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A. G. DAVIS

2,318,599

MULTIPLE FIRING X TYPE FOUR CYCLE INTERNAL COMBUSTION ENGINE

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*Fig. 1.*

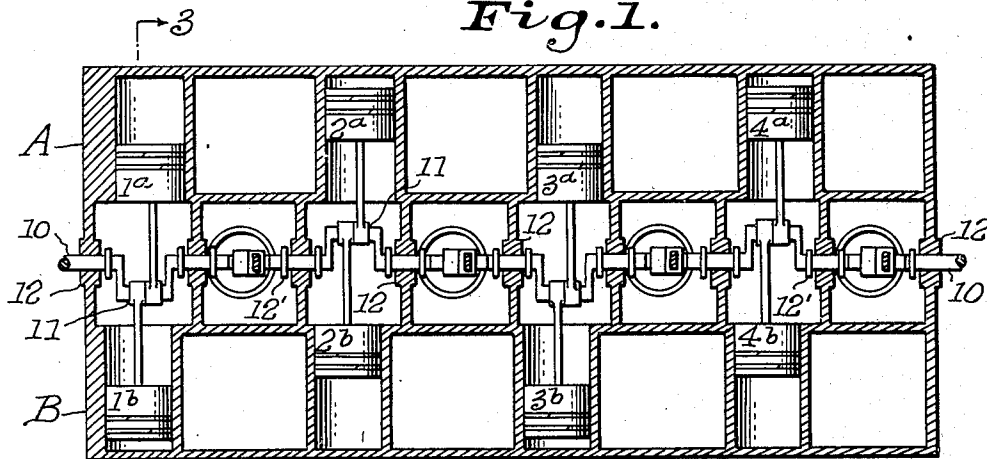


*Fig. 2.*

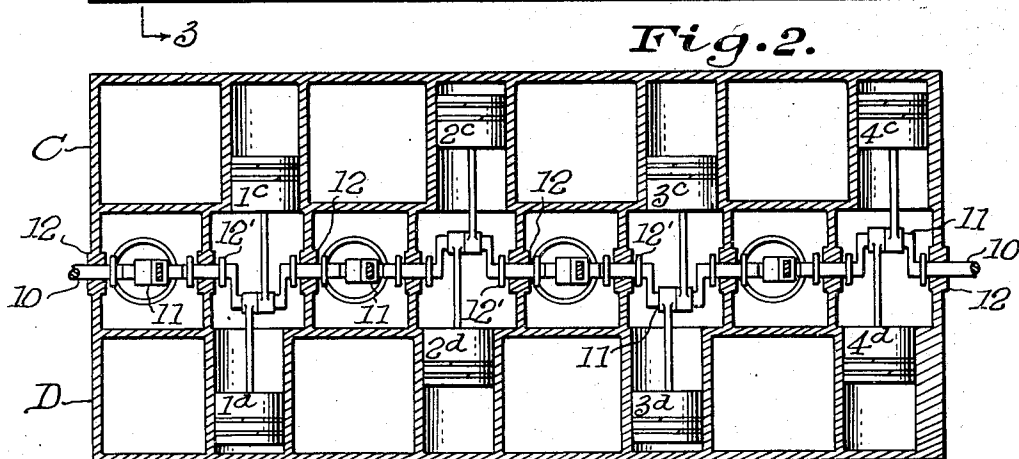


*Fig. 3.*

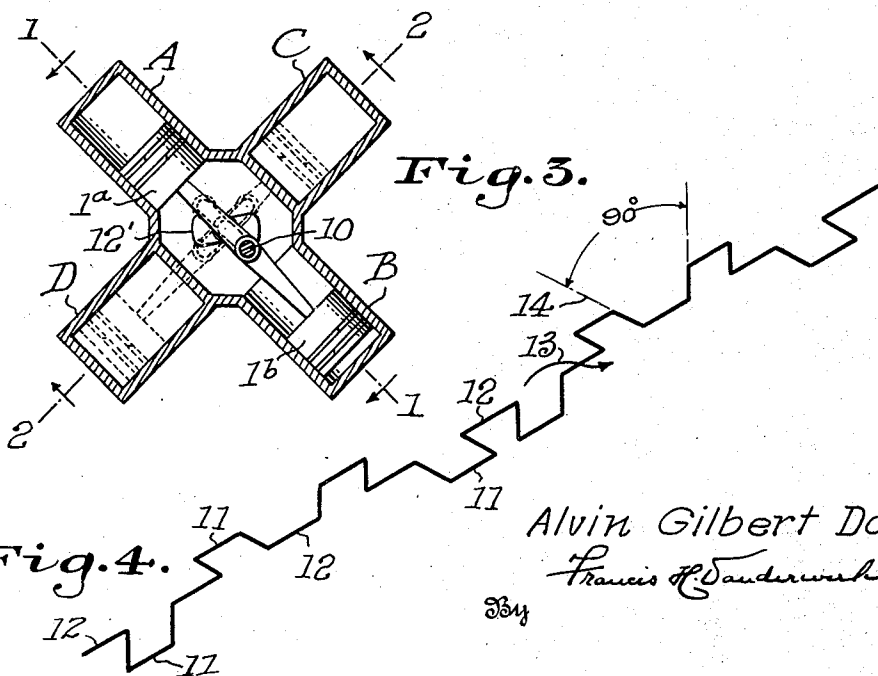
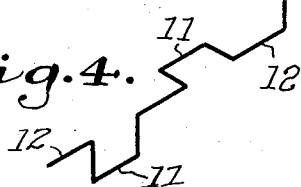


*Fig. 4.*



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## UNITED STATES PATENT OFFICE

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MULTIPLE FIRING X TYPE FOUR CYCLE  
INTERNAL COMBUSTION ENGINE

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6 Claims. (Cl. 123—55)

(Granted under the act of March 3, 1883, as  
amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to the firing order of an X type internal combustion engine and more particularly to a crankshaft for controlling said firing order. A general object of this invention is to control the firing order of an X type engine so that the engine is mechanically balanced at any rotative point of the crankshaft.

Another object of this invention is to provide a crankshaft to control the firing order of my improved engine.

A further object of this invention is to provide an X type engine wherein there are but four power impulses in the two revolutions of the crankshaft which comprise one cycle of the engine.

Another object of this invention is to provide an X type engine in which one fourth of the cylinders are fired simultaneously, said cylinders being evenly distributed in oppositely disposed blocks.

The various objects and features of my invention will be fully understood from the following detailed description of a preferred form of the invention, throughout which description reference is made to the accompanying drawing in which:

Fig. 1 is a diagrammatic longitudinal section taken on the line 1—1 of Fig. 3;

Fig. 2 is a similar view taken on the line 2—2 of Fig. 3;

Fig. 3 is a transverse vertical section taken on the line 3—3 of Fig. 1; and

Fig. 4 is a diagrammatic perspective view of the crankshaft.

As illustrated in Fig. 3 the preferred form of my engine has four blocks A, B, C, and D arranged about a central crankshaft 10. Each block A, B, C, and D has four cylinders and pistons as illustrated in Figs. 1 and 2. The blocks A, B, C, and D are arranged at right angles to each other about the crankshaft 10.

The crankshaft 10 has nine main bearings 12, eight connecting rod bearings 11, and suitably disposed counter-weights 12', as clearly shown in Figs. 1, 2 and 3 of the drawing. Each succeeding connecting rod bearing 11 is in a plane at 90° to the preceding connecting rod bearing. This positioning of the connecting rod bearings is shown at 14 in Fig. 4. The planes of the connecting rod bearings are preferably spirally in a right hand or clockwise direction as indicated by the arrow 13 in Fig. 4. Each con-

necting rod bearing supports two connecting rods which are in oppositely disposed blocks A and B, or C and D. This arrangement provides for and controls the firing order as will be more fully described.

I have numbered each of the cylinders as follows: in block A—1a, 2a, 3a, 4a, in block B—1b, 2b, 3b, 4b, in block C—1c, 2c, etc. The improved firing order of my engine is as follows: cylinders 1a, 3a, 2b, and 4b fire, then cylinders 2a, 4a, 1b, and 3b fire, then cylinders 1c, 3c, 2d, and 4d fire, then cylinders 2c, 4c, 1d, and 3d fire. This completes one cycle of the engine and two revolutions of the crankshaft.

In the light of the preceding firing order, it will be seen, reference being had to Figs. 1 and 2 of the drawing, that cylinders 2a and 4a are ready to fire and 1a and 3a to exhaust; cylinders 1b and 3b are ready to fire and 2b and 4b to exhaust; cylinders 2c and 4c are ready for intake and 1c and 3c for compression; cylinders 1d and 3d are ready for intake and 2d and 4d for compression.

Thus it will be seen that four cylinders of the sixteen cylinder engine illustrated are fired at one time and of these four two are in one block and the other two are in the block diametrically opposite or 180° from the first mentioned block. Where the total number of cylinders is eight or thirty-two there would still be one-fourth of the cylinders firing at one time. One-half of which would be in one block and the other half in the block diametrically opposite.

From the preceding disclosure it is readily seen that the power forces of my improved engine are always at 180° to each other and therefore the engine is mechanically balanced at all times. This relationship of the power forces results in a smoother running, more powerful engine than any heretofore designed.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. An internal combustion engine comprising an eight-throw crankshaft having adjacent throws disposed in planes normal to one another, and having each pair of throws lying in the same plane projecting in opposite directions, four rows of radially disposed, equally spaced, regularly arranged cylinders, each cylinder provided with

a slidable piston, the pistons in each pair of opposing cylinders being connected to one of each of said crank throws, and valved fuel admission and ignition means for each of said cylinders, whereby to effect simultaneous firing of one-fourth of the cylinders at 180° intervals.

2. An internal combustion engine comprising an eight-throw crankshaft having adjacent throws disposed in planes normal to one another and each pair of throws lying in the same plane projecting in opposite directions from the crankshaft, each pair of throws in one plane extending laterally from the crankshaft and each pair of throws in the remaining plane extending vertically from the crankshaft, four rows of radially disposed, equally spaced, regularly arranged cylinders, each cylinder provided with a slidable piston, the pistons in each pair of opposing cylinders being connected to one of each of said crank throws, and valved fuel admission and ignition means for each said cylinders, whereby to effect simultaneous firing at 180° intervals of one-fourth of the cylinders in a single power stroke, the power impulses from said one-fourth of the firing cylinders being equally divided between cylinders of opposing rows thereof.

3. An internal combustion engine comprising an eight-throw crankshaft having adjacent throws disposed in planes normal to one another, the throws of each pair lying in the same plane projecting in opposite directions from the crankshaft, balancing-weights in connection with each throw, four rows of radially disposed, equally spaced, regularly arranged cylinders, each provided with a slidable piston, the pistons in each pair of opposing cylinders being connected to one of each of said crank throws, and valved fuel admission and ignition means for each of said cylinders whereby to obtain simultaneous firing of one-fourth of the cylinders at intervals of 180°.

4. An internal combustion engine comprising a multi-throw balanced crankshaft having adjacent throws disposed in planes normal to one another and having each pair of throws lying in

the same plane projecting in opposite directions from the crankshaft, each pair of throws in one plane extending laterally from the crankshaft and each pair of throws in the remaining plane extending vertically from said crankshaft, four rows of radially disposed, equally spaced, regularly arranged cylinders, each cylinder provided with a slidable piston, the pistons in each pair of opposing cylinders being connected to one of each of said crank throws, and valved fuel admission and ignition means for each of said cylinders whereby to effect simultaneous firing of one-fourth of the cylinders at intervals of 180°, the power impulses from said one-fourth of the firing cylinders being equally divided between cylinders of opposing rows thereof.

5. An internal combustion engine comprising an eight-throw crankshaft, each throw of said crankshaft being disposed in a plane spaced 90° from that of the preceding throw, the planes of said throws spiralling around the crankshaft from the initial to the terminal throw thereof, four rows of radially disposed, equally spaced, regularly arranged cylinders, each cylinder provided with a slidable piston, and fuel admission and ignition means for the respective cylinders, all disposed in such a manner as to fire one-fourth of the cylinders simultaneously at intervals of 180°.

6. An internal combustion engine comprising an eight-throw crankshaft, each throw of said crankshaft being disposed in a plane spaced 90° from that of the preceding throw, the planes of said throws spiralling around the crankshaft from the initial to the terminal throw thereof, four rows of radially disposed, equally spaced, regularly arranged cylinders, each cylinder provided with a slidable piston, and fuel admission and ignition means for the respective cylinders, all disposed in such a manner as to fire one-fourth of the cylinders simultaneously at intervals of 180° with the power impulses equally distributed between the cylinders of opposing rows thereof.

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