ends forming a crank portion extending at an angle to the axis of the shaft less than forty-five degrees, a plurality of cylinders arranged around said shaft with their axes extending parallel with the axis of the shaft, pistons in said cylinders, a sleeve on the laterally-extending portion of the crank-shaft, arms on said sleeve, connecting-rods connecting the ends of said arms with the pistons, a stationary bearing for the shaft, a miter-gear secured to said bearing, a miter-gear on the sleeve, and wear-plates interposed between said gears.

4. In an explosive-engine, the combination of a crank-shaft having a laterally-bent portion extending at an angle to the axis of the shaft of less than forty-five degrees and forming a crank, bearings for the shaft adjacent to said crank, a plurality of cylinders secured to the bearing at one side of the crank and spaced apart around the shaft with their axes extending parallel with the axis of the shaft, arms on the bearing at the opposite side of the crank, ears on the cylinders, tie-bolts connecting said arms and the ears on the cylinders, pistons in said cylinders, a sleeve on the laterally-bent portion of the shaft, arms on said sleeve, connecting-rods attached at their ends to the pistons and the ends of said arms by universal connections, a miter-gear on the sleeve, and a miter-gear secured to the adjacent bearing, meshing with said gear on the sleeve.

5. In an explosive-engine, the combination of a crank-shaft and a plurality of cylinders around said shaft, pistons in the cylinders con-

necting with said crank-shaft for transmitting motion thereto, an open-ended cylindrical casing surrounding the cylinders and shaft, a fan-wheel on the shaft within the casing at one end thereof, and a fly-wheel at the opposite end thereof having spokes forming fan-blades.

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

JONATHAN D. MAXWELL.

Witnesses:
OTTO F. BARTHEL,
LEWIS E. FLANDERS.