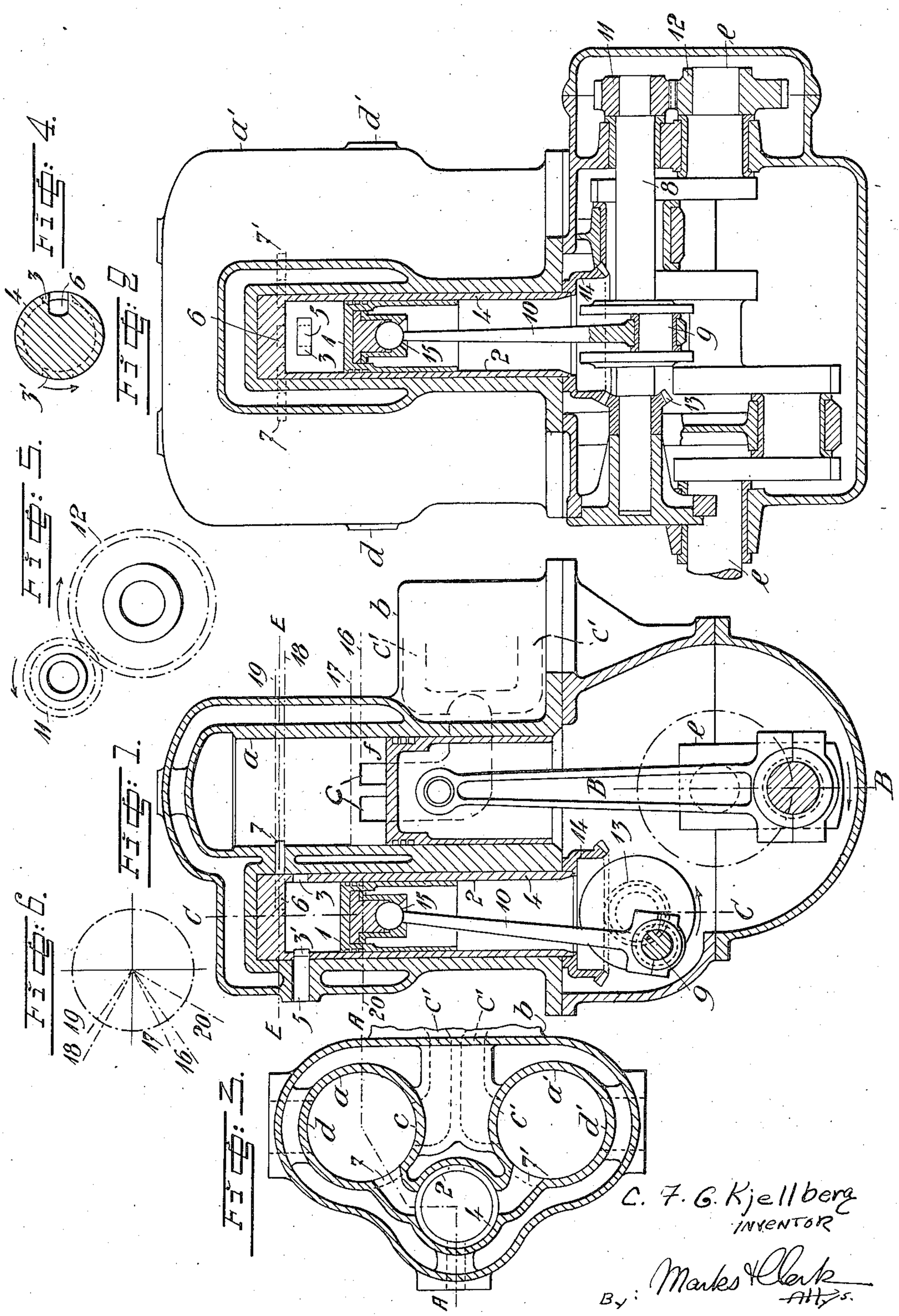
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INTERNAL COMBUSTION MOTOR

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INTERNAL COMBUSTION MOTOR

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The present invention refers to an arrangement in the ordinary two-stroke cycle internal combustion motor involving an increase of the degree of admission of the working cylinder by means of a pump, or supplying such quantity of air which upon scavenging is removed through the outlets during the first portion of the compression stroke of the working piston. Furthermore, the invention aims at supplying the additional air during such a period of the compression stroke of the working piston that no part of the air supplied will be lost through the outlets, and at utilizing the whole quantity of air in the combustion. Furthermore, the invention aims at supplying the charge in question with a pump work as small as possible and with the least possible number of pump units, so that one pump may be utilized for two or more working cylinders, the pump also permitting of being regulated in such manner as to be able to supply the required quantity of air to one working cylinder.

In order to utilize the quantity of air supplied by the pump, the introduction of the gas must not commence until the outlet openings of the working cylinders have been closed, and the introduction must be terminated before ignition of the fuel mixture takes place.

In order not to reduce the output of the motor through a large amount of pump work, the pressure of the pump must not exceed the compression pressure attained in the working cylinder at the end of the period of introduction. The pressing-in stroke of the pump is completed, therefore, during a part only of the compression stroke of the working piston, or faster than the crank movement of the piston.

By utilizing the pump for the charging of two working cylinders, as in the present embodiment of the invention, the construction is considerably simplified as compared with such motors where each working cylinder is arranged with a separate pump. Moreover, with a pump common to a plurality of cylinders, each cylinder is supplied with exactly the same quantity of charge, which will not be the case with two pumps, inasmuch as these would have a somewhat different efficiency even if they are of the same size.

This considerable simplification of arrangements hitherto known, which constitutes the principle of the invention, is brought about by combining the driving means for the pump piston with the control of the suction and pressing-in passages of the pump.

In one application of the invention, for example, where one pump supplies additional air to two working cylinders, the piston of the pump is driven with twice as many pump strokes as the number of working strokes for the one cylinder, and delivers its charge during the compression stroke, every other time to the one and every other time to the other cylinder. The angle formed by the pressing-in stroke on the crank pin movement will then be 90° against 180° for the working stroke. If the angle for the pressing stroke is 60°, the pump piston has been displaced only 30° when the valve opens for the pressing-in period. The inlets and the outlets of the pump are controlled by means of a suitable valve device. For one cylinder, the pump may be disconnected by means of the valve device for every other stroke, and for a number of cylinders exceeding two, the number of revolutions of the pump is increased to a suitable value.

The invention is applicable to every motor of the type in question, and different systems for scavenging or exhaust do not influence the principle of the invention.

The invention is illustrated in the accompanying drawing, which shows an embodiment where one pump is provided for two working cylinders to supply the additional air. Fig. 1 shows a section through the motor and the cylinders on the broken line A—A in Fig. 3, when extended in a straight line, through the pump and the working cylinders, and also shows the outline of the scavenging pump. Fig. 2 shows a section through the motor on lines B—B and C—C in Fig. 1, the first section being taken through the crank casing and the latter through the pump. Fig. 3 shows a section through the working cylinders and the pump cylinder on line E—E in Fig. 1. Fig. 4 is a section through the valve device for a pump with suction and pressing-in passages. Fig. 5 illustrates a gear drive for the pump shaft. Fig. 6 is a diagram illustrating the pressing-in period of the pump and so forth in relation to the crank movement of the working power.

As the drawing is represented, scavenging takes place in the working cylinders *a*, *a'* from a special scavenging pump *b* through the passages *C*, *C'*, the combustion gases being forced out through the outlets *d*, *d'*. The pump which supplies the additional charge to the working cylinders *a*, *a'*, obtains its suction and pressure action through the movement of the piston **1**, and the pump cylinder **2** is brought into communication with a suction passage **5** through a channel **3** in the valve device **4**. In the same manner, a passage **6** in the valve device **4** connects the pump cylinder **2** with the pressure channels **7**, **7'** and the working

cylinders *a*, *a'*. The passage **5** may be either in communication with the atmosphere, as shown in the drawing, or may be connected to a carbureter. The piston **1** of the pump obtains movements for suction and pressure strokes through the action of a crank pin **9** arranged on a shaft **8** and connected to a connecting rod **10**. The transmission of the movement onto the shaft **8** from the crank shaft *e* is effected by means of gears **11**, **12** respectively. In the present case, shafts *e* and **8** are connected with each other at such ratio of gear that the shaft **8** makes two revolutions when shaft *e* makes one revolution. In the present case, the valve device **4** is formed into a rotating sleeve obtaining movements from the shaft **8** through gear wheels **13** and **14** respectively. As the valve **4** is arranged with two passages **3** for induction and with one passage **6** for pressing, the valve **4** will make one revolution when the shaft **8** makes two revolutions. In order that the piston of the pump shall not trail in the valve **4**, but is caused to follow the latter, the piston **1** is rotatably mounted on the connecting rod **10** by means of a ball and socket joint **15**.

As indicated in Fig. 1 of the drawing, the crank shaft *e* rotates in the direction of the arrow, the working piston *f* has completed the working stroke, and the compression stroke commences. Scavenging takes place from the scavenging channel C and the exhaust gases are removed from the outlet openings *d*. The pump piston **1** is then in position for suction. The channel **3'** in the valve **4** connects the suction passage **5** with the pump cylinder **2**. The channel **6** in the valve **4** then opens the pressing-in passage **7** of the working cylinder *a*. The gas which is present in the working cylinder is removed during the commencing compression stroke through the outlet openings *d*, until the latter are closed by the piston *f* marked by the line **16**. The pump piston **1** completes the suction stroke and initiates the pressing-in stroke. When the working piston *f* has taken a position marked by the line **17**, the channel **6** in the valve **4** opens the channel connection **7** between the pump cylinder **2** and the working piston *a*, the gas then flowing from the pump into the working cylinder. When during the compression stroke the working piston *f* has reached a position indicated by the line **18**, the pump piston **1** has completed the pressing-in stroke, and the charge is in the working cylinder *a*. When the working piston *f* has reached a position indicated by the line **19**, it will close the pressing-in channel **7**, the compression in the working cylinder is continued, and a little before the working piston has completed the compression stroke, the gas mixture is ignited. The compression stroke having been completed, the working stroke follows. Immediately after the pump piston **1** has completed the pressing-in stroke, the suction stroke commences. Shortly thereafter the pressing-in channel **7** is closed by the valve **4** which opens the communication between the suction channel **5** and the pump cylinder **2** through the channel **3**. The suction stroke is continued until the piston **1** turns at a line indicated by **20**. During the next compression stroke, or when the working piston in the cylinder *a'* has closed the outlets C', the channel **6** of the valve **4** opens the channel **7'** between the pump cylinder **2** and the working cylinder *a'*. The cycle in the cylinder *a'* is then the same as in the cylinder *a*. At the following suction stroke of the pump piston **1** the channel **3'** of the valve **4** opens the suction passage **5**. If the supply passage **5** is connected with a carbureter, fuel is sucked in simultaneously with the air. The ignition of the gas may be effected either by an electric ignition device or, as in Diesel motors, through the compression pressure. Fig. 6 shows the pressing-in periods indicated in the path of the working crank in agreement with the respective positions of the pistons indicated in the cylinders.

What I claim is:—

1. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder its induction stroke to commence before said exhaust ports in said working cylinder have been closed and to end early enough before the ignition of the fuel gas in said working cylinder takes place at a point before the compression stroke of said piston in said working cylinder has been completed, a valve actuated from said crank shaft provided with ports to register with said suction and induction ports in said pump cylinder serving to open said induction port after said exhaust ports in said working cylinder have been closed by said piston in said working cylinder, said valve constituting a slide valve operatively situated within said pump cylinder.

2. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port in communication with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder, a valve actuated from said crank shaft provided with ports to register with ports in said pump cylinder and operatively situated within said pump cylinder, said valve constituting a sliding drum for said pump piston extending the whole length of said pump cylinder.

3. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, a pump cylinder provided with suction and induction ports, a piston in said pump cylinder actuated from said crank shaft, a rotary valve in the pump cylinder provided with ports to register with said ports for suction and induction in said pump cylinder extending the whole length of said pump cylinder, said piston in said pump cylinder being rotary mounted to its driving member by a ball bearing.

4. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said

crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder its induction stroke to commence before said exhaust ports in said working cylinder have been closed and to end early enough before the ignition of the fuel gas in said working cylinder takes place at a point before the compression stroke of said piston in said working cylinder has been completed, a valve actuated from said crank shaft provided with ports to register with said ports in said pump cylinder serving to open said induction port after said exhaust ports in said working cylinder have been closed by said working piston and operatively situated within said pump cylinder, said pump piston having its bottom adjacent the position of the bottom of said piston in said working cylinder at the end of said pump piston induction stroke.

5. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder its induction stroke to commence before said exhaust ports in said working cylinder have been closed and to end early enough before the ignition of of the fuel gas in said working cylinder takes place at a point before the compression stroke of said piston in said working cylinder has been completed, a valve actuated from said crank shaft provided with ports to register with said ports in said pump cylinder serving to open said induction port after said exhaust ports in said working cylinder have been closed by said working piston and operatively situated within said pump cylinder, said pump piston bottom takes in at the end of said pump piston induction stroke.

6. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder its induction stroke to commence before said exhaust ports in said working cylinder have been closed and to end early enough before the ignition of the fuel gas in said working cylinder takes place at a point before the compression stroke of said piston in said working cylinder has been completed, a valve actuated from said crank shaft provided with ports to register with said ports in said pump cylinder serving to open said induction port after said exhaust ports in said working cylinder have been closed by said working piston and operatively situated within said pump cylinder, said pump piston bottom being adjacent the position of the bottom of said piston in said working cylinder and said pump cylinder bottom situated adjacent the position said pump piston bottom takes in at the end of said pump piston induction stroke, said pump cylinder having its induction port situated adjacent said bottom of said pump cylinder.

7. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder its induction stroke to commence before said exhaust ports in said working cylinder have been closed and to end early enough before the ignition of the fuel gas in said working cylinder takes place at a point before the compression stroke of said piston in said working cylinder has been completed, a valve actuated from said crank shaft provided with ports to register with said ports in said pump cylinder serving to open said induction port after said exhaust ports in said working cylinder have been closed by said working piston and operatively situated within said pump cylinder, said pump piston bottom being adjacent the position of the bottom of said piston in said working cylinder and said pump cylinder bottom situated adjacent the position said pump piston bottom takes in at the end of said piston induction stroke, said induction port situated adjacent said bottom of said pump cylinder, said pump cylinder having said suction port situated a space from said bottom of said pump cylinder.

8. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder, a valve actuated from said crank shaft provided with ports to register with said ports in said pump cylinder and operatively situated within said pump cylinder, said pump piston bottom being adjacent the position of the bottom of said piston in said working cylinder and said pump cylinder bottom situated adjacent the position said pump piston bottom takes in at the end of said pump piston induction stroke, said valve being rotary actuated and having said ports arranged for said rotation.

9. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder, a valve

actuated from said crank shaft provided with ports to register with said ports in said pump cylinder and operatively situated within said pump cylinder, said pump piston bottom being adjacent the position of the bottom of said piston in said working cylinder and said pump cylinder bottom situated adjacent the position said pump piston bottom takes in at the end of said pump piston induction stroke, said actuation of said pump piston being timed and said valve having said ports arranged to serve a plurality of working cylinders.

10. In an internal combustion motor, the combination of working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, means for scavenging said working cylinder, a pump cylinder provided with suction and induction ports, said induction port communicating with said transfer port in said working cylinder, a piston in said pump cylinder actuated from said crank shaft to introduce an additional charge to said working cylinder during the compression stroke of said piston in said working cylinder, a valve actuated from said crank shaft provided with ports to register with said ports in said pump cylinders and operatively situated within said pump cylinder, said pump piston bottom being adjacent the position of the bottom of said piston in said working cylinder and said pump cylinder bottom situated adjacent the position said pump piston bottom takes in at the end of said pump piston induction stroke, said valve rotary actuated, said pump piston being rotary mounted to its driving member by a ball bearing.

11. In an internal combustion motor, the combination of a working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, a pump cylinder provided with suction and induction ports, a piston in said pump cylinder actuated from said crank shaft, a valve actuated from said crank shaft provided with ports to register with said suction and induction ports in said pump cylinder and operatively situated within said pump cylinder, said working cylinder having its transfer ports situated adjacent the position said working piston takes at the end of said pump piston induction stroke.

12. In an internal combustion motor, the combination of a working cylinder provided with inlet, exhaust and transfer ports, a piston in said working cylinder connected to crank shaft, a pump cylinder provided with suction and induction ports, a piston in said pump cylinder actuated from said crank shaft, a valve actuated from said crank shaft provided with ports to register with said suction and induction ports in said pump cylinder and operatively situated within said pump cylinder, said pump cylinder induction port situated adjacent said working cylinder transfer port, and said suction port in said pump cylinder being, in the direction of the pump piston induction stroke, situated at a point distant from said pump cylinder induction port.

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