H. JUNKERS.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAY 9, 1913. RENEWED AUG. 13, 1919.

1,320,062. Patented Oct. 28, 1919.

2 SHEETS—SHEET 1.

Fig. 1.

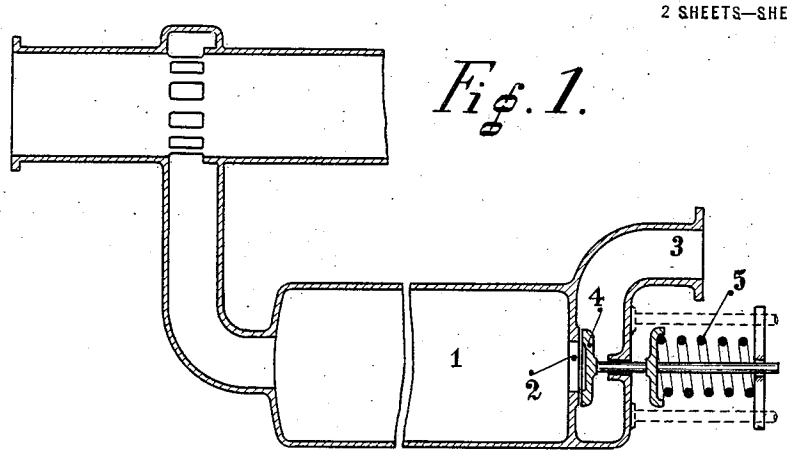


Fig. 1a.

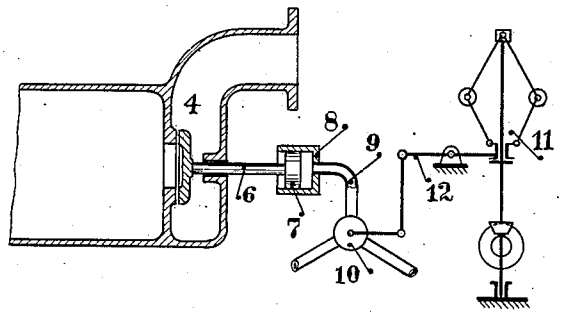
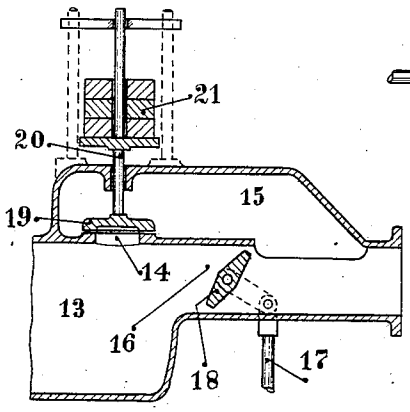


Fig. 2.



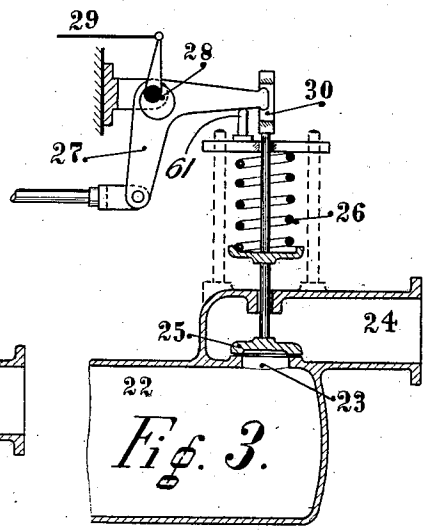


Fig. 3.

Witnesses.

Emil Wergien.

Hermann Fischer.

Inventor.

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2 SHEETS—SHEET 2.

Fig. 4.

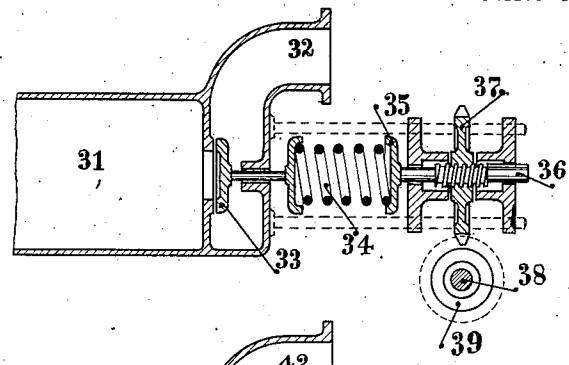


Fig. 5.

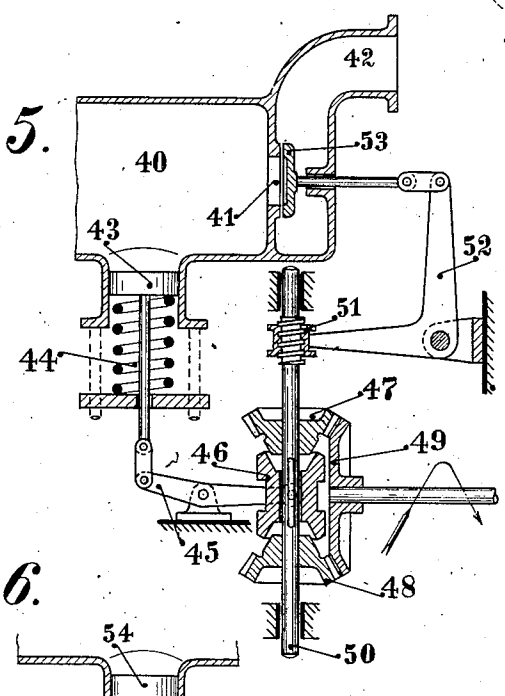
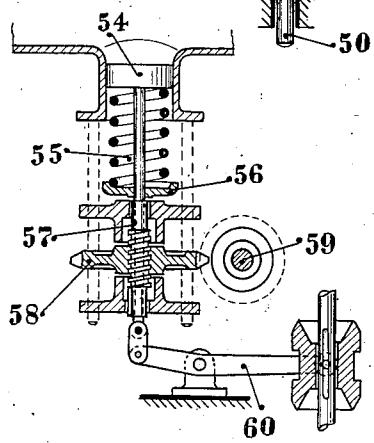


Fig. 6.



Witnesses.

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Hermann Tischer.

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UNITED STATES PATENT OFFICE.

HUGO JUNKERS, OF AACHEN, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO L. M. WHEELOCK, OF BOSTON, MASSACHUSETTS.

INTERNAL-COMBUSTION ENGINE.

1,320,062. Specification of Letters Patent. Patented Oct. 28, 1919.

Application filed May 9, 1913, Serial No. 766,470. Renewed August 13, 1919. Serial No. 317,377.

To all whom it may concern:

Be it known that I, HUGO JUNKERS, a citizen of the German Empire, residing at Aachen, No. 68 Bismarckstr., Kingdom of Prussia, Empire of Germany, have invented certain new and useful Improvements in Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to two-cycle internal combustion engines and its object is to provide improved means for increasing the power developed by such an engine and for facilitating the control of the operation of the engine.

The present invention constitutes an improvement upon that disclosed in Patent No. 891,078, granted to me June 16, 1908. That patent discloses means for controlling the power developed by an internal combustion engine by a throttling device operated by hand or by the governor of the engine for controlling the pressure within a suitable receiver connected to the exhaust outlet of the engine. In this way, the quantity of air for combustion or the charge present in the cylinder at the commencement of the compression stroke may be regulated if desired.

The object of the present invention is to provide an improved construction of this character whereby objectionable changing of the back pressure of the exhaust as the conditions of operation of the engine change are eliminated. This is accomplished by the provision of means for maintaining a substantially constant pressure of the exhaust throughout the changing conditions of operation of the engine; in other words, the charge of air in the cylinder prior to the compression stroke is always at a pressure higher than atmospheric pressure. The invention also involves the provision of means whereby this substantially constant pressure of the exhaust may be regulated as desired to increase or diminish the power developed by the engine, such regulation being effected either manually or automatically.

My improved construction is particularly advantageous when used in connection with engines which must start up with a large torque, such for instance as locomotives, hauling engines and the like. In the operation of such engines, it would be practically impossible to maintain the requisite pressure in the exhaust by manual manipulation of a throttling valve in accordance with the varying speed and fluctuating torque; furthermore, the operator would be fully occupied at the time of starting such an engine with the mechanism controlling the admission of fuel to the engine.

An engine constructed in accordance with the invention would preferably be arranged so that when atmospheric pressure prevails in the exhaust chamber, that is, when the engine is not in operation, the opening for the exit of the exhaust from the chamber would be completely closed. As a result, on starting the engine with compressed air, the required pressure in the exhaust chamber would be quickly attained. For this purpose the starting air alone would suffice. This would afford a high initial charging pressure for the first charges of fuel to be ignited.

The invention may also be employed to advantage in engines which are subjected to a temporary or continuous overload. Its use obviates the necessity of constant manual adjustment of the throttling device with changes in the torque and speed. It is useful also in engines operating continuously under a constant overload and at a fixed speed. In such engines a stationary non-automatic throttling device controlling the exhaust from the engine would become fouled by accumulating grit and the like, with the result that the area for the exit of the exhaust would become restricted and cause a change in the exhaust pressure.

The invention will be better understood by reference to the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a sectional view showing a spring-controlled throttling valve in the outlet conduit.

Fig. 1ª is a similar view showing the throttling valve moved by a piston actuated by a fluid whose flow is controlled by the governor.

Fig. 2 is a sectional view of a construction employing a weight-loaded throttling device in one outlet passage and a positive hand-actuated throttling device in another outlet passage.

Fig. 3 is a sectional view of a construction in which a spring-actuated throttling device in the outlet conduit is subject to both automatic and manual actuation.

Fig. 4 is a sectional view of a construction employing a spring-actuated valve in which the tension of the spring may be adjusted.

Fig. 5 is a sectional view of a construction in which the position of the throttling device is regulated mechanically under the control of a piston which is subjected to the pressure in the exhaust chamber.

Fig. 6 shows a construction similar to that shown in Fig. 5 but having means for adjusting the controlling action of the piston.

Referring to these drawings, Fig. 1 shows a loaded throttling valve held yieldingly upon its seat by a spring. This spring-actuated valve is the only throttling element provided in connection with the exhaust chamber. The exhaust chamber is shown at 1 connected to the cylinder of the engine and the exhaust gases pass from the chamber 1 through the opening 2 and out by the exhaust pipe 3. The throttling valve is shown at 4 and it is held yieldingly upon its seat by a spring 5. Fig. 1ª shows a construction similar to that shown in Fig. 1 except that the valve spindle 6 of the throttling valve 4 has a piston 7 on its end which piston moves within a cylinder 8. The space behind the piston 7 receives compressed air from a pipe 9, the air being supplied from the air-receiver of the engine or from a separate source. The compressed air admission valve 10 is connected to the governor 11 through the connecting rods 12.

With the apparatus constructed as shown in Fig. 1 or Fig. 1ª, the pressure of the air with which the cylinder is charged and the back pressure within the receiver 1 are maintained at a predetermined point, this substantially constant pressure being determined upon by reference to the amount of increase in the output of the engine desired. The quantity of fuel admitted to the engine, would, of course, be varied in accordance with the power to be developed. The operation of the engine would be similar to the normal operation except that it takes place at a higher pressure level. This method of operation involves substantially constant back pressure of the exhaust and variation of the fuel supplied, the speed and the torque. The back pressure of the exhaust is maintained substantially constant by the valve member controlling the exit from the exhaust receiver, which valve member is held yieldingly upon its seat under a definite load. This definite load may be provided by a spring as in Fig. 1 or by a weight as in Fig. 2, or by fluid pressure as in Fig. 1ª.

In Fig. 2 a construction is shown wherein an automatic throttling device is employed and, in addition thereto, a throttling device which is actuated by hand or by the governor of the engine. The exhaust chamber is shown at 13 having a port 14 therein. Two conduits 15 and 16 lead from this chamber 13, the conduit 15 being for the exhaust which passes through the port 14. The manually actuated throttling element consists of a butterfly valve 18 operated by a lever 17. The automatic throttling is effected by a valve 19 controlling the port 14 and having a spindle 20 which is adapted to carry a plurality of weights 21. These weights form the load upon the valve controlling the outlet from the exhaust chamber instead of the spring shown for that purpose in Fig. 1. Compared with the preceding constructions, however, the construction shown in Fig. 2 possesses a disadvantage in the inertia of the mass of the weights; therefore, for high-speed engines the method of loading by means of weights is recommended to a less degree. Any of the forms of automatic controlling valves for regulating the pressure of the exhaust as herein shown may be provided with a positively operated valve in the manner indicated in Fig. 2 if desired, such positively operated valve being actuated either by hand or by the engine.

The automatic and positively operated valves may be combined in a single structure if desired. But in such a construction they should be capable of independent operation so that total closing may be effected only by the automatic valve in order to guard against an excessively high pressure in the exhaust receiver. Such a construction is shown in Fig. 3. In this figure, the exhaust gases from the chamber 22 pass through the opening 23 into the exhaust pipe 24. The throttling valve is shown at 25 and it is held yieldingly upon its seat by a spring 26. A bell-crank lever 27 has one end thereof entering an eye 30 in the stem of the valve so that by rocking this bell-crank lever on its pivot by means of a suitable connection thereto, the valve 25 may be positively raised from its seat. The end of the bell-crank lever has an amount of play in the eye 30 of the valve, which will permit of the desired automatic operation of the valve against the tension of spring 26. For this purpose, a stud 61 is provided in position to limit the movement of bell-crank 27 in one direction. The lever 27 may be mounted upon an eccentric 28 so that by shifting the position of the eccentric by means of a connection 29 the lever 27 may be withdrawn from coaction

with the eye 30 and the manual operation of the valve thus prevented. Also, the device may be so constructed that a complete closing of the valve is precluded by having the eye 30 coact with the frame of the valve to form a stop.

Fig. 4 shows a loaded throttling device, the loading of which is made to vary in accordance with the turning-moment or torque of the engine. The exhaust chamber 31 has a port controlling an outlet through pipe 32 and this port is controlled by a valve 33, which is held yieldingly upon its seat by a spring 34. The spring 34 is initially compressed to the required extent by adjustment of the cap 35 for the spring. This adjustment is effected by means of the spindle 36 of the cap 35 which spindle is splined to the frame in which it is mounted. The spindle is shifted lengthwise by a wheel 37 mounted in the frame and having a threaded opening which receives the threaded portion of the spindle 36. The wheel 37 is actuated by a wheel 39 on a shaft 38 and the latter is turned in accordance with the speed or the load on the engine so as to vary the tension of the spring 34. The required rotation of shaft 38 may be provided for in any suitable manner. Thus, the shaft may be made to turn in accordance with changes in the quantity of fuel supplied in the engine, or the position of the fuel supply lever, or the quantity of scavenging air. By operating in this way, varying the load on the valve controlling the exhaust with changes in the supply of fuel to the engine, a saving in power consumed in the pumps is effected.

In the construction shown in Fig. 5, the gases pass out of the exhaust chamber 40 through the port 41 and the pipe 42. A piston is shown at 43 subjected to the pressure existing within the exhaust chamber 40. The piston 43 is positioned by a spring 44 of definite tension. If the pressure in the receiver is greater than the load on the valve, the piston moves outward and by means of the lever 45 the sleeve 46 is moved and pressed against the friction-disk 47. This disk 47, as well as the opposite disk 48, is driven by the gear 49 from any suitable source of power. The sleeve 46 is thus rotated and also the shaft 50 on which sleeve 46 is splined. The rotation of shaft 50 affects axial movement of a nut 51 threaded on shaft 50 and connected by a bell-crank lever 52 to the throttling device 53 which is, therefore, opened more and more. This movement of valve 53 is continued until the pressure in the receiver 40 becomes equal to the spring load 44 on piston 43. When this point is reached, the sleeve 46 disengages disk 47 and the opening movement of valve 53 terminates. On the other hand, if the pressure in the receiver 40 drops below the spring load 44, the sleeve 46 engages with the positively rotating friction-disk 48, with the result that the valve 53 is moved toward the closed position. When the piston is loaded by a spring as shown in Fig. 5, the spring must be so set that its tension is balanced by the desired pressure in the receiver 40 when the sleeve 46 is in the neutral position.

Fig. 6 shows a construction in which the features shown in Figs. 4 and 5 are combined. The tension of the spring 55 loading the piston 54 can be altered by changing the position of the cap 56 by means of the hollow spindle 57. This spindle is exteriorly threaded, is splined in the frame in which it is mounted and has a wheel 58 threaded thereon. This wheel is rotated by the shaft 59 in accordance with the power developed by the engine. This construction is similar to that of the adjustable throttling device shown in Fig. 4. The stem of the piston 54 passes through the hollow shaft 57 and is connected to a lever 60. The sleeve moved by this lever 60 and all of the parts associated therewith are similar to the corresponding parts shown in Fig. 5, so that an exhaust back pressure depending upon the load or torque is obtained.

I wish it understood that the utility of the invention is not confined to any special type of two-cycle internal combustion engines, but that, on the contrary, it is applicable to various types of two-cycle gas engines and oil engines whether operated by the explosion of the gaseous mixture or by more or less slow combustion of the mixture. Furthermore, the constructions herein illustrated and described may be modified in numerous respects without departing from the spirit of my invention, and all such modifications I consider as within the scope of the invention.

I claim:

1. A two-cycle internal combustion engine having means for increasing the power developed by the engine by automatically controlling the exhaust from the cylinder of the engine comprising a receiver connected to the exhaust outlet from the cylinder and yielding means for maintaining a predetermined pressure above atmospheric pressure within the receiver with all loads on the engine and at all speeds of revolution of the engine shaft; substantially as described.

2. A two-cycle internal combustion engine having means for increasing the power developed by the engine by automatically controlling the exhaust from the cylinder of the engine comprising a receiver connected to the exhaust outlet from the cylinder, yielding means for maintaining a predetermined pressure above atmospheric pressure within the receiver with all loads on the engine and at all speeds of revolu-

tion of the engine shaft, and means for effecting an adjustment to change the said predetermined pressure; substantially as described.

3. A two-cycle internal combustion engine having means for increasing the power developed by the engine by automatically controlling the exhaust from the cylinder of the engine comprising a receiver connected to the exhaust outlet from the cylinder, yielding means for maintaining a predetermined pressure above atmospheric pressure within the receiver with all loads on the engine and at all speeds of revolution of the engine shaft, and means for automatically varying said predetermined pressure in accordance with the power developed by the engine; substantially as described.

4. A two-cycle internal combustion engine having means for increasing the power developed by the engine comprising devices for automatically controlling the exhaust pressure in the cylinder with all loads and at all speeds of revolution consisting of means interposed in the path of the exhaust from the cylinder for maintaining a predetermined pressure above atmospheric pressure, said means being subjected to a load to hold it yieldingly in a definite position; substantially as described.

5. A two-cycle internal combustion engine having devices for automatically controlling the exhaust pressure in the cylinder with all loads and at all speeds of revolution comprising means interposed in the path of the exhaust from the cylinder for maintaining a predetermined pressure above atmospheric pressure, said means being subjected to a load to hold it yieldingly in a definite position, and means for automatically varying said load under the control of the engine; substantially as described.

6. A two-cycle internal combustion engine having means for controlling the exhaust from the cylinder thereof comprising a receiver connected to the exhaust outlet from the cylinder, a valve controlling an outlet from said receiver, means for subjecting the valve to pressure to hold it yieldingly in a predetermined position and means for varying the pressure to which the valve is subjected in accordance with the power developed by the engine; substantially as described.

7. An internal combustion engine having means for controlling the exhaust from the cylinder thereof, comprising a receiver connected to the exhaust outlet from the cylinder, a valve controlling an outlet from the receiver, means for positioning the valve, a yielding member communicating with the receiver and responsive to the pressure existing therein and mechanism controlled by the position of said yielding member for actuating the valve positioning means; substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

HUGO JUNKERS.

Witnesses:
EMIL WERGIEN,
HERMANN FISCHER.