Oct. 5, 1937. C. D. TOWN 2,094,830

MULTIPLE CYLINDER ENGINE

Filed Oct. 20, 1933 2 Sheets-Sheet 1

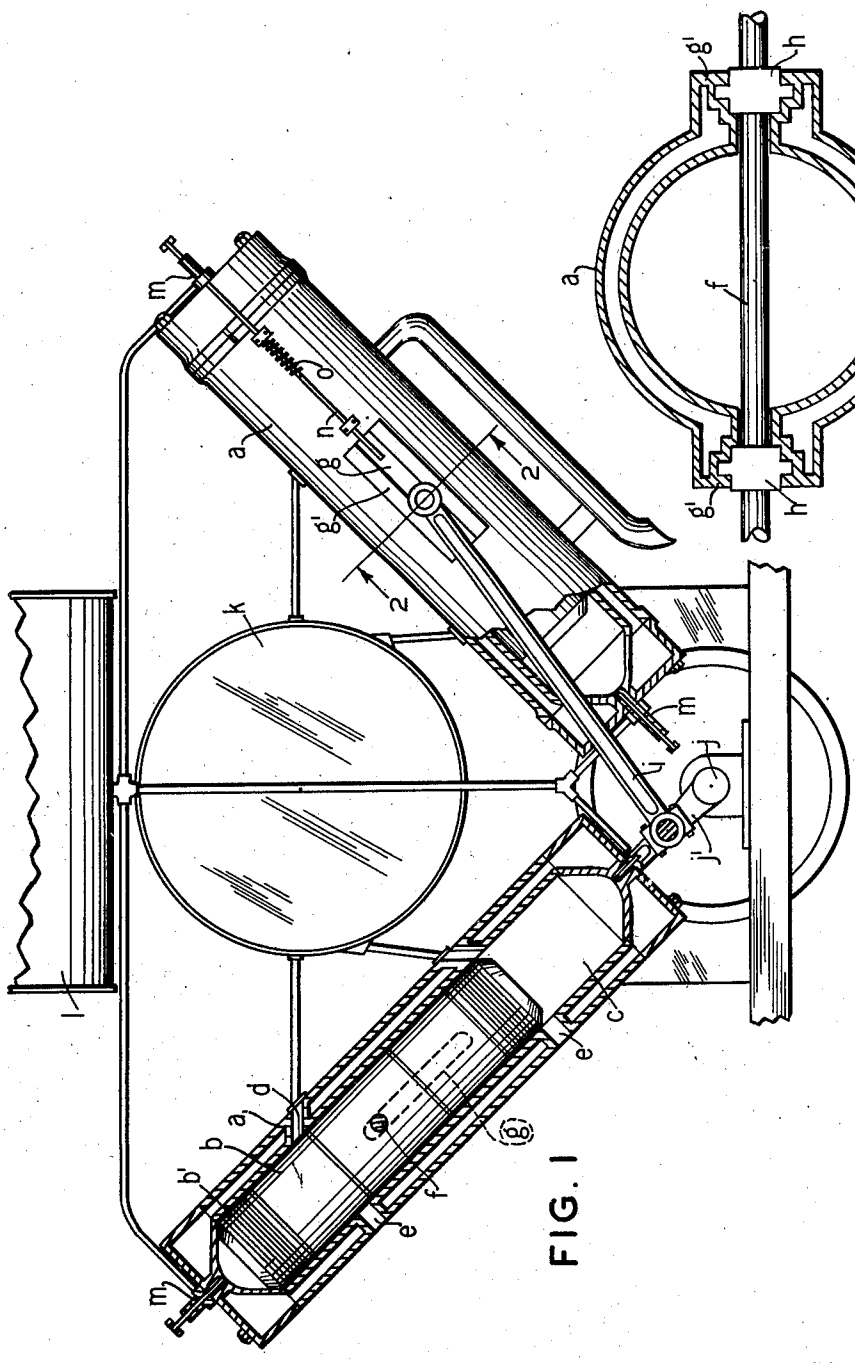

FIG. 1

FIG. 2

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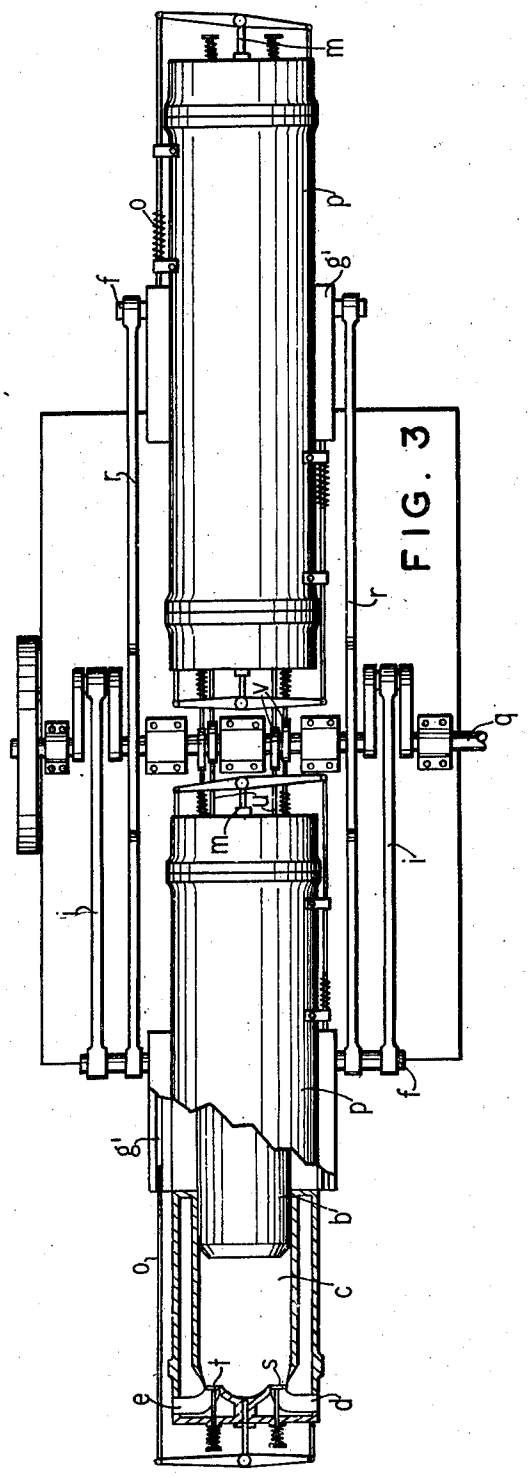

FIG. 3

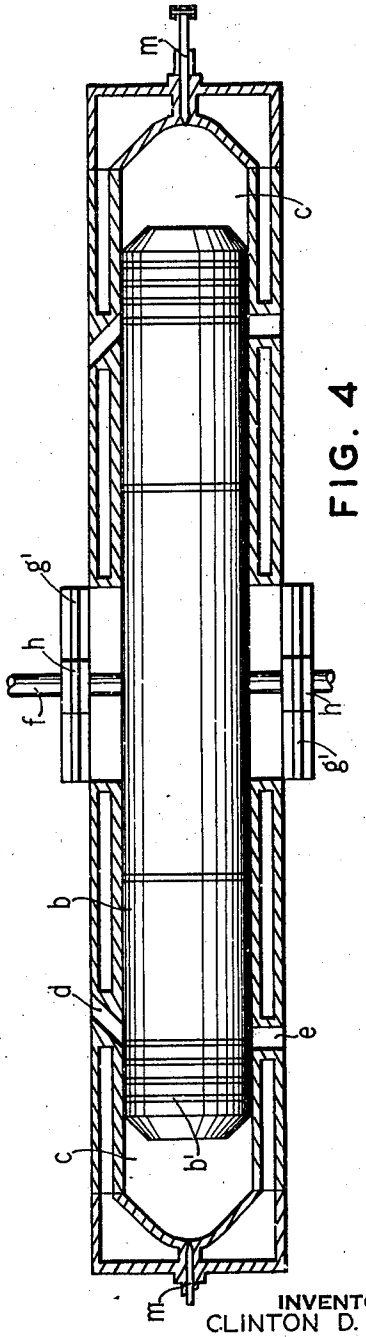

FIG. 4

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MULTIPLE CYLINDER ENGINE

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Application October 20, 1933, Serial No. 694,438

7 Claims. (Cl. 123—56)

My invention relates to internal combustion engines and similar power devices which utilize a cylinder and a reciprocating piston therein. My invention is illustrated not only in connection with internal combustion engines, but also in connection with steam engines and pumps.

One of the principal objects of my invention is to provide means, in devices of this character, by which the wear between the reciprocating piston and the cylinder will be taken upon crosshead guides rather than between the pistons and the cylinder walls, thereby to increase the effective life of said elements.

A further object of my invention is to provide a multi-cylinder power device in which each of the cylinders is double-acting and opposes another cylinder or other cylinders, the operation tending to provide substantially continuous driving strokes of the pistons in said cylinders which successively operate to drive the crank shaft or other common power device so that a minimum effective mass in the form of a flywheel, or similar operating structure, is necessary in order to produce uniform torque throughout the operating cycle of said engine. The latter object is attained by providing an engine in which a plurality of cylinders are arranged in longitudinally spaced alinement, the pistons being double acting, that is, provided with a firing chamber at each end thereof within each of the cylinders, said pistons being driven alternately back and forth by said firing chamber upon successive strokes, thereby to minimize the necessity of a heavy flywheel for carrying the operating parts thru a complete firing cycle.

A further feature of my invention is that it provides a double-acting cylinder with a piston housed therein and with a piston pin extending laterally thru the piston and thru the cylinder wall. Connecting rods, either bifurcated or in pairs, join the ends of said piston pin to the crank shaft of an engine. Thus said engine is devoid of packing glands and other devices which permit the loss of compression, require frequent replacement, and are subject to undue wear.

The details of my invention are hereinafter described with reference to the accompanying drawings, in which:—

Fig. 1 is a more or less diagrammatic illustration of an internal combustion engine of the two-stroke cycle Diesel type in which the cylinders are arranged at oblique angles with regard to each other and operate a crank shaft lying intermediate the adjacent ends of said cylinders;

Fig. 2 is a transverse section thru one of the cylinders of said engine and taken on the line 2—2 in Fig. 1;

Fig. 3 is a more or less diagrammatic plan view of an engine in which two cylinders are arranged in lateral and longitudinal alinement, with the crank shaft arranged intermediate said cylinders, said engine being shown as being of the four-stroke cycle type; and

Fig. 4 is a larger scaled longitudinal section thru one of said cylinders when of Diesel design.

In the adaptation of my invention shown in Figs. 1 and 2, two cylinders *a* make approximately a 90° angle with respect to each other and each cylinder operatively houses a double-acting piston *b* therein. Two firing chambers *c* are arranged in said cylinders, one at each end and thus one firing chamber is effective with regard to one head of the piston and the other firing chamber is effective with regard to the other piston head. Said engine is shown as being of the two-stroke cycle Diesel type and is provided with intake passageways *d* arranged at oblique angles with respect to the piston travel and exhaust passageways *e* extending substantially normal to said piston travel. Extending substantially diametrically thru said piston and intermediate the heads thereof is a piston pin *f* which extends thru elongated slots *g* in the cylinder. A crosshead is arranged upon each end of each piston pin and said crossheads bear in guides *g'* arranged upon each face of the elongated slot. The operating play between the piston pin, the crosshead and the guide is substantially less than the operating play between the sides of the piston and of the cylinder. It is to be noted in both modifications of my invention that the cylinders are adapted to be arranged so that the piston travel has a horizontal component and thus the weight of the piston would tend to bear in part, at least, upon the bore of the cylinders were it not for the piston pins extending thru the cylinder walls and being supported by the crossheads. Thus in operation the crossheads support the weight of said pistons and the latter are free to reciprocate within the bore of the cylinder with a negligible amount of friction. That is, the pistons might be said to float, to be free to travel back and forth in the cylinders between the firing chambers, and they are substantially frictionless except for the friction between the crossheads and the crosshead guides formed upon the cylinder, and the friction between the piston rings *b'* and the walls of the cylinders in which said pis-

tons operate. Connecting rods *i* are secured to the ends of the piston pins and to the crank shaft *j*. That is, a connecting rod is arranged at each side of each cylinder, being secured to the piston pin extending thru the walls of said cylinder, and the pair of connecting rods for each cylinder is joined to the crank shaft.

As is shown in Fig. 1, the throw or crank arm *j'* of the crank shaft *j* is arranged so that it is substantially in alinement with the left-hand cylinder shown in said Fig. 1. The piston in said left-hand cylinder is at its upper dead center or point of reciprocation and the piston in the right-hand cylinder is midway between upper and lower dead centers.

Inasmuch as the cylinders are of the two-stroke cycle design, each cylinder has two firing strokes per revolution of the crank shaft and thus there are four effective firing strokes with two cylinders for each rotation of the crank shaft and said firing strokes occur at quarter revolutions.

Air for said cylinders is diagrammatically shown as being contained in the central tank *k* and fuel is supplied from the tank *l*. Conventional fuel injectors *m* are indicated at both ends of each cylinder. Said injectors are operated by push rods *n* engaged and operated by the movement of the piston pins of each of the pistons. The push rods are returned to their inoperative position by coil springs *o*.

In the modification of my invention shown in Fig. 3, the cylinders *p* are arranged in lateral and longitudinal alinement, being spaced apart, and have a crank shaft *q* mounted transversely between them. The pistons, the exhaust and intake passageways, piston pins, crossheads and other auxiliary devices operating in connection with said cylinders are identical to those shown in the previous adaptation of my invention and the same reference characters are given to said parts as were given to the adaptation of my invention shown in Figs. 1 and 2 and described with relation thereto.

Connecting said piston pins *f*, however, in this modification are two members *r* which together form a frame and thus the pistons in said two opposed cylinders operate as a connected unit. Thus but two connecting rods are required for the two cylinders and each cylinder being double acting thus provides four firing chambers acting thru but two connecting rods which are arranged in a pair. The modification shown in Fig. 3 is of the four-stroke cycle type and is provided with valves *s* and *t* controlling the intake and exhaust respectively from each of the firing chambers in the cylinders. Cams *v* carried by the crank shaft *q* engage push rods *u*, which are shown diagrammatically to operate the intake and exhaust valves *s* and *t* respectively in proper time and sequence.

An engine of the Diesel type is shown in Fig. 4 and thus fuel injectors *m* control the flow of fuel, while the intake port controls the flow of air into each of the firing or combustion chambers, and the burned gases are emitted thru the exhaust ports therefor.

Fig. 2 shows the relationship between the piston pins and the crossheads arranged in each side of the pistons and the elongated guides formed in the cylinder walls. It is preferable that the piston pins be separate from the pistons but fit relatively tightly therein and the crossheads be separate from said piston pins, so that the parts are free to expand under the heat generated in operating the engine without imposing undue stresses upon the other operating parts of the engine. As is apparent to persons skilled in the art, the piston pins can be formed as trunnions on the sides of the pistons and said trunnions or the piston pin can bear upon guides formed in the side walls of the cylinders without the use of separable crossheads. I deem it desirable, however, to provide separate piston pins and crossheads for the purposes set out and to secure larger wearing surfaces and convenient replacement of worn parts. As has been pointed out, it is desirable that there be substantially less play between the crossheads, their guides, and the piston pin than between the piston and the cylinder walls, so that the weight of the piston and lateral thrust thereof can be taken upon said crosshead guides, to relieve friction between the piston and the cylinder walls. The piston rings *b'* therefore must function only to seal the compression about the pistons and the frictional drag of the piston heads within the bore of the cylinder is thus minimized. The piston thus serves as a relatively floating body which is shuttled back and forth between two firing chambers with a minimum amount of friction and resistance to motion.

I claim:

1. An internal combustion engine of the four-stroke cycle type comprising a pair of double acting piston and cylinder engine elements, said elements being in longitudinal axial alinement, lateral elements projecting from the pistons and extending through the cylinder walls in each of said elements, reciprocally mounted stiff tie rods joining said lateral elements, a crank shaft operatively joined to said rods, said crank shaft being common to both of said piston and cylinder engine elements, whereby said pair of pistons operate as a single element and said tie rods resist directly the operating stresses to which said pistons are subjected and transmit only the resultant power impulse generated by said engine to the crank shaft thereof and said engine elements produce substantially continuous application of power to the common crank-shaft.

2. An internal combustion engine of the four-stroke cycle type comprising a pair of double acting piston and cylinder engine elements, said elements being in longitudinal axial alinement, piston pins projecting laterally from the pistons and extending through the cylinder walls in each of said elements, reciprocally mounted stiff tie rods joining said piston pins, a crank shaft operatively joined to said rods, said crank shaft being common to both of said piston and cylinder engine elements, whereby said pair of pistons operate as a single element and said tie rods resist directly the operating stresses to which said pistons are subjected and transmit only the resultant power impulse generated by said engine to the crank shaft thereof and said engine elements produce substantially continuous application of power to the common crank-shaft.

3. An internal combustion engine of the four-stroke cycle type comprising a pair of double acting piston and cylinder engine elements, said elements being in longitudinal axial alinement, lateral elements projecting from the pistons at points intermediate the ends of said pistons and extending through the cylinder walls in each of said elements, reciprocally mounted stiff tie rods joining said lateral elements, a crank shaft operatively joined to said rods, said crank shaft being common to both of said piston and cylinder

engine elements, whereby said pair of pistons operate as a single element and said tie rods resist directly the operating stresses to which said pistons are subjected and transmit only the resultant power impulse generated by said engine to the crank shaft thereof and said engine elements produce substantially continuous application of power to the common crankshaft.

4. In an internal combustion engine comprising a piston and cylinder engine element, said piston having a horizontal component of travel in said cylinder, a piston pin projecting horizontally from said piston and extending into the walls of the cylinder in which it is mounted, said piston pin bearing in said cylinder walls, the play between the piston pin and the bearing surfaces of the cylinder being less than that between the piston and the bore of said cylinder, a crankshaft, connecting rods operatively arranged therewith and engaging both ends of said piston pin, whereby the lateral stresses to which said piston is subject are taken and the weight thereof is supported by the piston pins and the cooperating bearing surfaces of the cylinder with which said piston pin engages.

5. In an internal combustion engine comprising a piston and cylinder engine element, said piston having a horizontal component of travel in said cylinder, a piston pin projecting horizontally from said piston at a point intermediate the ends of said piston and extending into the walls of the cylinder in which it is mounted, said piston pin bearing in said cylinder walls, the play between the piston pin and the bearing surfaces of the cylinder being less than that between the piston and the bore of said cylinder, a crankshaft, connecting rods operatively arranged therewith and engaging both ends of said piston pin, whereby the lateral stresses to which said piston is subject are taken and the weight thereof is supported by the piston pins and the cooperating bearing surfaces of the cylinder with which said piston pin engages.

6. In an internal combustion engine comprising a piston and cylinder engine element, said piston having a horizontal component of travel in said cylinder, a piston pin projecting horizontally from said piston at a point substantially at the longitudinal middle of said piston and extending into the walls of the cylinder in which it is mounted, said piston pin bearing in said cylinder walls, the play between the piston pin and the bearing surfaces of the cylinder being less than that between the piston and the bore of said cylinder, a crankshaft, connecting rods operatively arranged therewith and engaging both ends of said piston pin, whereby the lateral stresses to which said piston is subject are taken and the weight thereof is supported by the piston pins and the cooperating bearing surfaces of the cylinder with which said piston pin engages.

7. In an internal combustion engine comprising a double-acting piston and cylinder engine element, said piston having a horizontal component of travel in said cylinder, a piston pin projecting horizontally from said piston at a point substantially at the longitudinal middle of said piston, said piston pin extending thru the walls of the cylinder in which it is mounted, crossheads encompassing said piston pin and bearing in said cylinder walls, the play between the crossheads and the bearing surfaces of the cylinder being less than that between the piston and the bore of said cylinder, a crankshaft, connecting rods operatively arranged therewith and engaging both ends of said piston pin, whereby the lateral stresses to which said piston is subject are taken and the weight thereof is supported by the crossheads and the cooperating bearing surfaces of the cylinder with which said crossheads engage.

CLINTON DAVID TOWN.