July 3, 1923.

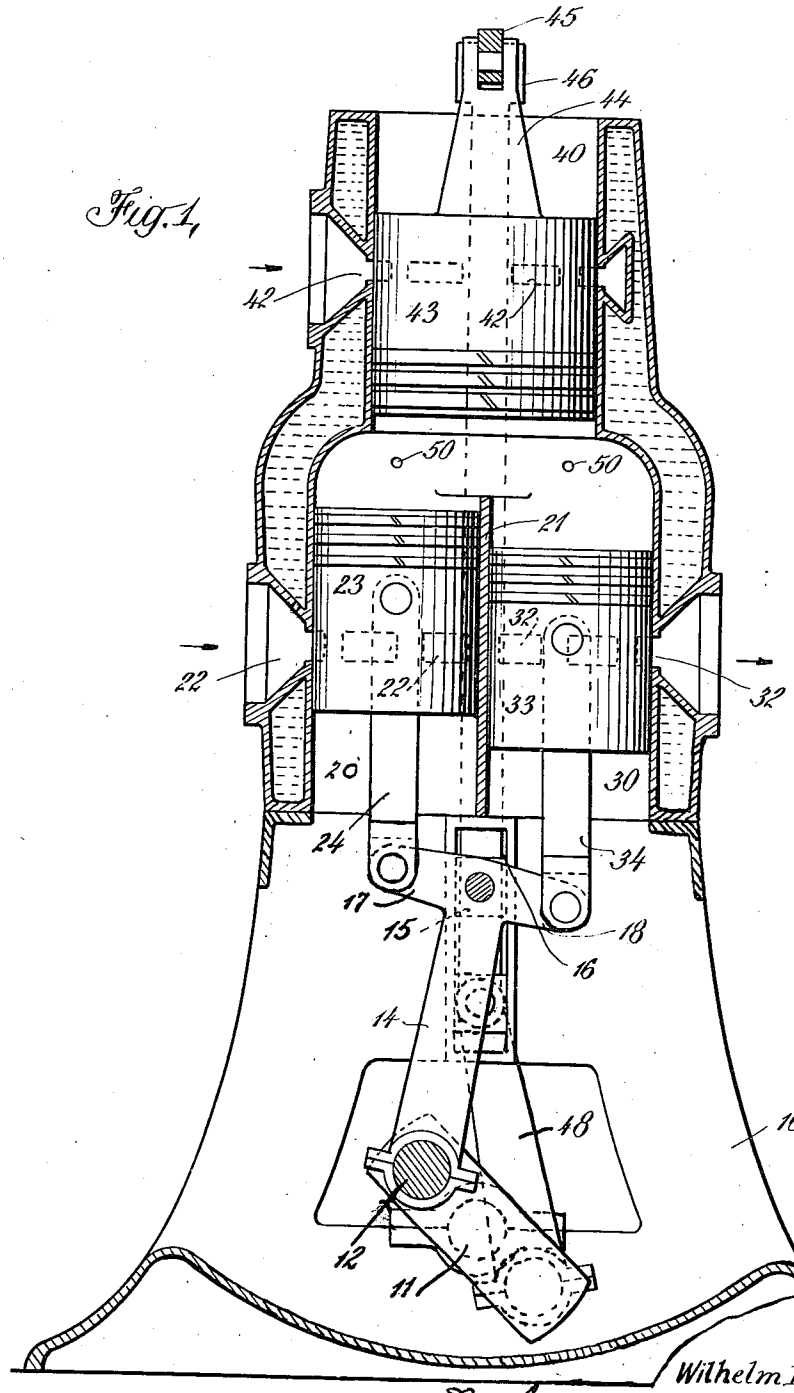
1,460,475

W. B. BRONANDER

INTERNAL COMBUSTION ENGINE

Original Filed Sept. 16, 1920 3 Sheets-Sheet 1

Fig. 1.



Inventor
Wilhelm B. Bronander
By his attorney
E. W. Marshall

July 3, 1923. 1,460,475

W. B. BRONANDER

INTERNAL COMBUSTION ENGINE

Original Filed Sept. 16, 1920 3 Sheets-Sheet 2

Fig. 2.

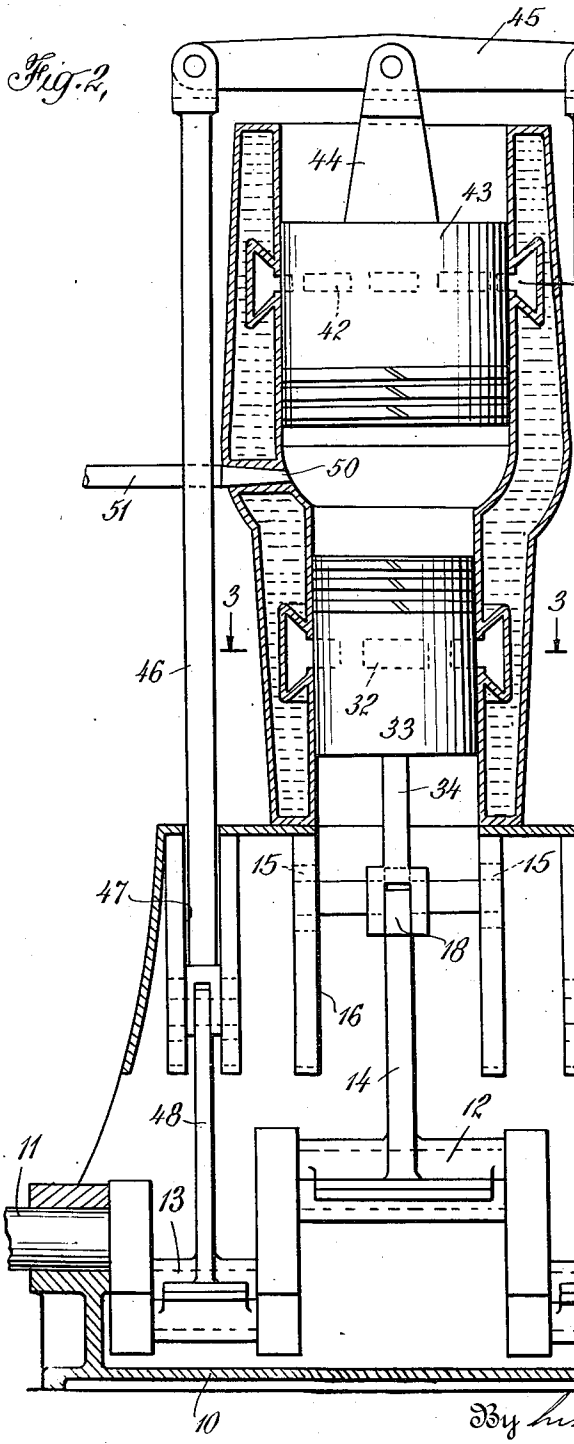
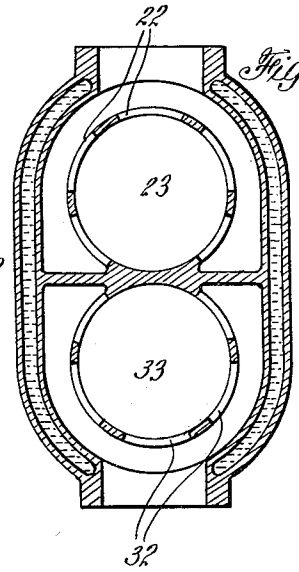


Fig. 3.



Inventor
Wilhelm B. Bronander
By his Attorney
E. M. Marshall

July 3, 1923. 1,460,475

W. B. BRONANDER

INTERNAL COMBUSTION ENGINE

Original Filed Sept. 16, 1920 3 Sheets-Sheet 3

Fig. 4,

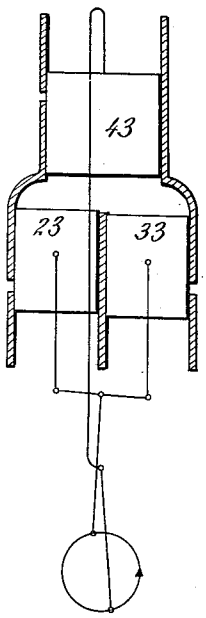


Fig. 5,

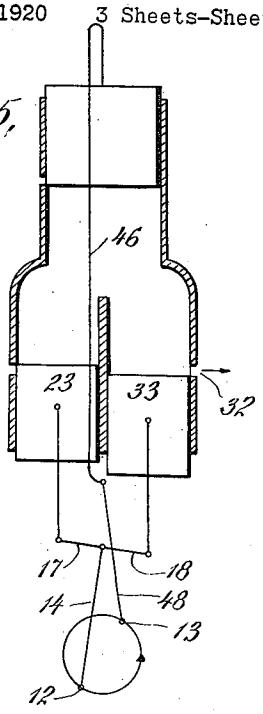


Fig. 6,

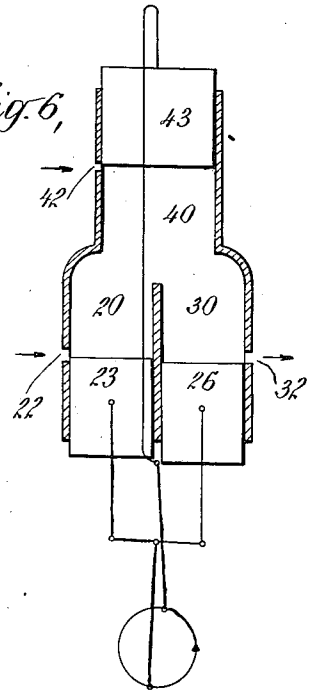
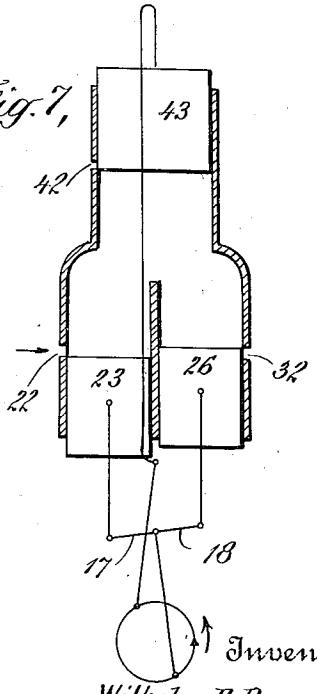


Fig. 7,



Inventor
Wilhelm B. Bronander

By his Attorney
E. W. Marshall

Patented July 3, 1923. 1,460,475

UNITED STATES PATENT OFFICE.

WILHELM B. BRONANDER, OF MONTCLAIR, NEW JERSEY.

INTERNAL-COMBUSTION ENGINE.

Application filed September 16, 1920, Serial No. 410,624. Renewed December 11, 1922.

To all whom it may concern:

Be it known that I, WILHELM B. BRONANDER, a citizen of the United States, and a resident of Montclair, Essex County, and State of New Jersey, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates to improvements in internal combustion engines, especially of those which are operated with comparatively slow burning oils for fuel. More specifically, its object is to provide an engine of the two-cycle type having a pair of cylinders with a piston in each, communicating with a third cylinder containing a piston and with mechanism connecting all of the pistons and arranged to move the pistons in such a manner as to control ports in the cylinders and to produce the desired cycle of operation. Another object is to provide a simple mechanism for producing long piston displacement with short eccentricity of the crank shaft. Another object is to provide an engine somewhat like that disclosed in my co-pending application for patent, Serial No. 338,694, in so far as the cycle of operations is concerned, but with three pistons instead of four and with a common combustion chamber between the aforesaid three cylinders.

These and other objects of the invention will appear in the following specification in which I will describe the invention the novel features of which will be set forth in the appended claims.

Referring to the drawings:

Figure 1 is a sectional end elevation of an engine which is made according to and embodies this invention.

Figure 2 is a sectional side elevation of the engine shown in Fig. 1.

Figure 3 is a sectional plan view of the same engine, the section in this figure being taken on the line 3—3 of Fig. 2.

Figures 4–7 are diagrams illustrating the cycle of operation of the engine.

Like characters of reference designate corresponding parts in all the figures of the drawings.

10 designates a base in which the shaft 11 is supported. This has a crank pin 12, and spaced on either side thereof are other crank pins 13, 13 of like angularity and eccentricity.

14 is a connecting rod extending upwardly from the crank pin 12 to blocks 15 which run in guides 16 transverse to the crank shaft. This connecting rod is T-shaped, as transverse projections 17 and 18 project transversely from its upper end.

Two cylinders 20 and 30 are mounted upon the base 10. These have a division wall 21 between them directly over the shaft 11. 40 is a third cylinder which is directly above this division wall and is preferably of larger diameter than either of the cylinders 20 or 30. Inlet ports 22 are provided in the cylinder 20 and opposite them in the cylinder 30 are exhaust ports 32. 42 designates inlet ports in the cylinder 40.

Pistons 23 and 33 are in the cylinders 20 and 30 respectively. The piston 23 is connected with the transverse projection 17 by a connecting rod 24. Piston 33 is connected with the transverse projection 18 by a connecting rod 34.

43 is a piston in the cylinder 40. This piston is constructed with an upwardly projecting bracket 44 near the upper end of which is connected a cross arm 45. To the ends of this cross arm are connected rods 46, 46, the lower ends of which are guided in stationary guides 47, 47 to move parallel with the block 15. 48, 48 are connecting rods between the lower ends of the rods 46 and the crank pins 13.

50, 50 designate ports connected with a pipe 51 by means of which fuel oil is injected into the space between the pistons 23, 33 and the piston 43.

With the structure thus described, the operation of this engine will be pointed out, having special reference to Figs. 4–7.

In Fig. 4, the charge is fired and the pistons have just passed the point at which they are in closest proximity with one another. Burning of a mixture between the pistons will drive the pistons 23, 33 downwardly and the piston 43 upwardly, and will cause the crank shaft to rotate in the direction indicated by the arrow heads shown in the circle indicating the path of movement of the crank pins.

This expansion or the working stroke will continue until the parts reach the relative positions in which they are shown in Fig. 5, at which time the piston 33 will uncover

the exhaust ports 32, thus releasing the burnt gases. The position of the pistons 23, 33 shown in Fig. 5 with the piston 23 above the piston 33 is caused by the angular position of the projections 17, 18.

A slight further movement of the crank shaft will cause the projections to lie in a nearly horizontal line, as shown in Fig. 6, and this will cause the piston 23 to be drawn down to uncover the inlet ports 22. Air under pressure is then admitted into cylinder 20 and because of the fact that exhaust ports 32 are still open, this air will be blown through cylinders 20, 40 and 30 and out through the exhaust ports thus scavenging the cylinders. At the same time, piston 43 has been raised to a position to uncover the inlet ports 42, so the compressed air is also admitted through these inlet ports and assists in scavenging the cylinders.

As soon as the crank shaft rotates a little further to tilt the projections 17, 18 to the positions in which they are shown in Fig. 7, the piston 26 will be raised to close the exhaust ports 32, and at the same time the piston 43 will be lowered to close the inlet ports 42. These pistons will close their respective ports before the piston 23 closes the inlet ports 22. The result is that some of the compressed air is forced into the cylinders at this time and trapped in the cylinders by the subsequent raising of the piston 23 across the ports 22. The compressed air thus trapped in the cylinders will be further compressed by the motion of the pistons from the positions in which they are shown in Fig. 7 to that in which they are shown in Fig. 4. At about the time the maximum compression has been reached, fuel oil is forced into this highly compressed air through the ports 50 and the mixture of this oil and air is immediately ignited by the heat caused by the compression of the air. It is obvious that this cycle as just described will then be repeated.

The engine thus described is designed and arranged to run in one direction only. It is entirely feasible, however, to use the same construction without modification for a reversible engine by using the ports 42 as exhaust ports and the ports 22 and 32 as inlet ports. In such a case, it is only necessary to so time the relative movements of the pistons in relation to the ports that the ports 32 will not be open before the ports 42 are open, and so that the ports 22 will remain open after the ports 42 are closed. It is also possible to make this a reversible engine by using the ports 42 as inlet ports as in the case formerly described and to use the ports 22 and 32 as exhaust ports.

In any of these cases an engine is provided which is compact and extremely simple and which has the desirable characteristics of a long stroke engine without the undersirable long eccentric, and an engine capable of performing an efficient cycle function.

I intend no limitations other than those imposed by the appended claims.

What I claim is:

1. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a crank shaft, a connecting rod having a cross arm operatively connected with the pistons and arranged to cause said pistons to move out of step to open and close said ports in desired sequence, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder and a connection between the third cylinder piston and the crank shaft.

2. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a crank shaft, a connecting rod having a cross arm operatively connected with the pistons and arranged to cause said pistons to move out of step to open the exhaust port before the inlet port is open and to close the exhaust port before the inlet port is closed, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder and a connection between the third cylinder piston and the crank shaft.

3. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a crank shaft, a guide at right angles thereto, a connecting rod between the shaft and the guide, transverse projections from opposite sides of the connecting rod near its guided end, connections between each piston and one of said projections, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder and a connection between the third cylinder and the crank shaft.

4. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder, and means for interconnecting the pistons arranged to cause the first mentioned pistons to move in substantially the same directions but out of step to open and close said ports in desired sequence and to cause

the third piston to move in directions opposed to those of the first mentioned pistons.

5. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, a port in said third cylinder, a piston in the third cylinder arranged to control its port, and means for interconnecting the pistons arranged to cause the first mentioned pistons to move in substantially the same directions but out of step and the third piston to move in opposite directions, to open and close all of said ports in desired sequence.

6. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, an inlet port in said third cylinder, a piston in the third cylinder arranged to control its port, and means for interconnecting the pistons arranged to cause the first mentioned pistons to move in substantially the same directions but out of step, to open the exhaust port before either of the inlet ports are open and to close the exhaust port before both of the inlet ports are closed.

7. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a crank shaft, a connecting rod having a cross arm operatively connected with the pistons and arranged to cause said pistons to move out of step to open and close said ports in desired sequence, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder, a connection between the third cylinder piston and the crank shaft, and means for injecting oil in the space between the pistons when the pistons are away from their port controlling positions.

8. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder, means for interconnecting the pistons arranged to cause the first mentioned pistons to move in substantially the same directions but out of step to open and close said ports in desired sequence and to cause the third piston to move in directions opposed to those of the first mentioned pistons, and means for injecting oil into the cylinders between the pistons therein at approximately the point of the cycle when the pistons are in nearest proximity.

9. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a third cylinder connected at one end with the connected ends of the first mentioned cylinders, an inlet port in said third cylinder, a piston in the third cylinder arranged to control its port, means for interconnecting the pistons arranged to cause the first mentioned pistons to move in substantially the same directions but out of step to open the exhaust port before either of the inlet ports are open and to close the exhaust port before both of the inlet ports are closed, and means for injecting oil into the cylinders between the pistons therein near the end of the compression stroke.

10. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a crank shaft, a connecting rod having a cross arm operatively connected with the pistons and arranged to cause said pistons to move out of step to open and close said ports in desired sequence, a third cylinder of larger diameter connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder and a connection between the third cylinder piston and the crank shaft.

11. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a third cylinder of larger diameter connected at one end with the connected ends of the first mentioned cylinders, a piston in the third cylinder, and means for interconnecting the pistons arranged to cause the first mentioned pistons to move in substantially the same directions but out of step to open and close said ports in desired sequence and to cause the third piston to move in directions opposed to those of the first mentioned pistons.

12. An internal combustion engine comprising a pair of cylinders with like ends thereof connected, an inlet port in one cylinder, an outlet port in the other cylinder, pistons in the cylinders arranged to control said ports, a third cylinder of larger diameter connected at one end with the connected ends of the first mentioned cylinders, an

inlet port in said third cylinder, a piston in the third cylinder arranged to control its port, means for interconnecting the pistons arranged to cause the first mentioned pistons to move in substantially the same directions but out of step to open the exhaust port before either of the inlet ports are open and to close the exhaust port before both of the inlet ports are closed, and means for injecting oil into the cylinders between the pistons therein near the end of the compression stroke.

In witness whereof, I hereunto set my hand this 14th day of September, 1920.

WILHELM B. BRONANDER