

No. 675,796.

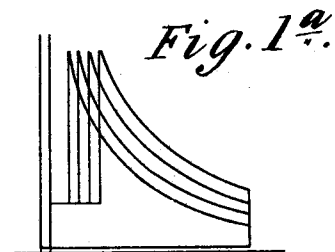
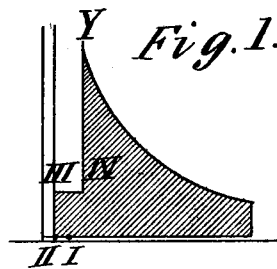
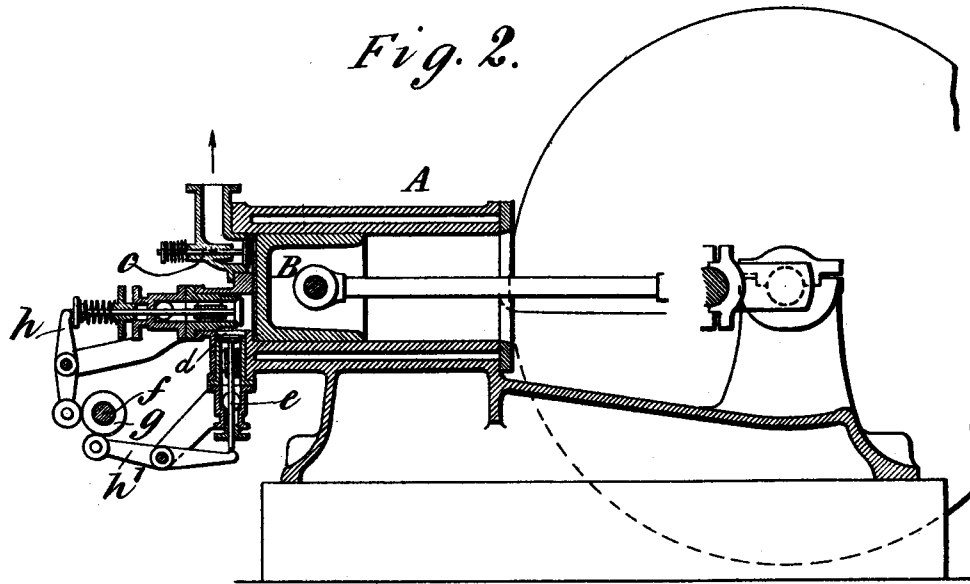
Patented June 4, 1901.

H. SCHUMM & M. MÖNZELL.
TWO-STROKE CYCLE GAS MOTOR ENGINE.

(Application filed Dec. 11, 1899.)

(No Model.)

2 Sheets—Sheet 1.



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2 Sheets—Sheet 2.

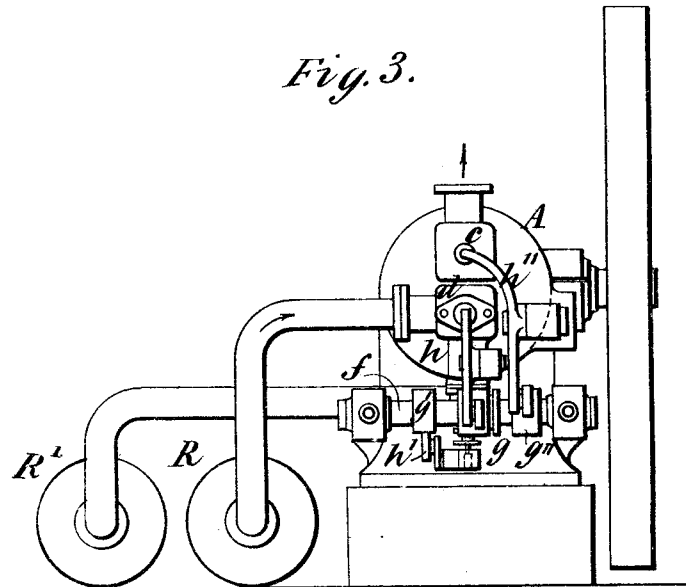


Fig. 3.

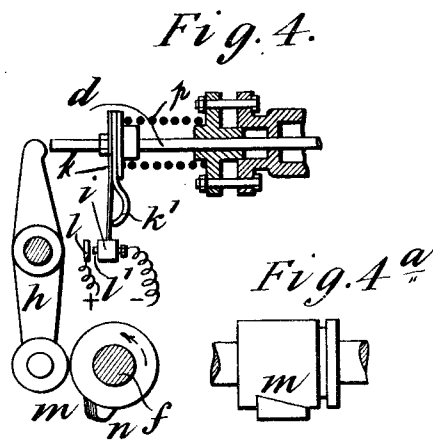


Fig. 4.

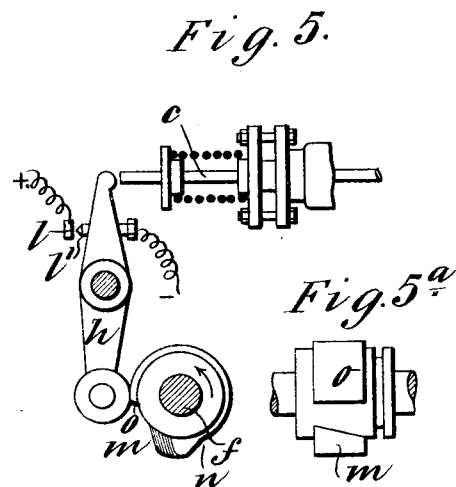


Fig. 5.

Witnessed
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att'y

UNITED STATES PATENT OFFICE.

HERMANN SCHUMM, OF BONN, AND MAX MUNZEL, OF MULHEIM, GERMANY, ASSIGNORS TO THE OTTO GAS ENGINE WORKS, OF PHILADELPHIA, PENNSYLVANIA.

TWO-STROKE-CYCLE GAS-MOTOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 675,796, dated June 4, 1901.

Application filed December 11, 1899. Serial No. 739,944. (No model.)

To all whom it may concern:

Be it known that we, HERMANN SCHUMM, residing at 85 Coblenzerstrasse, Bonn, and MAX MÜNDEL, residing at Deutzerstrasse, Mulheim, in the Province of the Rhine, Germany, citizens of Germany, have invented a certain new and useful Improved Method of Working Two-Stroke-Cycle Gas-Motor Engines, (for which application has been made for a patent in Great Britain, dated November 21, 1899, No. 23,235,) of which the following is a specification.

This invention relates to certain new and useful improvements in two-stroke-cycle gas-motor engines, whereby homogeneous compressed charges of gas-and-air mixture are introduced and ignited within the working cylinder after this has been cleared of combustion residues and still-burning gas particles, whereby an absolutely reliable ignition is insured, while the heat generated by the combustion is utilized to the greatest possible extent.

According to this invention there is forced through the engine-cylinder (which has no compression-space) shortly before the piston reaches the inner dead-center a scavenger charge of air, which carries with it the remaining combustion-gases and any particles of still-burning gas mixture and discharges the same through the discharge-valve. On the piston arriving at the dead-center the discharge-valve and scavenger-air valve are closed and a previously-formed homogeneous mixture of gas and air is introduced into the cylinder through a charging-valve while the piston is performing a certain portion of its outstroke, after which, the charging-valve being closed, the charge is ignited and the expansive action due to the heat generated causes the piston to complete its outstroke in doing work.

By constructing an engine to obtain the results set forth in the foregoing paragraph some of the objectionable features heretofore existing in two-stroke-cycle gas-motor engines are overcome, for the reason that the premature ignition of the charges is avoided, which frequently occurs with the known arrangements, owing to the entering combus-

tible charge becoming fired by residual burning gas particles or by highly-heated combustion residues of the previous charge. On account of this premature ignition it was, generally speaking, not practically possible to work two-stroke motors by means of previously-formed homogeneous explosive mixtures, as the store thereof contained in the reservoir would be liable to be exploded by such premature ignitions. The two parts of the mixture—namely, the air and gas—had therefore to be stored separately in different reservoirs or in the same reservoir without being mixed before entering the cylinder, and owing to the shortness of the charging period they had not time to mix thoroughly, so as to insure a reliable ignition and rapid combustion. The present improved construction of gas-motor engine effectually avoids the liability to premature ignition by causing the combustion residues and particles of burning gas to be swept out of the cylinder by a scavenger charge of air, enabling explosive charges to be used of a perfectly homogeneous nature previously formed outside the cylinder. On the other hand, in the case of those two-stroke gas-motors in which a scavenger charge of air has already been used for clearing out a compression-space existing in the cylinder behind the piston when at the end of instroke differ essentially from the present improved method, both as to the manner of forming the charges and as to the volume of the scavenger charge of air required. With these motor-engines the ignition of the charges is effected when the piston arrives at the inner dead-center, so that the introduction of the charges must necessarily be effected already during the compression period. Consequently not only the compression-space, but also a considerable portion of the space passed through by the piston, requires to be filled with clearing-air or air for combustion into which the gas then enters, and therefore the mixing of the gas and air constituting a combustible charge can only take place in the cylinder itself, while, as already stated, according to the present invention the charge enters the cylinder already in an intimately-

mixed condition and is not there mixed with any appreciable further quantity of air. Furthermore, with the two-stroke-cycle gas-motor engines now in general use a considerable quantity of air is necessary for the scavenger charge, as this has to force out a large volume of combustion-gases contained in the compression-space and a large portion of the cylinder. The scavenger charge remaining in the cylinder no doubt serves as the air-supply for the next explosive charge, but owing to the unavoidable mixture of the scavenger charge with the combustion-gases a very large volume of air must be employed in excess of that required for the explosive charge if all the combustion-gases are to be expelled. According to the present invention, on the other hand, only a comparatively small quantity of air is required for the scavenger charge—namely, only slightly more than the volume represented by the small dead-space or clearance between piston and cylinder end—so that a saving is effected both as to work done and weight of engine. Lastly, by the improved construction of engine hereinafter referred to a very energetic cooling and clearing of the piston's surface is effected, as the scavenger charge has to force its way at a high speed through the very narrow clearance or dead-space between piston and cylinder end, whereas in the gas-motor engines of this class now in general use the scavenger charge has to pass through the before-mentioned large capacity of the compression-space and part of cylinder, in which it consequently only travels at a slow speed and with imperfect contact for cooling purposes.

On the accompanying drawings, Figure 1 shows an indicator-diagram of the working of the engine, and Fig. 1^a shows indicator-diagrams for variable amounts of work. Figs. 2 and 3 show, respectively, a diagrammatic longitudinal section and end view of a gas-motor engine according to the present invention. Figs. 4, 4^a, 5, and 5^a show detached details.

A is the engine-cylinder; B, the piston; C, the discharge-valve; d, the admission or charging valve for the explosive charge; e, the valve for the scavenger-air charge; R, the reservoir for the compressed explosive mixture, and R' the reservoir for the compressed clearing air. Toward the end of the discharging period (point I of diagram Fig. 1) the air-valve e is opened and the compressed air entering from the reservoir R' drives the remaining combustion products out through the open discharge-valve c. At the dead-center (II) both the said valves are closed. On the other hand, the charging-valve d is opened and admits compressed explosive mixture into the cylinder during the first part of the piston's outstroke, (III to IV of diagram,) which charge is ignited directly at the point IV—that is, directly after closing the charging-valve. The pressure in the cylinder then suddenly rises

to point V and then gradually decreases, according to the expansion curve V to VI during the remainder of the piston's outstroke, after which the discharge valve is opened.

The valves are actuated in the arrangement shown by means of a way-shaft f, driven from the engine-shaft and having cam-disks g g' g'', which effect the opening of the valves through rollers and levers h h' h''. The valve-gear may, however, be arranged in any other suitable known way for effecting the above-described operations.

The regulation of the gas-motor engine is effected by varying the duration of the admission of explosive mixture, and consequently the volume of each explosive charge. Fig. 1^a shows a series of indicator-diagrams varied in this manner for producing variable amounts of work. With this arrangement the ignition of the charges must be made dependent upon the working of the charging-valve in such manner that the ignition in every case occurs immediately after the closing of the valve. Figs. 4 and 4^a and 5 and 5^a show two different arrangements for this purpose. In the arrangement at Fig. 4 there is combined with the stem of the charging-valve d, through the medium of a blade-spring k, a body i, which is ordinarily held by a stop k' in a definite position relatively to the valve-stem, in which position a contact-piece l', carried by the body i and connected to one part of an electric circuit, is kept out of contact with the fixed contact-piece l, connected to the other part of the circuit.

The lever h of the charging-valve is actuated by means of a movable cam m n, with inclined following face m, as shown in side view at Fig. 4^a, and controlled by a governor in the known manner. When the charging-valve after being held open by lever h for a length of time determined by the position of cam m n is closed by the action of its spring p, the body i in moving with the valve-spindle continues to move to the left hand by reason of the impetus imparted to it after the valve has closed, and thereby causes contact to be made between l and l', thus closing the electric circuit, in which is included the igniting device, and effecting the ignition of the charge in the cylinder by an electric spark in the well-known manner.

In the arrangement at Fig. 5 the cam m n for actuating the charging-valve has joined to it a lower long cam n o, which extends almost completely around the cam-boss, leaving only a small portion of the latter free. With the lever h of the charging-valve is connected an electrical contact l l', which is only closed when the roller of the lever moves over the free part m o of the boss, the circuit being open as long as the roller runs over the cams o n or m n. Consequently immediately after the roller has run off the inclined following side m of the charging-cam m n the lever h causes the contacts l l' to close the

electric circuit and effect the firing of the charge, the circuit being broken again as soon as the roller passes onto the cam *on*.

With the motor-engine can be combined any suitable known arrangement of force-pump for forcing the gas-and-air mixture or a separate gas-and-air pump for producing and compressing the mixture of gas and air, or the said compressed gaseous mixture can be produced independently of the motor-engine. The only essential feature in this respect is the interpolation of a reservoir R for compressed gas-and-air mixture between the engine-cylinder and the force-pump in order to enable a thoroughly homogeneous mixture of the gas and air to be effected before entering the cylinder. The said homogeneous mixture may contain, in addition to combustible gas and air, any other suitable gas of a neutral or inert nature.

The compressed store of clearing-air in the reservoir R' will require to be replenished either continuously during the working or from time to time by means of a special air-pump driven by the engine or separately therefrom. If, as above stated, there be provided separate pumps for supplying the compressed air and compressed gases required for the explosive mixture stored in R, the air force-pump for this purpose may be made of such a capacity as to supply not only the air required for the combustible mixture, but also that for the scavenger charges, in which case a special pump for the latter would be dispensed with.

It will be evident that the special reservoir R' for the clearing-air and the charging-pump therefor might be dispensed with and the necessary compressed clearing-air be supplied by a fan or blower working with requisite pressure.

Having thus described the nature of this invention and the best means we know of carrying the same into practical effect, we claim—

1. In a two-stroke-cycle gas-motor having no compression-space in the cylinder, means for forcing a scavenger charge of air into the space intervening between the piston and cyl-

inder of said engine just before the piston reaches the inner dead-center, means for operating a charging-valve for introducing a charge of previously intimately-mixed gas and air to the cylinder during a portion of the out-stroke of the piston, and means for firing said charge when said valve is closed.

2. In a two-stroke-cycle gas-motor having no compression-space in the cylinder, means for forcing a scavenger charge of air into the space intervening between the piston and cylinder just before the piston reaches the inner dead-center, means for opening an admission-valve for the explosive mixture when the piston is home, means for closing said valve at various points of the stroke of the piston, and means for igniting the explosive charge at various points of the stroke of the piston when said admission-valve is closed.

3. In a two-stroke-cycle gas-motor having no compression-space in the cylinder, means for blowing out the products of combustion when the piston is all but home, an admission-valve for the explosive mixture, means for opening said valve when the piston is home, means for closing said valve at various points of the stroke of the piston, and means for igniting an explosive charge at various points of the stroke of the piston.

4. In a two-stroke-cycle gas-motor having no compression-space in the cylinder, an exhaust-valve, operating means therefor, means for blowing out the products of combustion when said valve is opened when the piston is all but home, an admission-valve, means for opening said valve when the piston is at home, means for closing said valve at various points of the stroke of the piston, and means for igniting an explosive charge at various points of the stroke of the piston.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

HERMANN SCHUMM.
MAX MÜNZEL.

Witnesses:

WILLIAM H. MADDEN,
GEORG LEHMANN.