July 25, 1933. P. SCHMALJOHANN 1,919,572

INTERNAL COMBUSTION ENGINE

Filed Jan. 24, 1931 2 Sheets-Sheet 1

Fig.1.

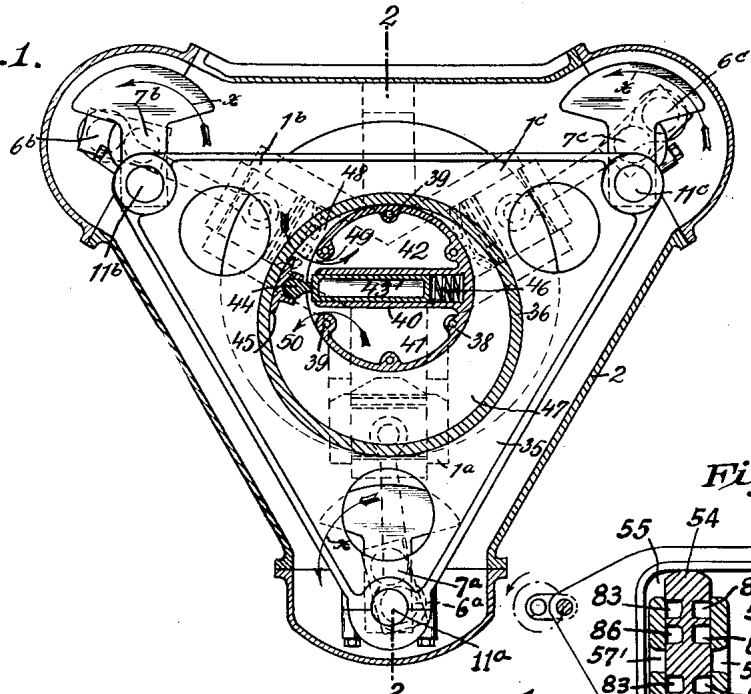


Fig.8.

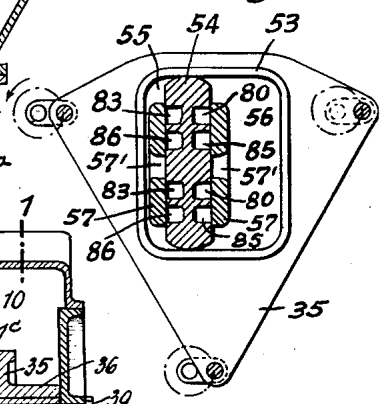
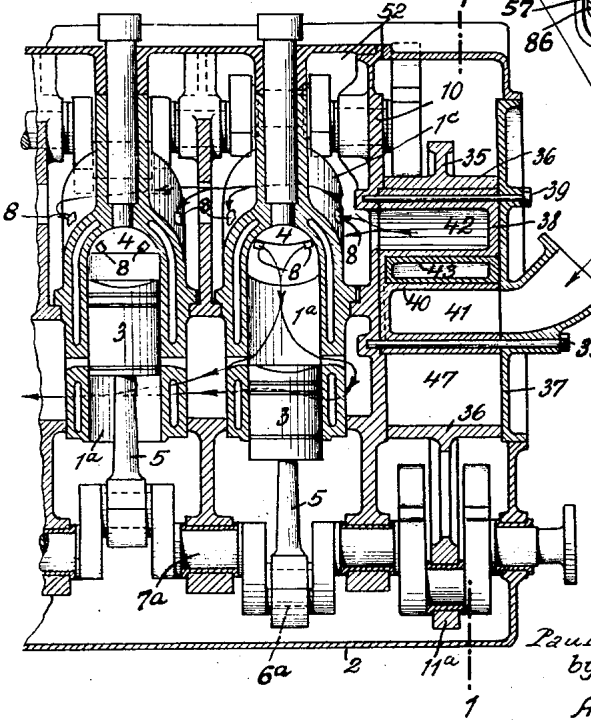


Fig.2.



Inventor:
Paul Schmaljohann
by
Attorney:

July 25, 1933. P. SCHMALJOHANN 1,919,572

INTERNAL COMBUSTION ENGINE

Filed Jan. 24, 1931 2 Sheets-Sheet 2

Fig.3.

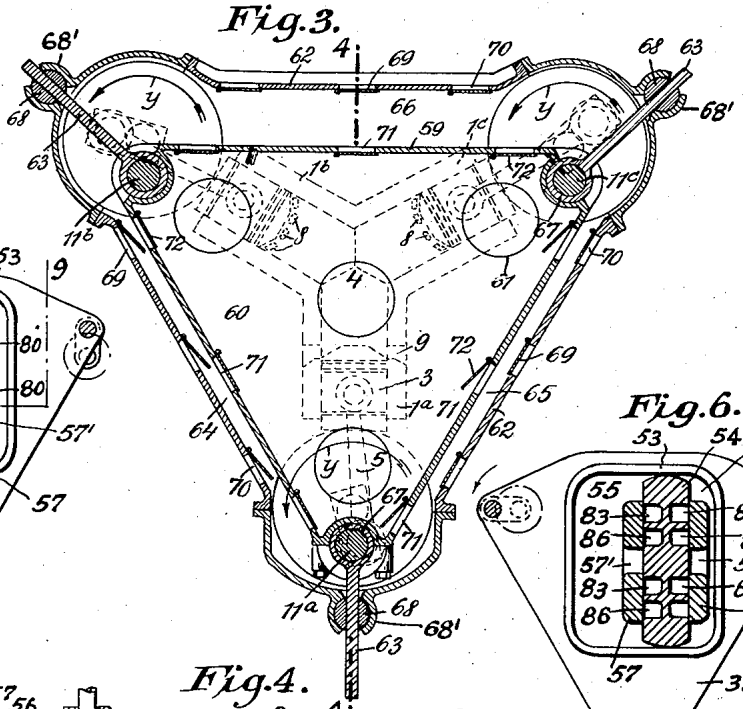


Fig.5.

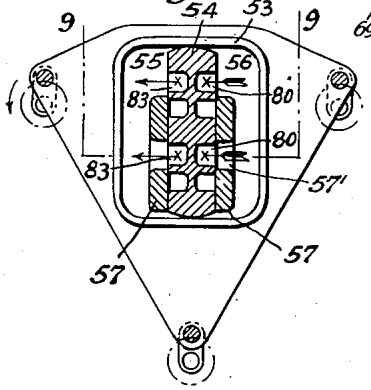


Fig.6.

Fig.9.

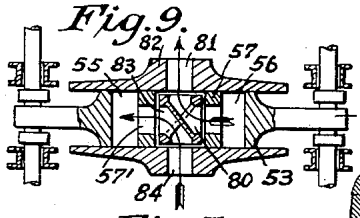


Fig.4.

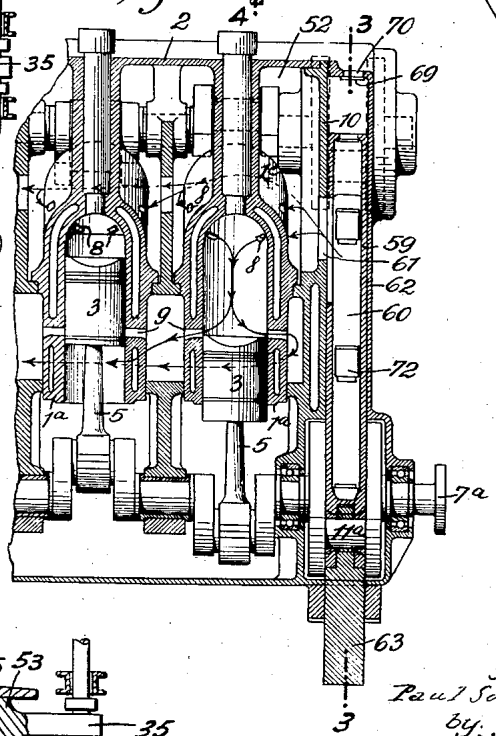


Fig.7.

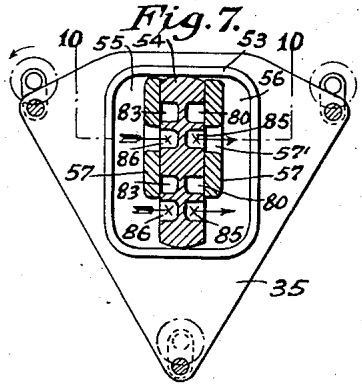
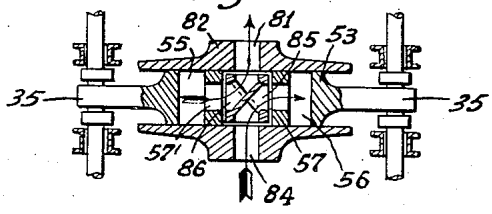


Fig.10.



Inventor:
Paul Schmaljohann
by Lucius Tamblyn
Attorney.

Patented July 25, 1933 1,919,572

UNITED STATES PATENT OFFICE

PAUL SCHMALJOHANN, OF KIEL, GERMANY, ASSIGNOR TO CENTRA HANDELS- & INDUSTRIE A.-G., OF CHUR, SWITZERLAND, A CORPORATION OF SWITZERLAND

INTERNAL COMBUSTION ENGINE

Application filed January 24, 1931, Serial No. 511,052, and in Germany January 31, 1930.

My invention relates to improvements in internal combustion engines and more particularly in engines of the type comprising a plurality of oppositely moving pistons having a common combustion chamber and each acting on a crank shaft, the said crank shafts being provided with additional cranks connected with each other by a frame insuring rotation of all the cranks in one direction. The object of the improvements is to provide an engine of this type in which the said coupling frame provides a part of a certain subsidiary apparatus such as a fuel pump or a scavenging pump or a fuel pump and a scavenging pump, and with this object in view my invention consists in constructing the said frame and the frame or casing of the engine in the form of cooperating elements of the said subsidiary apparatus. In one embodiment of the invention the frame provides a part of a rotary pump the stationary member of which is fixed to or made integral with the frame of the engine. By thus constructing the pump or other apparatus special driving members therefor are dispensed with and the apparatus does not require room of its own in the system, because the inner space of the frame which otherwise is useless is used for disposing the elements of the said apparatus. By reason of the comparatively large size of the said frame resulting from the relative distance between the main crank shafts a pump of high capacity may be provided.

The suction or pressure chamber provided by a member connected to or made integral with the machine frame may be disposed internally of the coupling frame or externally thereof.

For the purpose of explaining the invention several examples embodying the same have been shown in the accompanying drawings in which the same reference characters have been used in all the views to indicate corresponding parts.

In said drawings,

Fig. 1 is a sectional elevation of the engine taken on the line 1—1 of Fig. 2,

Fig. 2 is a sectional elevation taken on the line 2—2 of Fig. 1,

Fig. 3 is a sectional elevation of a modified construction taken on line 3—3 of Fig. 4,

Fig. 4 is a sectional elevation taken on line 4—4 of Fig. 3, and

Figs. 5 to 10 are diagrammatic sectional views showing a modification of certain details in various positions assumed by the parts during operation, and in which Fig. 9 is a view taken on line 9—9 of Fig. 5, and Fig. 10 is taken on line 10—10 of Fig. 7.

In Figs. 1 and 2 I have shown a two-stroke cycle internal combustion engine. But I wish it to be understood that my invention is not limited to this type of engines. As shown the engine comprises three cylinders 1*a*, 1*b*, 1*c* disposed radially of one another within a casing 2 and having a common combustion chamber 4. Within the cylinders there are three pistons 3 connected by crank shafts 5 with crank pins 6*a*, 6*b*, 6*c* of crank shafts 7*a*, 7*b*, 7*c* mounted in the casing 2. The cylinders 1*b*, 1*c* are provided with intake or scavenging ports 8 and the cylinder 1*a* with exhaust ports 9. The pistons are displaced relatively to each other so that the pistons of the cylinders 1*b* and 1*c* slightly lag behind the piston within the cylinder 1*a*, so that in the operation of the engine at first the exhaust ports and thereafter the scavenging ports are opened.

At the end projecting through the wall 10 of the casing 2 the crank shafts 7*a*, 7*b* and 7*c* are provided each with an additional crank having crank pins 11*a*, 11*b* and 11*c* disposed parallel to each other and positively connected with each other by a rigid frame 35 so that they rotate in the same direction. Therefore the forces of the crank shafts connected with the pistons 3 are uniformly transmitted to the shaft 11*a* by which the power of the engine is transmitted to a driven member.

In the construction shown in Figs. 1 and 2 the rigid coupling frame itself is used as a driving member and a component part of the scavenging pump.

The coupling frame 35 is provided at its middle with a large recess providing the inner chamber of a cylinder 36, the said cylinder tightly bearing with one end face on

the wall 10 of the machine frame and with the other end face on a head 37. Within the cylinder 36 a cylindrical hollow body 38 is eccentrically mounted, which is secured by means of screws 39 to the wall 10 of the machine frame. The hollow chamber of the cylindrical body 38 is subdivided by a hollow partition 40 into two chambers 41 and 42, and within the said hollow partition 40 a slide 43 has reciprocating movement, which is connected by a cylindrical head 44 with a shoe 45 adapted to slide on the inner surface of the cylinder 36, springs 46 being provided for pressing the shoe into engagement with the wall of the cylinder 36. By the shoe 45 and the slide 43 the cylinder 36 is divided into two chambers 47 and 48, and the chamber 48 communicates with the chamber 42 of the cylindrical body 38 through a passage 49, and the chamber 47 communicates through a passage 50 with the chamber 41 of the said body.

The cylinder 36, the cylindrical body 38 and the slide 43 provide a rotary engine which is operated by the cylinder 36 being rotated by means of the frame 35, and which is formed with a crescent-shaped compression chamber. The chamber 41 of the stationary body 38 communicates through a tubular stud 51 with the outer air and provides the suction chamber of the pump, while the chamber 42 acts as a pressure chamber and communicates with the inner space 52 of the machine casing 2, the said machine casing being closed tightly as against the outer air. The inner space 52 is adapted to communicate with the combustion chamber 4 through the scavenging or intake ports 8 made in the cylinders 1*b* and 1*c*.

If the frame 35 is rotated from the position shown in Fig. 1 in the direction of the arrows *x* the air confined within the suction chamber 47 of the rotating cylinder 36 is compressed and forced through the slots 49 into the pressure chamber 42 of the stationary hollow body 38 from whence it is delivered to the scavenging ports 8 of the cylinders. During such rotation the cylinder 36 slides on the shoe 45.

It appears therefore that the pump 36, 38 for scavenging is confined within the frame 35 so that separate room is not needed for the said pump. The frame 35 acts as a driving member and it provides a component part of the rotary engine. By reason of the large space within the frame 35 the suction and pressure chamber can be made comparatively large, so that a large volume of air is supplied with small air velocities. Thereby a noiseless operation of the pump is insured.

In the embodiment shown in Fig. 5, the working chamber of the scavenging air pump is made rectangular instead of crescent shaped. A rectangular housing 53 is provided on the connecting frame 35, the interior of said housing being divided into two chambers 55 and 56 by means of a slide 54. The slide 54 is so mounted in a guide 57 provided with openings 57′, that it can take part in the upward and downward movement of the connecting frame 35, but not in the transverse movement of said connecting frame, upon the revolution of the latter about the crank pins, in the direction of the arrow in Fig. 5. The guide 57 is secured to the frame 2 of the machine, and therefore does not partake of the movement of the connecting frame 35.

The slide 54 is perforated with four types of ports. The ports 80 provide a connection of the chamber 56 with an opening 81 of the machine element 82. The opening 81 leads to the chamber 52 (Fig. 2) of the machine, into which open the scavenging air slots 8 of the cylinders 1*b* and 1*c*. In the operating position of the connecting frame 35 shown in Figs. 5 and 9, the ports 83 of the slide 54 provide a connection between an opening 84 communicating with the outer air, and the chamber 55.

From the operating position of the connecting frame 35 shown in Figs. 7 and 10, it will be seen that the ports 85 may provide a connection to the outer air, or to the opening 84, with the chamber 56, whereas the ports 86 serve for providing a communication between the chamber 55 and the opening 81 or the scavenging air chamber 52. The four pairs of ports 80, 83, 85 and 86 are thus so controlled during the upward and downward movement of the slide 54, by means of the guides 54 or the openings 57′ thereof, that the outer air enters through the slide into the chamber 55 or 56, when these chambers are serving as suction chambers. When these chambers are serving as pressure chambers, the compressed air is conducted out of said chambers through the slide 54 to the scavenging air slots 8.

These individual steps of the operation may be followed upon reference to Figs. 5 to 10:

In Fig. 5 the connecting frame 35 is positioned at the upper dead center. Upon further rotation of the connecting frame 35 in the direction shown by the arrow, around the crank pins illustrated, the chamber 55 is enlarged, whereas the chamber 56 decreases. Thus in this operative position the chamber 55 is a suction chamber, whereas the chamber 56 is a compression chamber. Therefore air is forced into the scavenging air chamber 52 from the chamber 56, through the two ports 80, whereas the chamber 55 draws outer air into itself through the ports 83.

In Fig. 6 the connecting frame 35 has been turned through 90° further, beyond the position shown in Fig. 5. The slide 54 has thus reached the right hand dead center position in the housing 53, that is, the compression chamber 56 has its minimum volume, whereas the suction chamber 55 has its maximum vol-

ume. The slide 54 is in the inactive middle position, in which air can neither be drawn in or forced out, because all the pairs of ports, 80, 83, 85 and 86 are closed.

In accordance with Fig. 7 the connecting frame 35 has again been shifted through 90° further, beyond the position shown in Fig. 6. The chamber 55 is therefore a compression chamber, whereas the chamber 56 is a suction chamber. From Fig. 5 it follows that a connection is established between the compression chamber 55 and the scavenging air chamber 52 by the position of the guides 57 with respect to the slide 54. On the other hand, the suction chamber 56 is connected to the outer air.

In accordance with Fig. 8 the connecting frame 35 has again been shifted with respect to Fig. 7, likewise by 90° further. The slide 54 is located in the left hand dead center position. The chamber 55 thus has just terminated its action as a pressure chamber. A corresponding condition exists as to the suction chamber 56. All the ports of the slide 54 are closed.

In Figs. 3 and 4 I have shown a modification in which the hollow space of the frame 59 connecting the crank pins 11*a*, 11*b* and 11*c* provides the pressure chamber 60 continuously communicating through an opening 61 made in the wall 10 with the chamber 52 of the machine frame 2. The frame 59 is guided in an airtight manner between the end wall 10 and the head 62 secured to and spaced from the machine frame, and the space provided between the same and the head 62 is divided by partitions 63 into three chambers 64, 65 and 66, which partitions are formed with cylindrical tubular heads 67 engaging the crank pins 11*a*, 11*b* and 11*c* and are guided with their opposite ends in cylindrical guide blocks 68 rockingly mounted in cylindrical bearings 68^1 made integral with the head 62.

The head 62 is provided with openings 70 through which the sectional chambers 64, 65 and 66 are adapted to communicate within the outer air, the said openings being adapted to be closed by hinged gates or valves 69. In a similar way the wall of the frame 59 is provided with openings 71 which are adapted to be closed by hinged gates or valves 72, and which are adapted to establish communication between the sectional chambers 64, 65 and 66 and the pressure chamber 60.

When the frame is rotated in the direction of the arrows *y* the space 65 provides the presure chamber, and the valves 69 are closed and the valves 72 opened, so that air under pressure is delivered into the chamber 60 and to the scavenging ports 8 of the cylinders. The chamber 64 acts as a suction chamber, so that the valves 69 are opened and the valves 72 closed. When further rotating the frame 59 the chamber 66 begins to act as a pressure chamber while the chamber 65 begins to act as a suction chamber.

In this case the head 62 and therefore the frame of the engine provides a component part of the pump for scavenging, which part communicates with the rotary frame 59.

While in describing the invention reference has been made to particular examples embodying the same I wish it to be understood that my invention is not limited to the constructions shown in the drawings, and that various changes may be made in the general arrangement of the apparatus and the construction of its parts without departing from the invention.

I claim:

1. An internal combustion engine, comprising a plurality of cylinders having a common combustion chamber, pistons reciprocating in said cylinders, crank shafts connected one with each of said pistons, subsidiary cranks for said crank shafts, a frame connecting said subsidiary cranks for insuring rotation of all the crank shafts in the same direction, and a frame on which said cylinders are mounted, said frames being provided with a bore for providing an auxiliary cylinder and a piston cooperating therewith and being equipped with means controlling the intake and delivery of fluid to and from said auxiliary cylinder and piston.

2. An internal combustion engine, comprising a plurality of cylinders having a common combustion chamber, pistons reciprocating in said cylinders, crank shafts connected one with each of said pistons, subsidiary cranks for said crank shafts, a frame connecting said subsidiary cranks for insuring rotation of all the crank shafts in the same direction, and a frame on which said cylinders are mounted; said frames being provided with a bore and a piston to constitute the cylinder and piston of an auxiliary rotary fluid pump and being provided with means controlling the intake and delivery of fluid to and from said cylinder and piston.

3. An internal combustion engine, comprising a plurality of cylinders having a common combustion chamber, pistons reciprocating in said cylinders, crank shafts connected one with each of said pistons, subsidiary cranks for said crank shafts, a frame connecting said subsidiary cranks for insuring rotation of all the crank shafts in the same direction, and a frame on which said cylinders are mounted, said frames being formed respectively with a stationary and a movable cylinder disposed eccentrically one within the other to provide a rotary pump having a crescent-shaped chamber, a partition dividing said chambers into sectional chambers, and ports controlling the intake and delivery of the fluid into and from said sectional chambers.

4. An internal combustion engine, com-

prising a plurality of cylinders having a common combustion chamber, pistons reciprocating in said cylinders, crank shafts connected one with each of said pistons, subsidiary cranks for said crank shafts, a frame connecting said subsidiary cranks for insuring rotation of all the crank shafts in the same direction, a frame on which said cylinders are mounted, said frames being formed one with a rectangular case and the other one with a slide dividing said case into two chambers and provided with a section and a pressure chamber, and slots in said slide adapted alternately to establish communication between said suction and pressure chambers within the slide and said chambers within the rectangular casing.

5. An internal combustion engine, comprising a casing, a plurality of cylinders within said casing having a common combustion chamber, pistons reciprocating within the said cylinders, crank shafts connected one with each of said pistons, subsidiary cranks for each of said crank shafts, a frame within said casing and connected with said subsidiary crank shafts, said casing and frame providing a chamber, and partitions movable with said frame and dividing said chamber into sectional chambers, said casing and frame being provided with openings and valves controlling the intake to and delivery from said sectional chambers.

6. An internal combustion engine, comprising a casing, cylinders within said casing having a common combustion chamber and having intake ports adapted to establish communication between said casing and combustion chamber, pistons reciprocating within said cylinders and controlling said intake ports, crank shafts connected one with each of said pistons, a frame connecting said crank shafts and insuring rotation thereof in one direction, cylinders connected respectively with said casing and said frame and disposed eccentrically one within the other to provide a working chamber, a partition dividing said working chamber into sectional chambers, and slots adapted alternately to establish communication between said sectional chambers and said casing.

PAUL SCHMALJOHANN.