Feb. 21, 1939. J. A. EATON 2,147,644

INTERNAL COMBUSTION ENGINE

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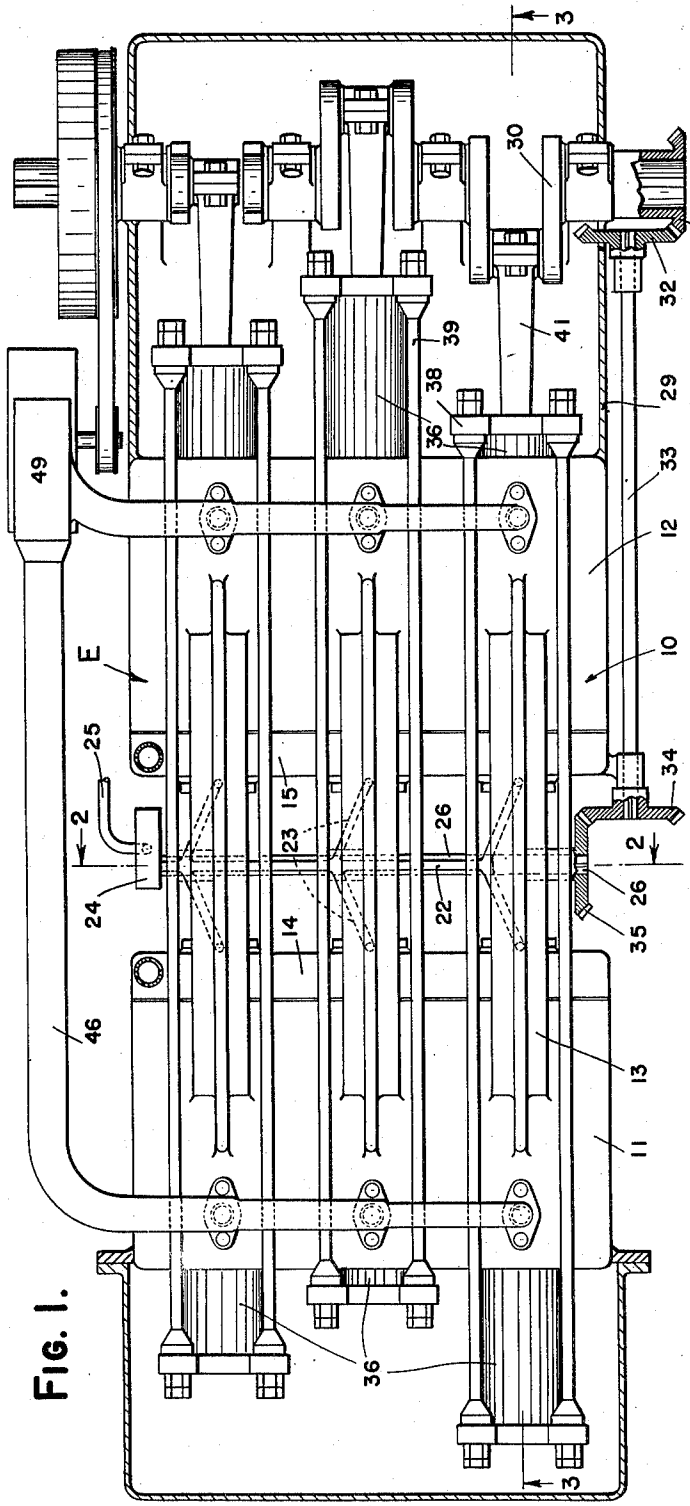


FIG. 1.

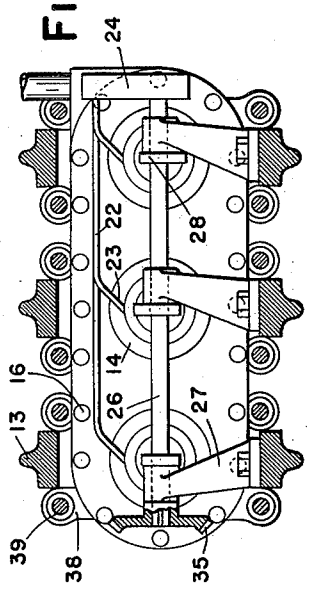


FIG. 2.

INVENTOR

JAMES A. EATON

BY

ATTORNEYS

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FIG. 3.

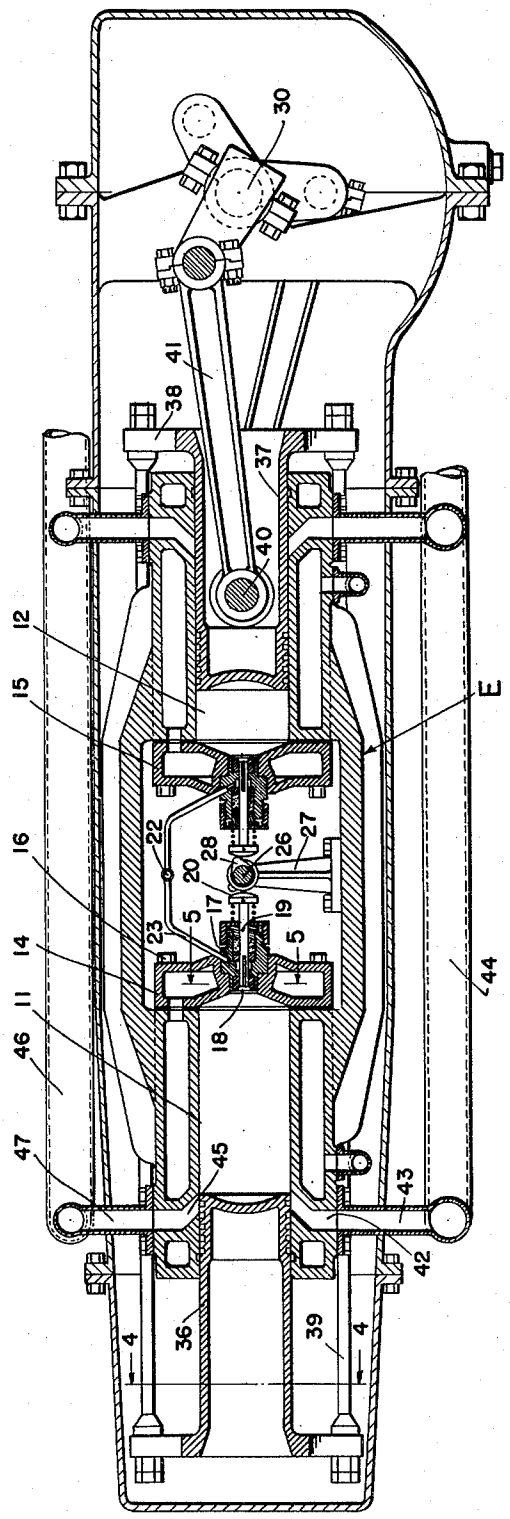


FIG. 5.

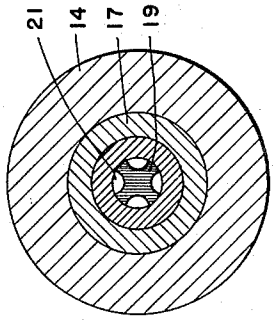
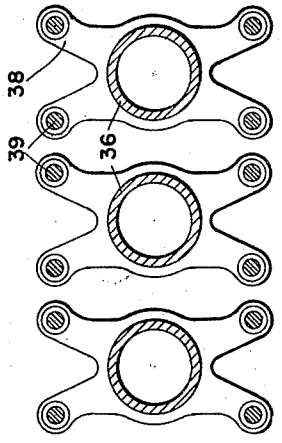


FIG. 4.



INVENTOR

JAMES A. EATON

BY

ATTORNEYS

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FIG. 6.

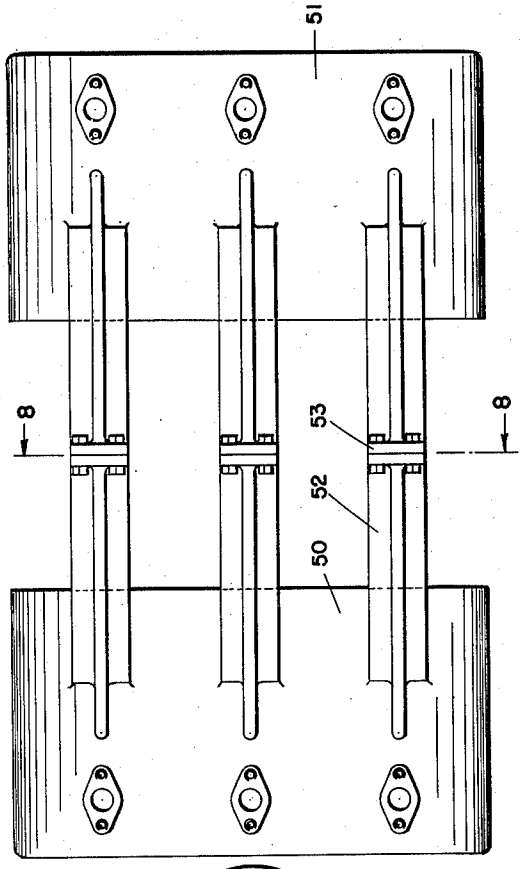


FIG. 7.

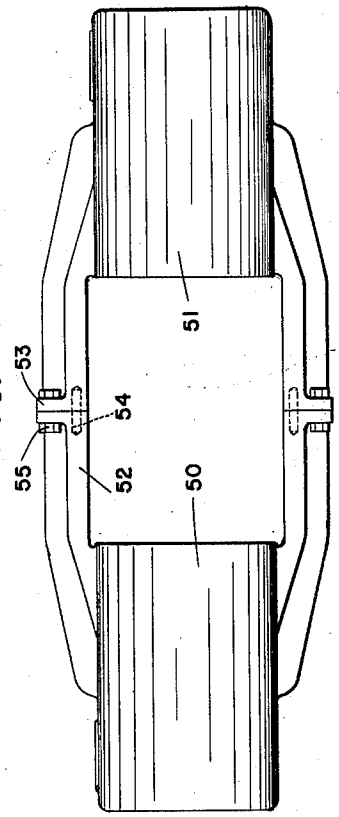
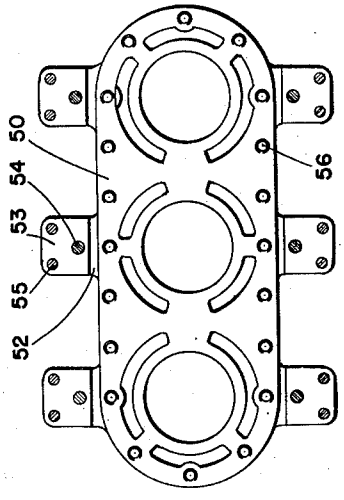


FIG. 8.



INVENTOR

JAMES A. EATON

BY

ATTORNEYS

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UNITED STATES PATENT OFFICE

2,147,644

INTERNAL COMBUSTION ENGINE

James A. Eaton, Birmingham, Mich.

Application November 17, 1936, Serial No. 111,235

2 Claims. (Cl. 123—57)

This invention appertains to internal combustion engines, and more particularly to a two-cycle engine of the Diesel type having opposed pistons.

One of the primary objects of my present invention is to provide an internal combustion engine of either the stationary or automotive type, having one or more units, each including a double cylinder having opposed pistons therein, with novel means for connecting the pistons together and to the crank shaft, whereby a substantially constant power surge will be transmitted to the crank shaft, and whereby as the firing cycle decreases in one cylinder of a unit the compression cycle in the other cylinder increases, thus bringing about the balancing of the pistons and the reduction of shock, vibration, and friction in the engine.

Another salient object of my invention is to provide novel means for forming the cylinders together as a single unit or casting, whereby the walls of the cylinders can be bored and finished simultaneously to bring about the exact axial alinement of the cylinders.

A further object of my invention is the provision of novel means for incorporating the cylinder heads with the cylinders of the units, whereby to bring about the easy assembly of the engine, and to permit ready access to be had to the fuel line, valves, cam shaft, and the like.

A further important object of my invention is the provision of an engine having floating trunk pistons provided with laterally extending flanges at their outer ends, to which are firmly connected the tie-rods to rigidly connect the pistons together, one of the pistons being connected substantially in the ordinary way with the crank shaft.

A still further object of my invention is to provide an exceptionally powerful Diesel engine, which will be of extremely light weight, and in which wear and vibration will be reduced to a minimum.

With these and other objects in view, the invention consists in the novel construction, arrangement, and formation of parts, as will be hereinafter more specifically described, claimed, and illustrated in the accompanying drawings, in which drawings:

Figure 1 is a top plan view of my improved engine, with parts thereof broken away and in section.

Figure 2 is a transverse section through the engine taken substantially on the line 2—2 of Figure 1, looking in the direction of the arrows.

Figure 3 is a longitudinal section through the engine.

Figure 4 is a transverse section taken substantially on the line 4—4 of Figure 3, looking in the direction of the arrows, illustrating the formation of the pistons, and the means of connecting the tie-rods thereto.

Figure 5 is an enlarged detail sectional view taken substantially on the line 5—5 of Figure 3, looking in the direction of the arrows, illustrating one of the fuel inlet valves.

Figure 6 is a top plan view illustrating a modified form of the invention.

Figure 7 is a side elevation of the same.

Figure 8 is a central transverse section taken substantially on the line 8—8 of Figure 6, looking in the direction of the arrows.

Referring to the drawings in detail, wherein similar reference characters designate corresponding parts throughout the several views, the letter E generally indicates my improved internal combustion engine, which, as stated, is of the two-cycle Diesel type, having opposed pistons. The engine includes one or more units 10, each of which consists of oppositely extending cylinders 11 and 12 connected together by integral struts or ribs 13. In the present instance I have shown three units, and the units and the cylinders are preferably cast en bloc but it is to be understood that an engine can be made embodying a single unit, or any number of units that may be desired.

I lay great stress on the fact that the cylinders 11 and 12 of the unit are cast together, and are rigidly connected by the ribs 13, in that the cylinders can be bored and finished simultaneously, and thereby bring about the true axial alinement of the cylinders of each unit. The inner ends of the cylinders are spaced apart, and the cylinder heads 14 and 15 can be slid transversely through the engine into proper position and bolted to the cylinders by means of machine screws 16. This allows the easy assembling of the heads with the cylinders, and these heads carry inlet injection valves 17. The valves include valve heads 18 which fit against the valve seats, and outwardly extending shanks 19 which terminate in rounded heads 20. The valves are normally held on their seats by means of expansion springs coiled about the shanks between the heads 20 and the valve casings.

The shanks 19 adjacent to the valve bodies are grooved at quarters, as at 21, so that when the valves are moved off their seats, and the fuel is injected under pressure, the fuel will be broken

up and sprayed into the cylinders. Extending between the cylinder heads 14 and 15 is the fuel inlet manifold pipe 22, having branches 23, which communicate with the valve casings. One end of the manifold 22 is connected to the outlet end of a fuel injection jump 24, and the inlet of the pump has connected thereto a fuel line pipe 25, which can be led to the source of supply of the fuel oil.

Arranged between the outer ends of the valve shanks is a transversely extending cam shaft 26. This cam shaft is rotatably mounted in bearing brackets 27, which can be bolted to certain of the connecting ribs 13. Formed on, or secured to, the shaft 26 are the cams 28, and a cam is mounted between the heads 20 of the valves so that during rotation of the cam shaft one cam will serve to actuate both valves at the desired and proper intervals. Bolted to, or formed on, one end of the cylinder block is a crank case 29 for receiving the crank shaft 30, and this crank shaft 30 has keyed or otherwise secured thereto a bevel gear 31, which meshes with a similar bevel gear 32 carried by a drive shaft 33. The drive shaft 33 extends longitudinally of the engine, and has secured to its inner end a bevel gear 34, which meshes with a bevel gear 35 keyed on to the cam shaft 26. Thus, the cam shaft is driven from the crank shaft, and the valves will be operated in exact accordance with the rotation of the crank shaft.

Reciprocally mounted in the cylinders 11 and 12 of each unit are opposed floating pistons 36 and 37 of the trunk type. The pistons can carry any desired number of piston rings. The outer ends of the pistons 36 and 37 have formed thereon laterally extending pairs of ears 38, and these ears have rigidly connected thereto the tie-rods 39, which serve to rigidly connect the pistons 36 and 37 together, whereby movement of one piston will cause movement of the other piston.

The piston 37, which is adjacent to the crank shaft 30, is provided with a wrist-pin 40, on which is mounted the connecting rod 41. The connecting rod is rotatably mounted on one of the arms of the crank shaft. The outer ends of the cylinders 11 and 12 have formed therein exhaust ports 42, which are connected by means of branch pipes 43, with an exhaust manifold 44. Diametrically opposite the exhaust ports 42 the cylinders are provided with fresh air inlet ports 45.

By referring to Figure 3 of the drawings, it will be noted that the ports 42 and 45 incline inwardly toward the cylinder heads, and the purpose of this formation will be later set forth. The pistons themselves open and close the ports 42 and 45, and the ports 45 are connected to a fresh air manifold 46 by means of branch pipes 47. The manifold 46 is connected with the outlet of an air pump or compressor 49, which can be driven from the crank shaft 30. The fuel pump 24 can be driven from the cam shaft or crank shaft, as may be desired.

In operation of my engine, as a piston reaches the end of its firing stroke, the ports 42 and 45 are uncovered and there is a rush of fresh air under pressure into the cylinder. Due to the inclination of the walls of the port 45, the air is directed toward the cylinder head, and then back toward the port 42. By this arrangement products of combustion are completely driven out from the engine, and a fresh supply of air is delivered to the cylinder. On the compression stroke the air is placed under high pressure, and when the piston nears the completion of its compression stroke, the fuel oil is injected into the cylinder also at a high pressure. When the firing takes place, the piston will be forcibly driven toward the outer end of its cylinder.

It can be seen that as one position is on its firing stroke, the other piston of the same unit is on its compression stroke. As the arrangement of the two pistons are of the floating type, and opposed to one another, and as the power stroke of one piston pulls the opposed piston up against its compression stroke, the tie-rods are always kept in tension. As the firing cycle decreases, the compression cycle increases, thus balancing the two pistons and their weight against an air cushioning in the cylinders. This reduces the friction of the bearings and crank.

From the foregoing description it can be seen that I have provided an exceptionally simple and durable engine of the two-cycle Diesel type, which will be of exceptionally light weight, and which will generate a maximum amount of power for its weight. The cylinders and their heads can be of a water jacket construction, whereby to bring about the cooling of the engine, and means can be provided for insuring a proper lubrication of all parts.

While I have shown the tie-rods 39 of a solid construction, it is to be understood that the same can be of a tubular construction, and that the lubricating oils can be led through the tubing.

Likewise, oil can be pumped through the rods for cooling purposes.

In order to facilitate the boring and tapping of the holes in the cylinders for the cylinder heads, the upper and lower cylinder blocks can be made separate. Thus, in Figures 6 to 8 inclusive I have shown such a construction.

In these figures, 50 and 51 indicate the opposed cylinder blocks, each containing three cylinders. The cylinder blocks 50 and 51 have formed thereon inwardly extending ribs 52, terminating in attaching feet 53. These feet are adapted to abut and are accurately centered by dowel pins 54. Bolts 55 are extended through the feet for firmly connecting the cylinder blocks together. Obviously, the inner ends of the cylinder blocks are provided with the tapped holes 56 prior to the joining of the blocks together.

If desired, the walls of the cylinders of the opposed cylinder blocks can be finished after the blocks are united, so as to bring about the perfect alinement of the cylinders.

In Figures 6 to 8 I have only illustrated the cylinder blocks themselves and the means for joining the blocks together, but obviously the engine utilizing the blocks 50 and 51 is constructed in the same manner as the engine shown in Figures 1 to 5 inclusive. Thus, the cylinder heads are slipped in through the sides of the cylinder blocks, and the bolts for the heads are threaded into the openings 56.

Changes in details may be made without departing from the spirit or the scope of my invention, but what I claim as new is:

1. An internal combustion engine of the two-cycle Diesel type comprising a series of units each including axially alined cylinders, the inner ends of the cylinders being spaced apart, integral ribs connecting the cylinders of the units together, independent cylinder heads for the cylinders of each unit arranged between the ribs and bolted to the cylinders, fuel injection valves for the cylinders carried by the heads, a cam shaft arranged between the heads having cams thereon

for operating the fuel injection valves, a fuel pump operated from the cam shaft for connection with the fuel injection valve, pistons reciprocally mounted in the cylinders, tie-rods connecting the pistons together, a crank shaft, and means operatively connecting one piston of each unit with the crank shaft.

2. In a two-cycle internal combustion engine of the Diesel type, a pair of axially alined cylinders, inwardly extending ribs formed on the cylinders, feet formed on the terminals of the ribs, arranged in abutting relation, dowel pins between the ribs, and bolts firmly joining the feet together.

JAMES A. EATON.