Nov. 24, 1936. D. F. COOK 2,062,209

INTERNAL COMBUSTION ENGINE

Filed Feb. 3, 1934 3 Sheets-Sheet 1

Fig. 1.

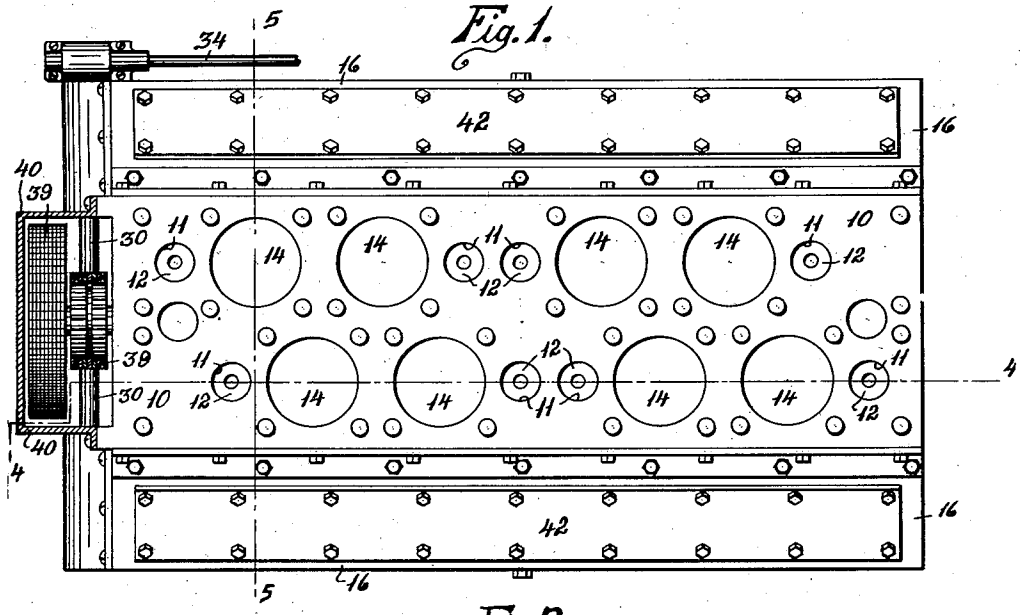


Fig. 2.

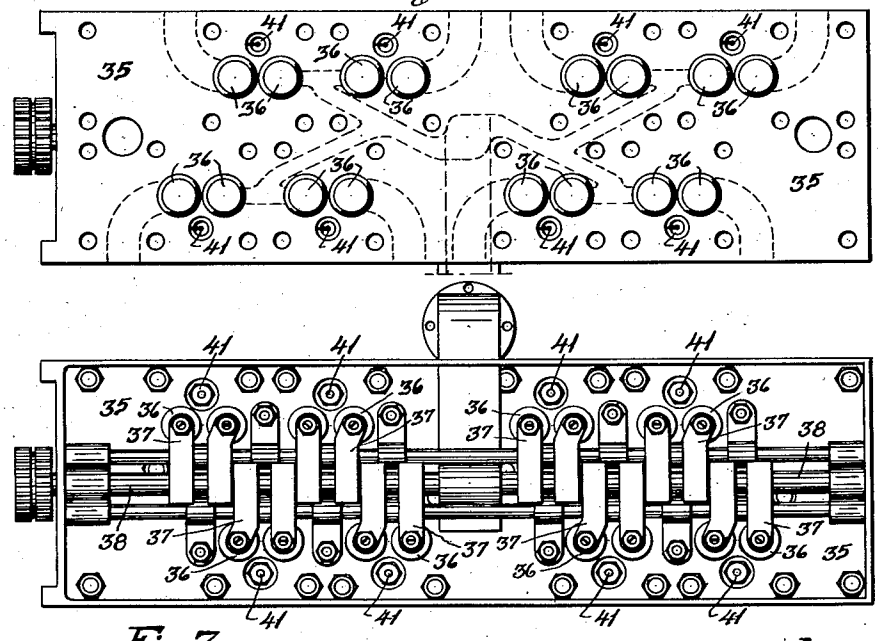


Fig. 3.

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Filed Feb. 3, 1934 3 Sheets-Sheet 2

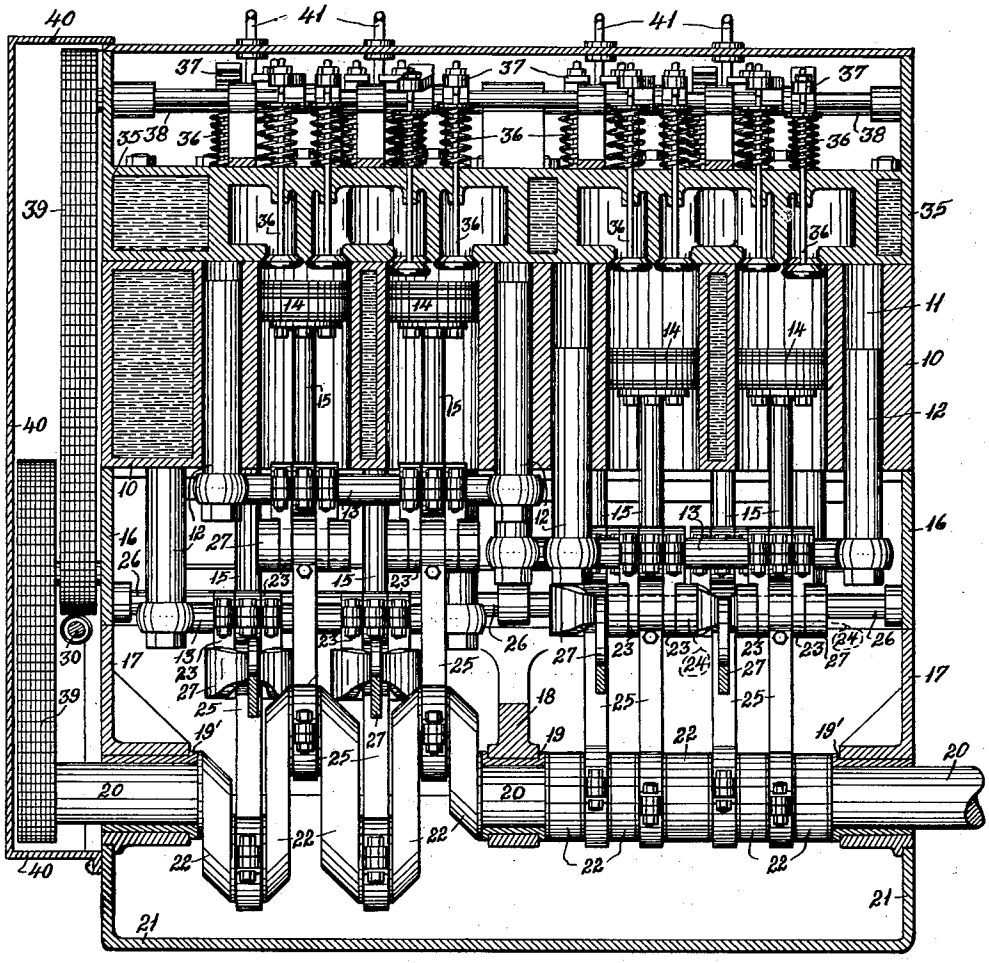


Fig. 4.

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Filed Feb. 3, 1934 3 Sheets-Sheet 3

Fig. 5.

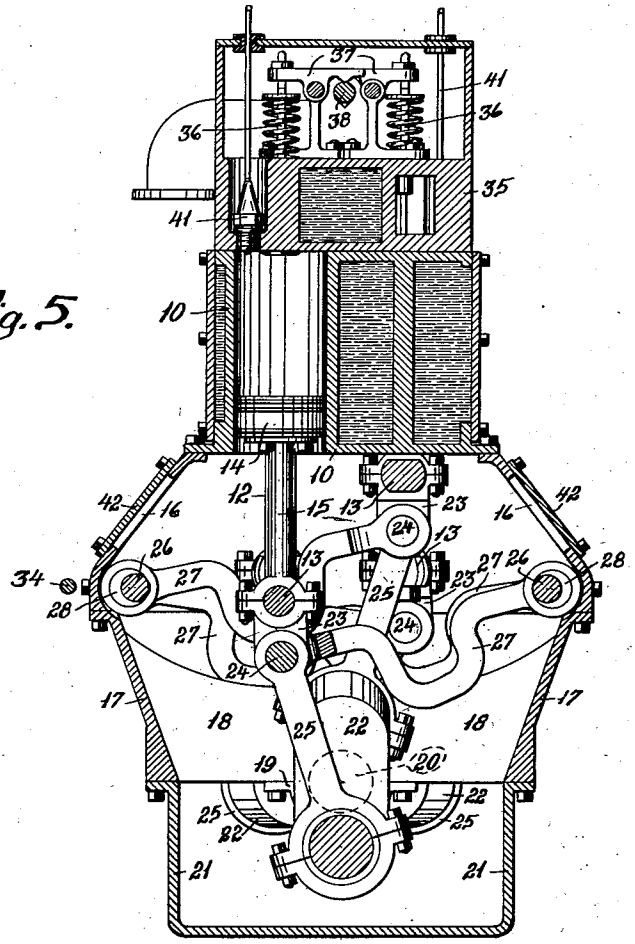
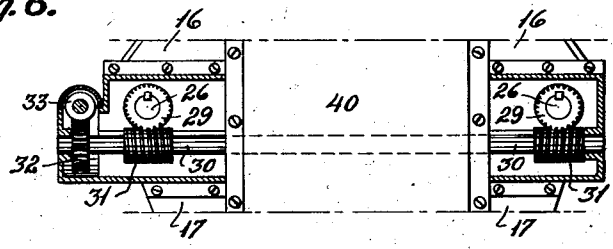


Fig. 6.



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Patented Nov. 24, 1936 2,062,209

UNITED STATES PATENT OFFICE

2,062,209

INTERNAL COMBUSTION ENGINE

David F. Cook, Cheyenne, Wyo.

Application February 3, 1934, Serial No. 709,612

3 Claims. (Cl. 123—54)

This invention relates to internal combustion engines and has as an object to provide an improved construction and arrangement of the operative elements of such engines.

A further object of the invention is to provide an improved piston and cylinder arrangement in an internal combustion engine, which arrangement enhances the engine efficiency and minimizes certain difficulties resulting from conventional arrangements.

A further object of the invention is to provide an improved arrangement of the elements interconnecting the pistons and crankshaft of an internal combustion engine.

A further object of the invention is to provide improved means for operatively connecting pistons working in laterally spaced, parallel cylinders with the crankshaft of an internal combustion engine.

A further object of the invention is to provide an improved operative combination of pistons in a multi-cylinder internal combustion engine.

A further object of the invention is to provide an improved construction and arrangement of the operative elements of an internal combustion engine, whereby side thrust or pressure between piston and cylinder walls is eliminated.

A further object of the invention is to provide an improved construction and arrangement of the operative elements of an internal combustion engine, wherethrough variation in the compression factor of said engine may readily be had.

A further object of the invention is to provide an improved construction and arrangement of the operative elements of an internal combustion engine, wherethrough the compression factor of said engine may be varied during operation thereof.

A further object of invention is to provide an improved construction and arrangement of the operative elements of an internal combustion engine resulting in an operative assembly that is compact, susceptible of construction in various multiples of even numbered cylinders, readily accessible for maintenance and repair, highly efficient, and susceptible of immediate adjustment of the compression factor to varying fuel and load conditions.

My invention consists in the construction, arrangement and combination of elements hereinafter set forth, pointed out in my claims and illustrated by the accompanying drawings, in which—

Figure 1 is a plan view of an eight-cylinder internal combustion engine embodying the principles of the invention, the cylinder head of the assembly being removed and certain of the elements being shown in section. Figure 2 is a bottom plan view of the cylinder head assembly employed with the assembly shown in Figure 1. Figure 3 is a top plan view of the showing of Figure 2, the cover plate being removed. Figure 4 is a longitudinal, vertical section through the complete engine assembly according to Figures 1, 2 and 3, taken on the indicated line 4—4 of Figure 1. Figure 5 is a transverse, vertical section through the complete engine assembly, taken on the indicated line 5—5 of Figure 1. Figure 6 is a fragmentary, detail elevation, partly in section, illustrating one arrangement operable to vary the compression factor of the engine.

In the construction of the improvements as shown, the numeral 10 designates the cylinder assembly or block, which is formed in any suitable manner of any suitable material, preferably as an integrally cast or moulded unit. The cylinder bores, in multiples of two, in this instance eight in number, open through top and bottom of the block 10 in axially parallel relation and are arranged with one-half the total number of bores aligned longitudinally of the block 10 at one side of the longitudinal median line of said block and the other half of the bores similarly aligned and offset laterally a like distance from the median line of said block, the bores in each alignment being staggered somewhat relative to those in the other alignment, as is clearly shown in Figure 1. The cylinder bores in each alignment are similiarly grouped in pairs, which pairs are preferably spaced apart a distance somewhat greater than the spacing between the bores constituting a pair, and a relatively smaller bore 11 is formed in the block 10 on each side of each pair of cylinder bores in axially parallel relation with said cylinder bores, the centers of the bores 11 being aligned with the centers of their respective paired cylinder bores. Smooth, straight, cylindrical guides 12, each formed with an axial bore to reduce weight and provide a free air passage therethrough, are mounted for axial reciprocation in the bores 11, the lower ends of the guides 12 projecting below the block 10 for rigid connection with the ends of straight, cylindrical rods 13, which rods have a length sufficient to interconnect the guides 12 of each pair of cylinder bores and are thus positioned in horizontally disposed relation longitudinally of the block 10 and beneath

the centers of each pair of cylinder bores. Each pair of guides 12 with its interconnecting rod 13 thus forms a rigid yoke arranged for vertical reciprocation relative to the block 10 in a plane containing the axes of the corresponding pair of cylinder bores. A piston 14, suitably equipped with piston rings and of such specific form and construction as may be desired, is mounted for axial reciprocation in each of the cylinder bores and is rigidly supported on the upper end of a stem or post 15 which is, in turn, yoked at its lower end to and for motion relative to the corresponding rod 13, the posts 15 in each pair of cylinder bores being identical in length to similarly position the pistons 14 in the paired bores, which arrangement and linkage provides that the pistons 14, guides 12 and rod 13 of each group of paired cylinder bores constitute a single unit reciprocable relative to said bores, the pistons, through the connection at the lower ends of the posts 15, being free to adapt themselves to slight differences in the alignment of the cylinder bores and bores 11, while any side pressure or thrust acting on the yoke 12, 13 is absorbed in the slide bearings formed by the bores 11 and guides 12 and is not transmitted to the piston and cylinder walls.

The block 10 is formed with or fixed to a housing 16 diverging laterally and downwardly from the lower side of said block, which housing, in turn, is formed with or fixed to a complementary housing 17 converging somewhat laterally and downwardly, the housings 16 and 17 thus forming the upper portion of a crankcase and defining a supporting enclosure for operative elements hereinafter described. A web 18 is formed transversely of the housing 17 and supports a journal bearing 19 which, together with journal bearings 19', formed in and carried by end portions of the housing 17, provides an operative mounting for a crankshaft 20, thus positioned beneath the longitudinal median line of the block 10. A suitable housing or cover 21 is removably carried by and in closing relation with the lower end of the housing 17. The crankshaft 20 is formed with throws 22, each provided with a crank pin in spaced, parallel relation with the shaft axis, as is common practice, the throws being variously arranged as may be desired for a given engine, the drawings illustrating a shaft formed with eight throws and pins grouped in alined pairs, which practically corresponds with four throws and pins, the first two and the last two pairs of alined pins being set in common planes, or at one hundred and eighty degrees of rotation with each other, which planes are arranged perpendicularly, thus arranging the four sets of alined pins symmetrically ninety degrees of rotation apart. Links 23 are yoked at their upper ends to and for motion about the rods 13 on each side of the yoke connecting each post 15 with said rods, said links depending in pairs, one pair for each post 15, to support a pin 24 in spaced, parallel relation with its adjacent rod 13 beneath each of the posts 15, which pins 24 traverse the upper ends of connecting rods 25 received between the links 23 of each pair, the lower ends of said connecting rods 25 being yoked about the pins of the crankshaft throws 22, the rods 25 linked to a given rod 13 naturally connecting with aligned pins of the throws 22. The connection between a rod 13 and the crankshaft 20 afforded by the links 23, pin 24 and rod 25 constitutes a toggle joint which is effective in transmitting power impulses acting on a piston 14 to said crankshaft when the knuckle of the toggle joint is held to a definite orbit, to which end parallel shafts 26 are journaled in suitable bearings longitudinally of and on opposite sides of the housing 16, which shafts hingedly support arms 27 that extend transversely of the crankcase to hingedly connect with pins 24 of the more remote piston and rod assemblies, thus holding the knuckle joints of the toggles to a definitely limited motion during actuation of the engine elements. The arms 27 are preferably yoked for connection with the pins 24 and are shaped and provided with offset portions as needed to avoid interference with the other operative elements housed in the crank case. In an engine having a fixed compression factor, the arms 27 may be mounted directly on the shafts 26 or on bearings carried by and concentric with said shafts, but when variation of the compression factor is desired, the shafts 26 are provided with aligned eccentrics 28, whereon the arms 27 are mounted, or, which is functionally the same, the shafts 26 are eccentrically mounted in their bearings, so that, when either shaft 26 is rotated about its axis, the arms 27 carried thereby are moved transversely of the engine assembly, varying their effective lengths and consequently the position of the knuckle joint pins controlled thereby, with resultant variation in the position of the pistons relative to their cylinders and change in size of the compression chambers above said pistons. Various means may be employed for synchronizing the positions of the shafts 26 and for simultaneously and uniformly rotating said shafts, one such means being illustrated as comprising identical gears 29 fixed to said shafts, an operating shaft 30 supported in suitable bearings adjacent and perpendicular to said shafts 26 and provided with oppositely directed worms 31 in operative engagement with the gears 29, a worm gear 32 on one end of the shaft 30 in operative engagement with a suitably supported worm 33 and a shaft or rod 34 whereby the worm 33 may be rotated from any convenient location. It is of course obvious that rotation of the rod 34 effecting rotation of the worm 33 acts through the elements described to rotate the shafts 26 uniformly and simultaneously in opposite directions, thus simultaneously and uniformly varying the size of all the compression chambers, which variation can thus be had during operation of the engine if desired to compensate for varying conditions of fuel or load.

The upper end of the cylinder block 10 is closed by a removable, unitary cylinder head 35 adapted to be securely bolted to said block in a common manner. The head 35 may be of any desired type and construction to meet the requirements of a specific engine, the head shown being of semi-conventional type wherein are formed the required inlet and exhaust passages, shown in dotted lines in Figure 2, controlled by poppet valves 36 thus positioned in overhead relation with the cylinders they serve. The valves 36 are actuated by means of rocker arms 37 suitably supported for oscillation and operatively engaging with a cam shaft 38 driven from the crankshaft 20 through suitable chains 39, or equivalent connections housed beneath a cover 40 at one end of the assembly. Ignition devices 41 are positioned in the head 35 adjacent the valves 36 and are timed and controlled in any suitable manner.

The engine is illustrated as of water-cooled type

provided with chambers and passages in the cylinder block 10 and head 35 through which a cooling fluid may circulate, but it is to be understood that the principles of the invention may well be adapted to engines of air-cooled type if desired. Any suitable system of lubrication, fuel supply and exhaust of burned gases may be employed with the improved engine, such systems in themselves forming no part of the instant invention.

To facilitate maintenance and repair, elongated apertures may be formed in the sides of the housing 16 wherethrough access may be had to the operating elements within the crankcase, such apertures being provided with removable closure plates 42.

In the practical operation of the improved engine, the pistons are paired to permit of their functioning as a single unit with the stages of their individual cycles spaced one hundred and eighty degrees apart, thus making possible complete elimination of side thrust or pressure acting on cylinder and piston walls and producing the advantages of eight-cylinder performance with the simplicity of four-cylinder construction, the adjustability of the compression factor lending enhanced adaptability and increasing functional efficiency.

Since many changes in the specific form, construction and arrangement of the elements shown and described may be had without departing from the spirit of the invention, I wish to be understood as being limited solely by the scope of the appended claims rather than by any details of the illustrative showing and foregoing description.

I claim as my invention—

1. An internal combustion engine comprising a cylinder block, a crank case associated with said cylinder block, a crankshaft operatively mounted in said crankcase, a plurality of axially-parallel cylinders formed in double alignment in said block on opposite sides of the longitudinal median line thereof, pistons reciprocably mounted in said cylinders, a plurality of separate guide means reciprocably engaging said block and secured to said pistons, toggle-joint connections through said guide means between each of said pistons and said crankshaft, and guide arms connecting the knuckle pins of said toggle-joints with said crankcase.

2. An internal combustion engine comprising a cylinder block, a crankcase associated with said cylinder block, a crankshaft operatively mounted in said crankcase, a plurality of axially-parallel cylinders formed in paired, double alignment in said block on opposite sides of the longitudinal median line thereof, pistons reciprocably mounted in said cylinders, guide means reciprocably engaging said block in yoking relation with each pair of said cylinders and secured to the pistons thereof, and operative direct connections through said guide means between each of said pistons and said crankshaft.

3. In an internal combustion engine having a cylinder block formed with a plurality of axially-parallel cylinders in double alignment on opposite sides of the longitudinal median line of said block, a crankcase associated with said cylinder block, a crankshaft operatively mounted in said crankcase and pistons reciprocably mounted in said cylinders, means for eliminating side pressure between said cylinder and piston walls, said means comprising guide yokes secured to said pistons and each formed with spaced stems in axial parallelism with said cylinders and reciprocably engaging guide bores in said block, and operative connections between said guide yokes and said crankshaft.

4. In an internal combustion engine having a cylinder block formed with a plurality of axially-parallel cylinders, a crankcase associated with said cylinder block, a crankshaft operatively mounted in said crankcase and pistons reciprocably mounted in said cylinders, means for eliminating side pressure between said cylinder and piston walls, said means comprising guide yokes each formed with spaced stems engaging guide bores in said cylinder block for reciprocation parallel with said cylinder axes and each rigidly interconnecting a pair of said pistons, and operative connections between said guide yokes and said crankshaft.

5. In an internal combustion engine having a cylinder block formed with a plurality of axially-parallel cylinders, a crankcase associated with said cylinder block a crankshaft operatively mounted in said crankcase and pistons reciprocably mounted in said cylinders means for eliminating side pressure between said cylinder and piston walls said means comprising guide yokes each formed with spaced stems engaging guide bores in said cylinder block for reciprocation parallel with said cylinder axes and secured to said pistons and toggle-joint direct connections operatively through said guide yokes between each of said pistons and said crankshaft.

6. In an internal combustion engine having a cylinder block formed with a plurality of axially-parallel cylinders a crankcase associated with said cylinder block a crank-shaft operatively mounted in said crankcase and pistons reciprocably mounted in said cylinders, means for eliminating side pressure between said cylinder and piston walls, said means comprising guide yokes each formed with spaced stems engaging guide bores in said cylinder block for reciprocation parallel with said cylinder axes and secured to said pistons, toggle-joint direct connections operatively through said guide yokes between each of said pistons and said crankshaft, and guide arms connecting the knuckle pins of said toggle-joints with said crankcase.

7. In an internal combustion engine having a cylinder block formed with a plurality of axially-parallel cylinders in paired, double alignment on opposite sides of the longitudinal median line of said block, a crankcase associated with said cylinder block, a crankshaft operatively mounted in said crankcase and pistons reciprocably mounted in said cylinders, supplementary bores on each side of and in axially-parallel alignment with said paired cylinders, guide means formed with spaced stems reciprocably mounted in said supplementary bores in yoking relation with said paired cylinders and secured to said pistons, and toggle-joint connections operatively through said guide means between each of said pistons and said crankshaft.

8. In an internal combustion engine of the character described, the combination with a plurality of axially-parallel cylinders in paired, double alignment, of pistons in each pair of cylinders yoked for simultaneous, guided reciprocation, toggle-joint direct connections between each of said pistons and the engine crankshaft, and means for controlling the effective mean angle of said toggle-joints.

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