Jan. 23, 1951 O. LINDLAND 2,539,258

TOGGLE ACTION ENGINE MECHANISM

Filed Dec. 12, 1949 5 Sheets-Sheet 1

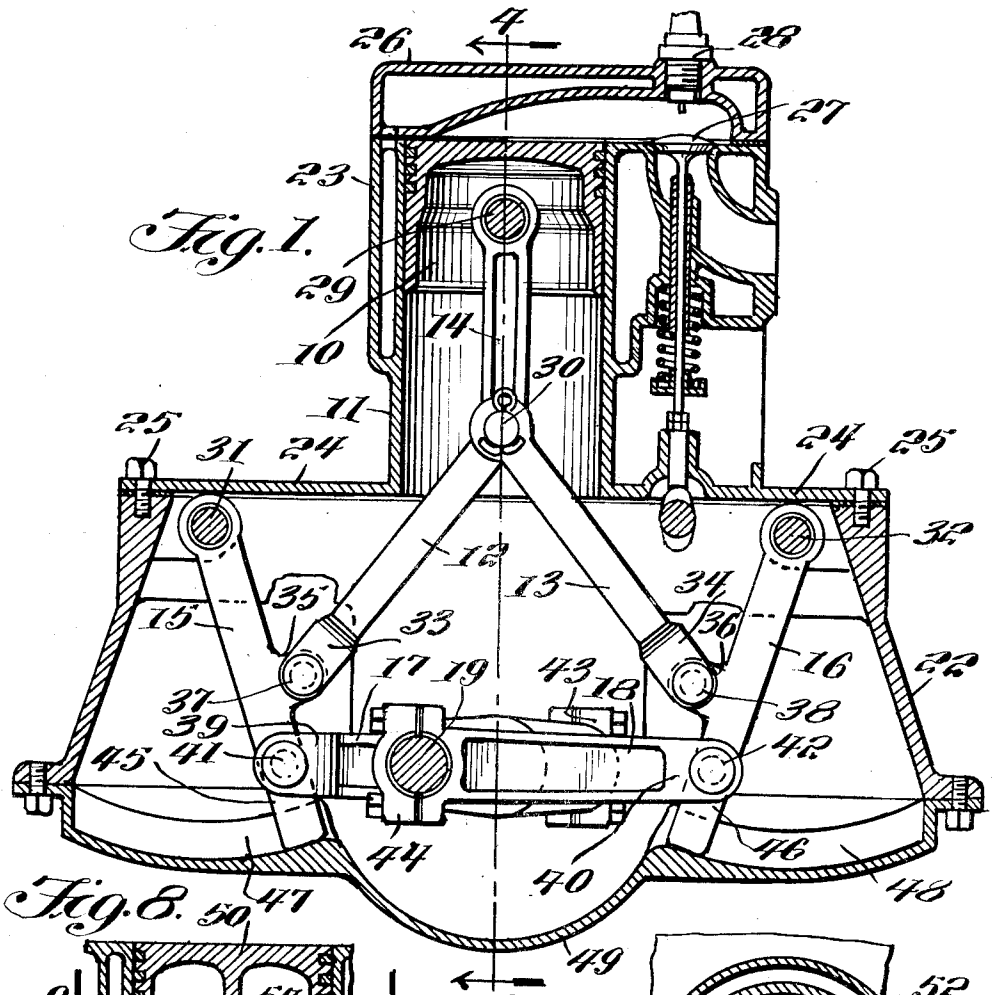

Fig. 1.

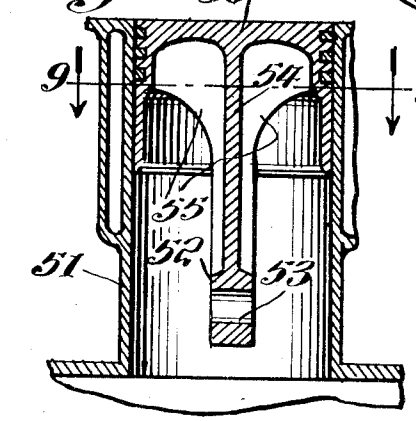

Fig. 8.

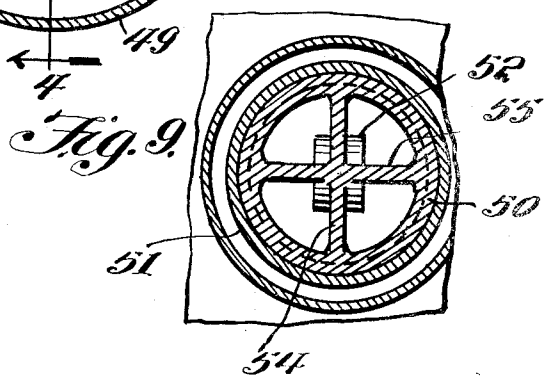

Fig. 9.

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Fig. 2.

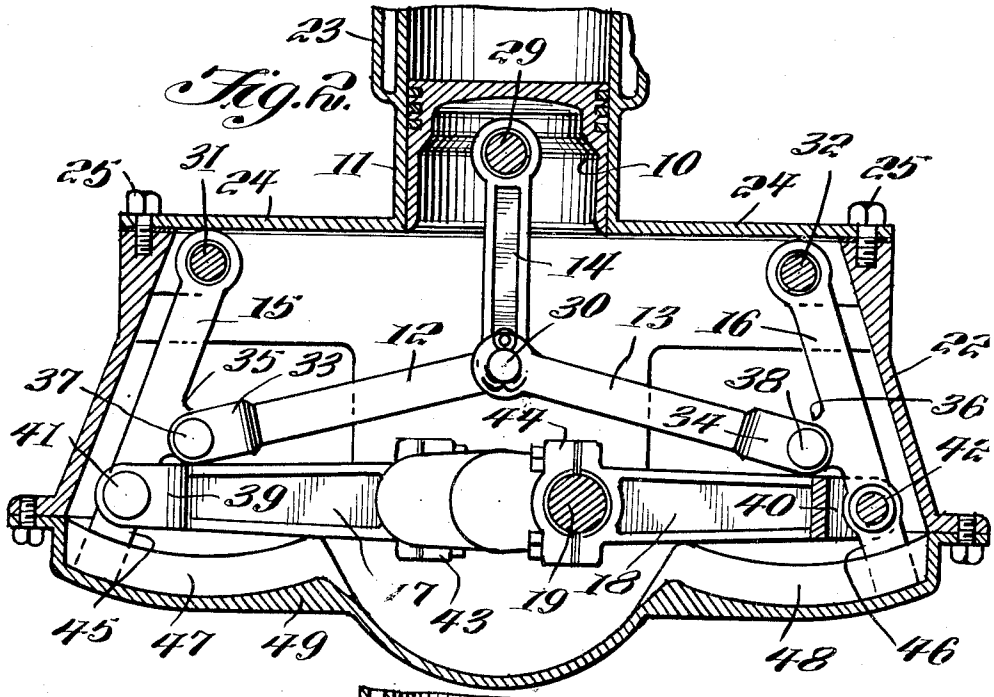

Fig. 3.

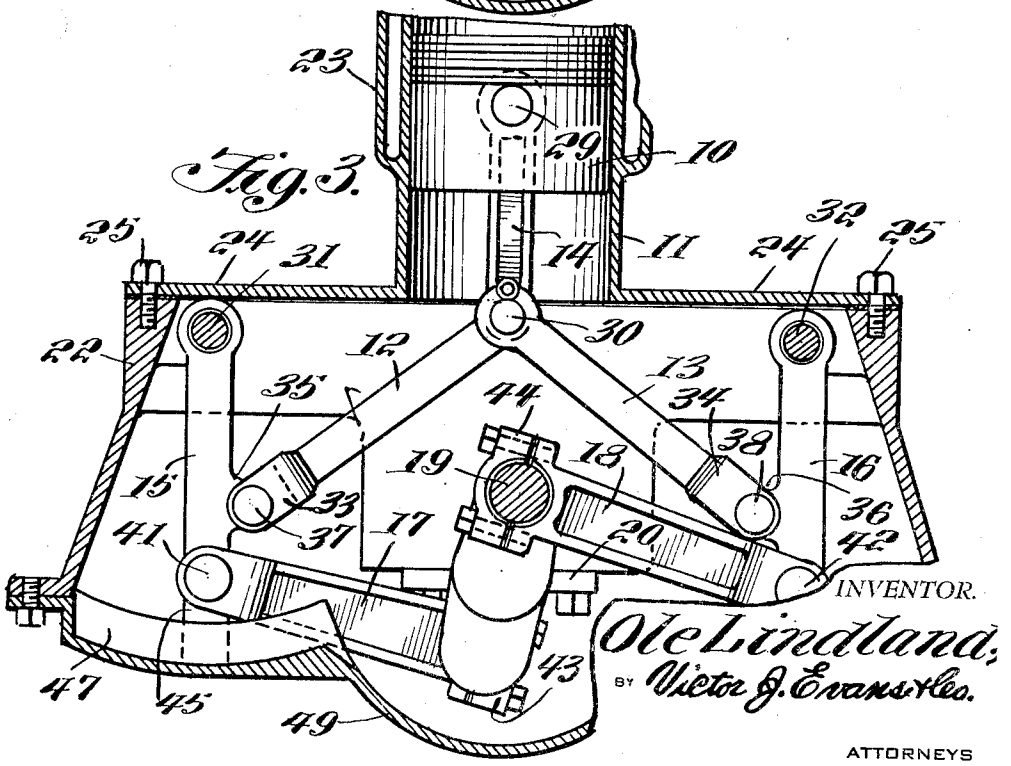

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Fig. 4.

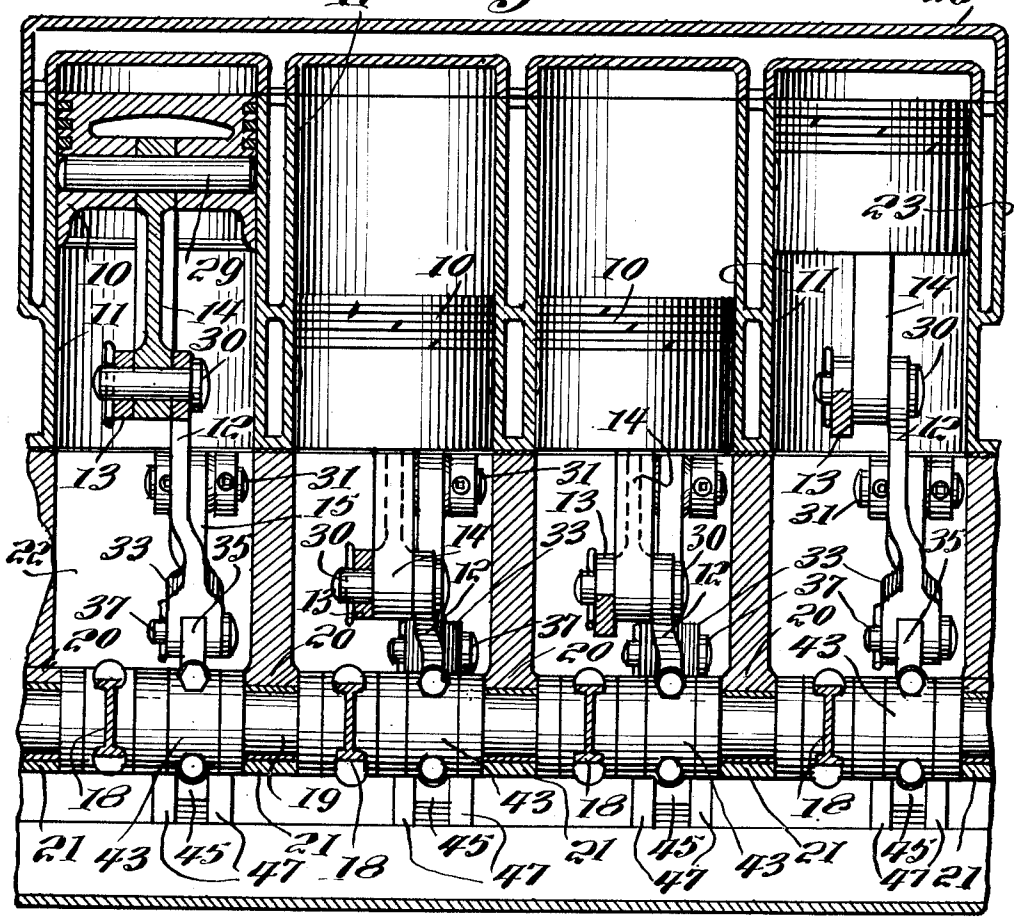

Fig. 5.

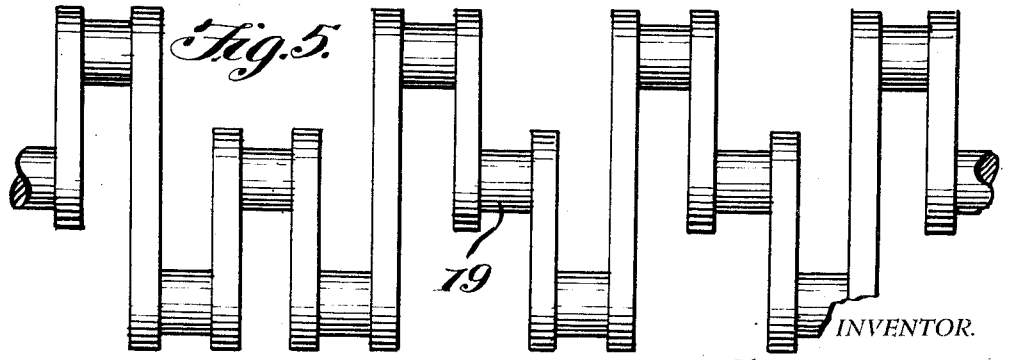

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Fig. 6.

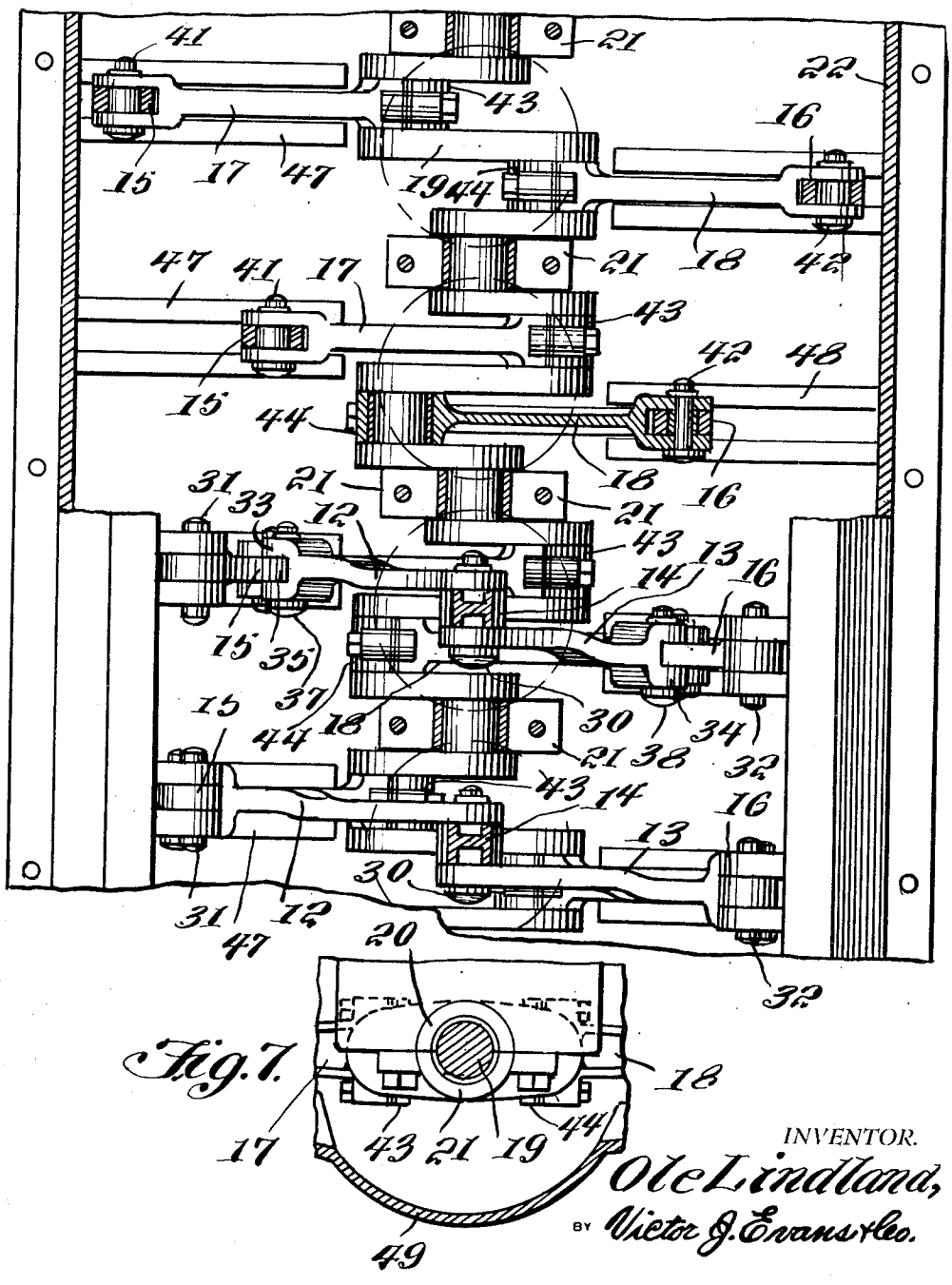

Fig. 7.

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TOGGLE ACTION ENGINE MECHANISM

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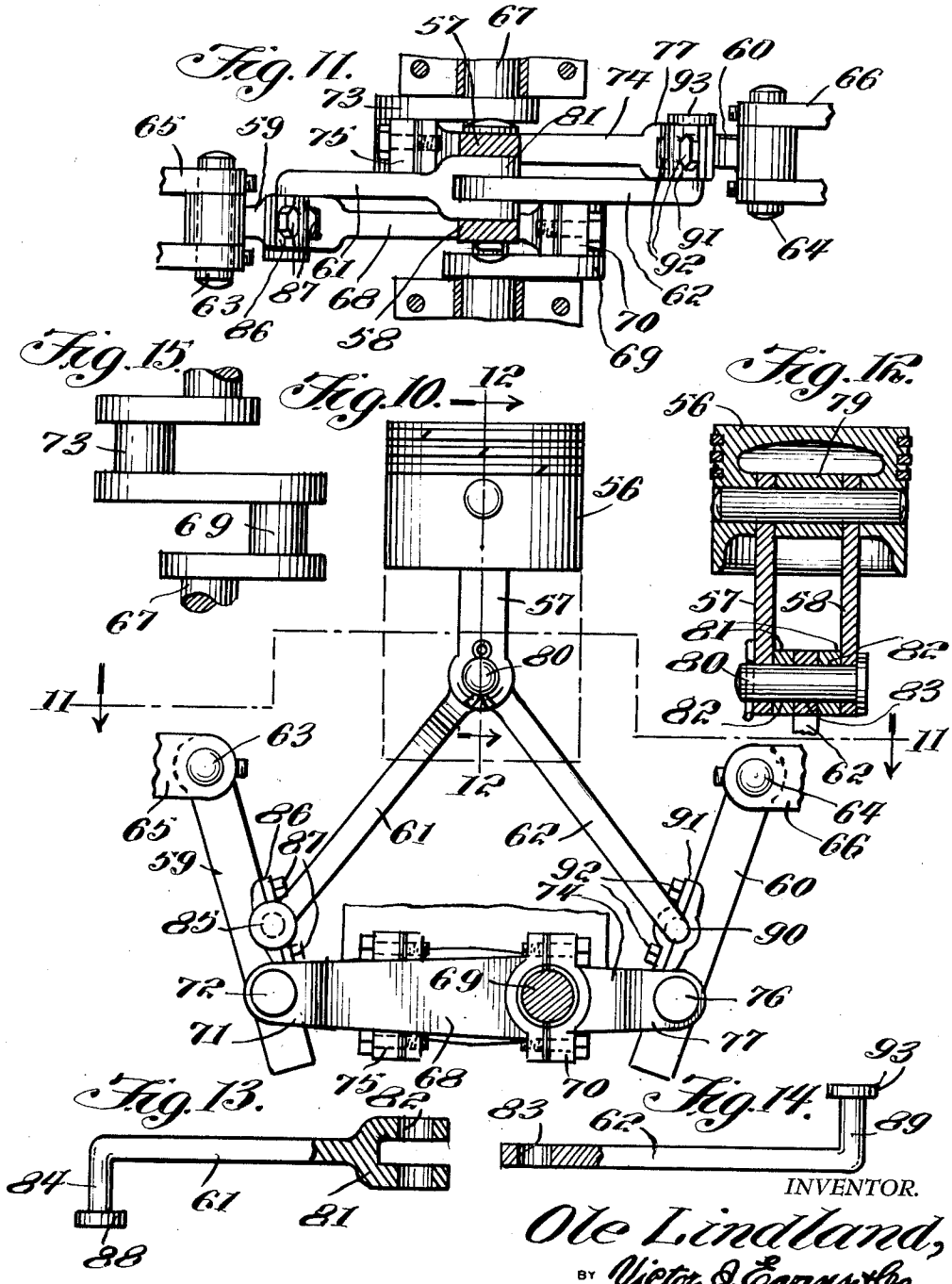

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UNITED STATES PATENT OFFICE

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TOGGLE ACTION ENGINE MECHANISM

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Application December 12, 1949, Serial No. 132,460

7 Claims. (Cl. 74—40)

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This invention relates to internal combustion engines particularly the type used for motors of motor vehicles, and in particular the invention relates to connections between pistons of internal combustion engines and a crank shaft of the engine in which the piston through spreading arms drives pivotally mounted levers outwardly and the levers impart rotary motion to the crank shaft through connecting rods extended from offset sections of the crank shaft.

The purpose of this invention is to increase the power and efficiency of internal combustion engines by multiplying the leverage, through a toggle action, between the pistons and crank shaft.

In the usual type of internal combustion engines the piston rod directly connects the wrist pin of the piston to an offset portion of a crank shaft and in the power stroke the power of the piston is applied to the crank shaft from a point slightly over the center to a point approaching the center on the opposite side of the shaft and the maximum leverage is the radius of the offset portion of the crank shaft. It is difficult to increase this leverage in the usual type of engine design. With this thought in mind this invention contemplates a plurality of levers providing the connecting means between a piston and a crank shaft in which the leverage is multiplied and in which the power is applied to the crank shaft in both sides of the center thereof so that the reaction force is reduced to a minimum.

The object of this invention is, therefore, to arrange the connecting elements between a piston and a crank shaft of an internal combustion engine whereby the power stroke is multiplied and the force, instead of being applied to one side of the crank shaft only, is applied to both sides of the crank shaft from the same piston.

Another object of the invention is to provide power multiplying linkage between the piston and crank shaft of an internal combustion engine without materially increasing the size of the engine.

Another object of the invention is to provide means for increasing the power stroke of internal combustion engines and for applying the power on both sides of the crank shaft without changing the distance between the cylinder and the center of the crank shaft.

A further object of the invention is to provide connecting means between the piston of an internal combustion engine and the crank shaft thereof that increases the power and applies the power to both sides of the crank shaft, which is

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of a comparatively simple and economical construction.

With these and other objects and advantages in view the invention embodies an engine block having a plurality of cylinders therein with extensions in the sides of the crank case and with levers pivotally mounted in the extensions of the crank case, connected to the piston through spreading arms and connected to offset sections of the crank shaft by connecting rods.

Other features and advantages of the invention will appear from the following description taken in connection with the drawings wherein:

Figure 1 is a typical cross section through an internal combustion engine showing a cylinder block positioned on a crank case with the improved connecting elements between a piston in the cylinder block and a crank shaft extended through the crank case.

Figure 2 is a similar view illustrating the positions of the parts with the piston at the end of the power stroke.

Figure 3 is a similar view illustrating the positions of the parts with the piston in the intermediate portion of the power stroke.

Figure 4 is a longitudinal section through a portion of the engine shown in Figure 1 being taken on line 4—4 of Figure 1.

Figure 5 is a detail showing a portion of the crank shaft of the engine.

Figure 6 is a sectional plan showing a portion of the engine with parts thereof taken substantially on the center of the crank shaft and with part taken from a plane corresponding with the upper end of the crank case.

Figure 7 is a detail showing a cross section through one end of the crank case and illustrating the position of the main bearing of the crank shaft.

Figure 8 is a detail illustrating a modification wherein the piston rod is integral with the piston.

Figure 9 is a cross section through the piston shown in Figure 8 being taken on line 9—9 of Figure 8.

Figure 10 is a view similar to that shown in Figure 1 illustrating a modification wherein the piston rod is connected to the guide levers by arms with bearing pins formed on the ends of the arms.

Figure 11 is a sectional plan taken on line 11—11 of Figure 10 showing the modification illustrated in Figure 10.

Figure 12 is a detail showing a vertical section through one of the pistons taken on line 12—12 of Figure 10.

Figure 13 is a detail showing one of the connecting arms with a yoke on the piston end.

Figure 14 is a similar view showing a connecting arm with a straight end.

Figure 15 is a detail illustrating a section of a crank shaft for one of the cylinders.

Referring now to the drawings wherein like reference characters denote corresponding parts the improved engine of this invention includes a piston 10 in a cylinder 11, arms 12 and 13 pivotally connected to a piston rod 14, levers 15 and 16, connecting rods 17 and 18 and a crank shaft 19.

The crank shaft 19 is journaled in suitable bearings 20, with bearing caps 21 in a crank case 22 and a cylinder block 23 in which cylinders 11 are provided is mounted on the upper part of the crank case through a horizontally disposed flange 24 with bolts 25. The cylinder block is provided with a head 26 and suitable valves 27 and spark plugs 28 are provided therein.

In the design shown in Figure 1 the piston 10 is connected to the piston rod 14 by a wrist pin 29 and the piston rod is pivotally connected to the arms 12 and 13 through a pin 30.

The levers 15 and 16 are pivotally mounted in the crank case 22 by pins 31 and 32, respectively and yokes 33 and 34 extend over projections 35 and 36, respectively on the levers 15 and 16 providing means whereby the arms are pivotally connected to the levers by pins 37 and 38, respectively.

The levers 15 and 16 are also straddled by yokes 39 and 40 on the ends of the connecting rods 17 and 18, respectively and the connecting rods are connected to the levers by pins 41 and 42 that extend through the yokes and levers. The connecting rod 17 is provided with a bearing cap 43 and the connecting rod 18 is provided with a similar bearing cap 44 thereby providing the usual type of connection between connecting rods of pistons of internal combustion engines with crank shafts.

The levers 15 and 16 are provided with extended ends 45 and 46, respectively that extend into tracks 47 and 48 in the crank case section 49 thereby providing guide means for the levers.

In the design illustrated in Figures 8 and 9 a piston 50 in a cylinder 51 is provided with a piston rod 52 similar to the piston rod 14 and, as illustrated in Figure 8 the piston rod 52 is integral with the piston and the lower end of the rod is provided with an opening 53 to receive the pin 30 which, as illustrated in Figure 4, connects the piston rod to the arms 12 and 13 with one arm on each side of the rod. In the design shown in Figures 8 and 9 the piston is provided with webs 54 and 55 that support the piston rod.

With the parts arranged in this manner and assuming that the explosion occurs at the end of the upward stroke of the piston, pressure on the upper end of the piston 10 moves the piston downwardly with the arms 12 and 13 spreading and forcing the levers 15 and 16 outwardly and, with the crank shaft turning in a clockwise direction the connecting rod 17 pulls on the lower side of the crank shaft while the connecting rod 18 pulls on the upper side. By this means the force of the explosion or power stroke is applied evenly to both sides of the crank shaft.

In the design illustrated in Figures 10 to 15, inclusive a piston 56 having a piston rod formed of spaced bars 57 and 58 is connected to guide levers 59 and 60 by arms 61 and 62, respectively and the levers are pivotally mounted in the crank case by pins 63 and 64 in projections 65 and 66, respectively of the crank case.

The lever 59 is connected to a crank shaft 67 by a connecting rod 68 with the connecting rod journaled on an offset section 69 of the crank shaft and secured thereto by a bearing cap 70. The outer end of the connecting rod 68 is formed with a yoke 71 through which the connecting rod is pivotally connected to the lever 59 through a pin 72.

The lever 60 is connected to an offset section 73 of the crank shaft by a connecting rod 74 with the inner end of the connecting rod journaled on the section 73 of the crank shaft and secured thereto by a cap 75 and with the outer end of the connecting rod pivotally connected to the lever 60 by a pin 76 extended through a yoke 77 on the end of the connecting rod.

In this design the bars 57 and 58 of the piston rod are pivotally mounted on a pin 78 in the piston 56 with a spacer 79 between the bar and the arms 61 and 62 are pivotally mounted on a pin 80 in the lower end of the bar. The upper end of the arm 61 is provided with a yoke 81 and the pin 80 extends through an opening 82 therein, and the arm 62 is provided with an opening 83 through which the pin 80 extends, with the end in which the opening is positioned mounted between the arms of the yoke 81 as shown in Figure 12.

A bearing pin 84 is provided on the lower end of the arm 61 and this pin is secured in a bearing recess 85 in the arm 59 with a cap 86 securing the bearing pin in the recess, the cap being bolted to the lever 59 by bolts 87. The outer end of the bearing pin 84 is provided with a collar 88. The lower end of the arm 62 is provided with a bearing pin 89 that is pivotally mounted in a recess 90 in the lever 60, and the pin is secured in the recess by a bearing cap 91 which is held in position by bolts 92. The outer end of the bearing pin 89 is provided with a collar 93.

With the parts arranged in this manner the length of the crank shaft and accordingly, the length of the engine is reduced, the connecting arms being positioned substantially in a common plane.

With the pistons operating alternately or consecutively the power stroke of one piston is transmitted to another piston for actuating the piston in the compression stroke and continuous operation of the engine is obtained.

It will be understood that other modifications may be made in the design and arrangement of the parts without departing from the spirit of the invention.

What is claimed is:

1. An internal combustion engine having a cylinder block with cylinders therein and a crank case with a crank shaft having offset sections therein, pistons in said cylinders, piston rods depending from said pistons, a pair of arms extended from and pivotally connected to each of the said piston rods, levers pivotally mounted in the crank case on opposite sides of the pistons, means pivotally connecting the arms to the levers, and connecting rods pivotally connected to the levers and also pivotally connected to offset sections of the crank shaft.

2. An internal combustion engine having a cylinder block with cylinders therein and a crank case with a crank shaft having offset sections therein, pistons in said cylinders, piston rods depending from said pistons, a pair of arms extended from and pivotally connected to each of

the said piston rods, levers pivotally mounted in the crank case on opposite sides of the pistons, means pivotally connecting the arms to the levers, and connecting rods pivotally connected to the levers and also pivotally connected to offset sections of the crank shaft, with one connecting rod connected to an offset section on one side of the center of the crank shaft and the other to an offset section on the opposite side of the center.

3. An internal combustion engine having a cylinder block with cylinders therein and a crank case with a crank shaft having offset sections therein, pistons in said cylinders, piston rods depending from said pistons, a pair of arms extended from and pivotally connected to each of the said piston rods, levers pivotally mounted in the crank case on opposite sides of the pistons, means pivotally connecting the arms to the levers at points intermediate of the length thereof, and connecting rods pivotally connected to the levers and also pivotally connected to offset sections of the crank shaft.

4. An internal combustion engine having a cylinder block with cylinders therein and a crank case with a crank shaft having offset sections therein, pistons in said cylinders, piston rods depending from said pistons, a pair of arms extended from and pivotally connected to each of the said piston rods, levers pivotally mounted in the crank case on opposite sides of the pistons, means pivotally connecting the arms to the levers at points intermediate of the length thereof, and connecting rods pivotally connected to the levers at points between the points where the arms are connected to the levers and the outer ends of the levers and also pivotally connected to offset sections of the crank shaft.

5. An internal combustion engine having a cylinder block with cylinders therein and a crank case with a crank shaft having offset sections therein, pistons in said cylinders, piston rods depending from said pistons, a pair of arms extended from and pivotally connected to each of the said piston rods, levers pivotally mounted in the crank case on opposite sides of the pistons, means pivotally connecting the arms to the levers at points intermediate of the length thereof, and

connecting rods pivotally connected to the levers at points between the points where the arms are connected to the levers and the outer ends of the levers and also pivotally connected to offset sections of the crank shaft, said levers having extended ends and said crank case having tracks therein in which the extended ends of the levers slide providing guide means for the levers.

6. An internal combustion engine having a cylinder block with cylinders therein and a crank case with a crank shaft having offset sections therein, pistons in said cylinders, piston rods depending from said pistons, a pair of arms extended from and pivotally connected to each of the said piston rods, levers pivotally mounted in the crank case on opposite sides of the pistons, means pivotally connecting the arms to the levers at points intermediate of the length thereof, and connecting rods pivotally connected to the levers at points between the points where the arms are connected to the levers and the outer ends of the levers and also pivotally connected to offset sections of the crank shaft, said crank case having guide means therein positioned for sliding engagement with the ends of the levers.

7. An internal combustion engine having a cylinder block with cylinders therein and a crank case with a crank shaft having offset sections therein, pistons in said cylinders, piston rods depending from said pistons, a pair of arms extended from and pivotally connected to each of the said piston rods, vertically disposed levers pivotally mounted at the upper ends thereof in the crank case on opposite sides of the pistons, levers pivotally mounted in the crank case on opposite sides of the pistons, means pivotally connecting the arms to the levers at points intermediate of the length thereof, and connecting rods pivotally connected to the levers at points between the points where the arms are connected to the levers and the outer ends of the levers and also pivotally connected to offset sections of the crank shaft, said crank case having guide means therein positioned for sliding engagement with the ends of the levers.

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No references cited.