

J. MUCHKA.
 PRODUCTION OF GAS MIXTURES OF NITROGEN AND CARBON DIOXIDE THAT ARE DEFICIENT
 IN OXYGEN.

APPLICATION FILED JAN. 6, 1921.

1,406,479.

Patented Feb. 14, 1922.

2 SHEETS—SHEET 1.

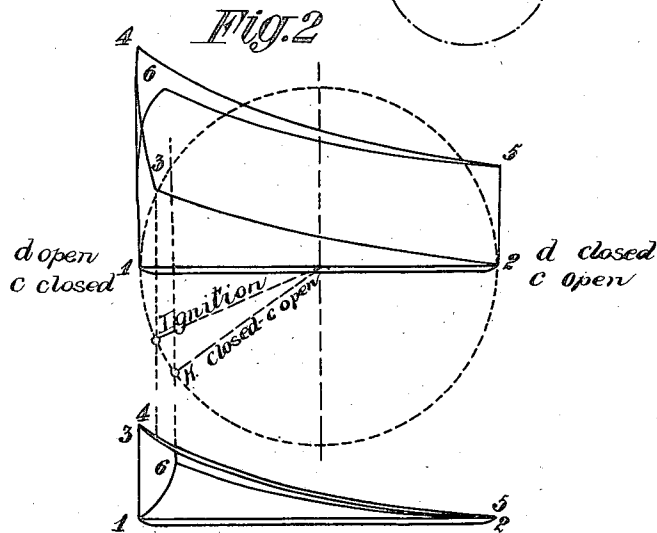
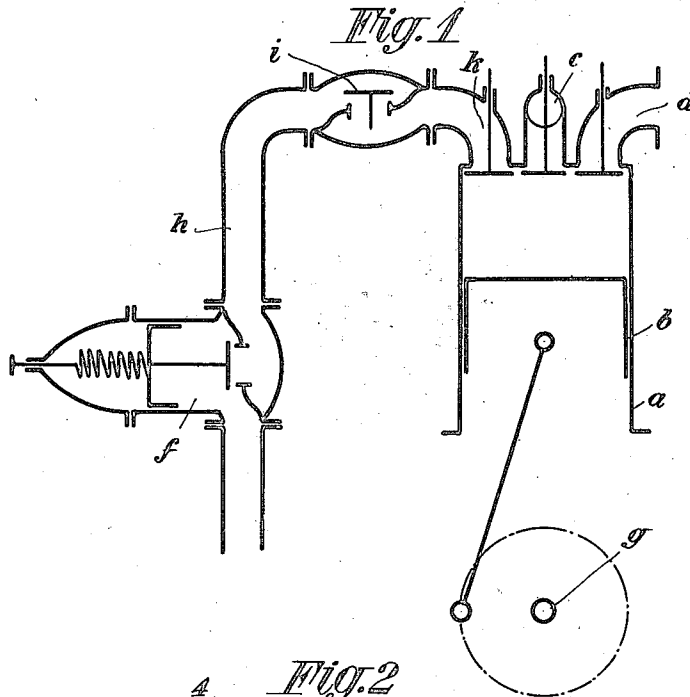


Fig. 3.

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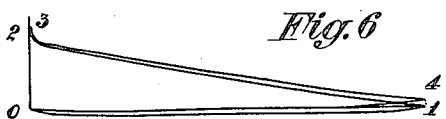
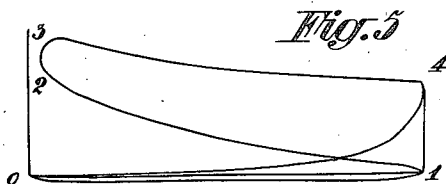
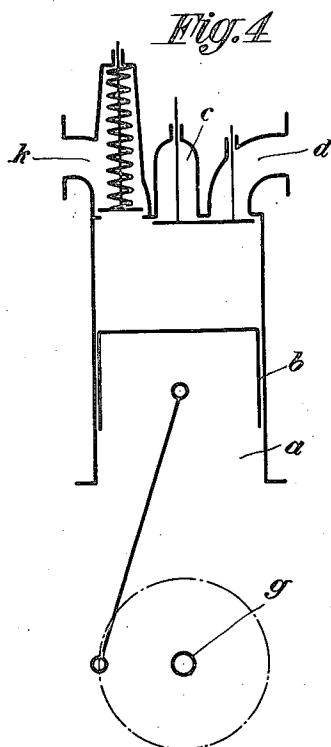
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UNITED STATES PATENT OFFICE.

JOSEF MUCHKA, OF VIENNA, AUSTRIA.

PRODUCTION OF GAS MIXTURES OF NITROGEN AND CARBON DIOXIDE THAT ARE DEFICIENT IN OXYGEN.

1,406,479.

Specification of Letters Patent. Patented Feb. 14, 1922.

Application filed January 6, 1921. Serial No. 435,557.

To all whom it may concern:

Be it known that I, JOSEF MUCHKA, residing at 39 Wallgasse, Vienna VI, Austria, have invented certain new and useful Improvements in and Relating to the Production of Gas Mixtures of Nitrogen and Carbon Dioxide That are Deficient in Oxygen, (for which I have filed applications in Austria, Dec. 3, 1917; Germany, Dec. 31, 1917,) of which the following is a specification.

Gas mixtures of nitrogen and carbon dioxide which are deficient in oxygen are used industrially in installations for the "fire-proof" and "explosion proof" storage of highly inflammable liquids such as petrol, benzol, methylated spirits and the like, for filling the hollow spaces in the storage vessel above the liquid. These gas mixtures are obtained with advantage during the combustion of a hydrocarbon in an internal combustion engine while work is performed. The work obtained is utilized for storing the waste gases in a compressed state in a collecting vessel.

Protective gas producers of this type are known and consist substantially of an internal combustion engine and a gas compressor driven by it. Work is performed in the combustion cylinder while in the compression cylinder the work performed is converted into compression work.

The subject of the present invention is a method and an apparatus for the production of gas mixtures that are deficient in oxygen, in which the combustion of the fuel mixture and the compression of the burnt gases is effected in a single cylinder. The invention consists in delivering the exhaust gases in a compressed state from the working cylinder of an internal combustion engine, through a pressure regulator into a collecting vessel.

For carrying the method into effect an internal combustion engine is used which, in addition to the ordinary exhaust valve, is fitted with a second exhaust valve which coacts with a loading device and is connected up to a collecting vessel by means of delivery pipe.

In the drawing two constructional examples of the apparatus for carrying out the method in accordance with the invention are shown diagrammatically along with the indicator diagrams belonging thereto.

In the constructional form shown in Figures 1—3, *a* is the cylinder of the internal

combustion engine, *b* is the piston, *g* the crank shaft, *c* the suction valve and *d* the usual exhaust valve. In addition to this exhaust valve, an exhaust valve *k* is provided to which a pipe *h* is connected leading to a cooling coil (not shown) and from thence to a collecting vessel, likewise not shown. A non-return valve *i* is interposed in the pipe *h* and behind this valve is fitted a pressure regulator *f* which serves for the purpose of maintaining a definite gas pressure in the pipe *h*.

In the constructional form shown in Figures 4—6, the engine is also provided with two exhaust valves, namely a normal exhaust valve *d* and a spring loaded exhaust valve *k*. The two valves *k* and *d*, however, may also be positively controlled in a suitable manner.

In the constructional form shown in Fig. 1, contrary to the ordinary mode of operation, the usual exhaust stroke of the piston is utilized as the compression stroke, whereby the gases, which were expanded during the expansion stroke are again compressed and conveyed past the valve *k* by way of a suitably loaded non-return valve *i* and the pressure regulator *f* into a cooler and thence into a collecting vessel.

Shortly before the end of the compression period of the engine, i. e. before the commencement of the next following suction period the exhaust valve *k* is closed and the second exhaust valve *d* opened in order to free the compression space of the engine completely from the burnt gases and to allow the pressure thereof to drop, so that during the next following suction period fresh fuel mixtures can be sucked in without reducing the volumetric efficiency of the suction stroke.

Behind the exhaust valve *k*, in the pipe *h*, a pressure is always maintained by means of the pressure regulator *f* which pressure is greater than the compression pressures of the compressed combustible working gases, this pressure being constantly maintained by the regulator *f* at a pressure which is higher than the maximum compression pressure of the compressed combustible gas mixture.

Should a misfire take place, a combustible gas mixture, i. e. a gas mixture which is rich in oxygen, can never be forced into the collecting vessel because the non-return valve *i* cannot be opened. The protective

gas apparatus will therefore be put out of action when the production of a protective gas deficient in oxygen is not possible.

Figure 2 shows the diagram of the engine when working normally, i. e. when delivering waste gases which are deficient in oxygen, and

Figure 3 the diagram in the case of a misfire.

At 1 the suction period commences, at 2 the compression of the charging mixture, at 3 the highest compression pressure is reached. Ignition of the gas mixture now takes place; 4 being the commencement of the expansion stroke, while at 5 the end of the expansion is reached. At this point commences the compression of the combustion gases which are conveyed past the first exhaust valve *k* by way of the non-return valve *i* through the pipe *h* into the collecting vessel.

After the flowing off of the compressed gases the valve *k* closes and the normal exhaust valve *d* opens whereby, the waste gases of the engine are completely expanded and blown out, so that at the commencement of the suction stroke at 1 charging mixture can again be sucked in.

In the diagram according to Figure 3, it is shown that in the case of a misfire the following compression during the expulsion stroke is not capable of overcoming the pressure obtaining in the pipe behind the non-return valve *i*; the compressed unburnt gases can only escape through the second exhaust valve *d* into the atmosphere.

The mode of operation of the constructional form of the engine according to Figure 4 differs from that of the constructional form shown in Fig. 1 only in this that during the explosion period the spring loaded exhaust valve *k* opens at a definite pressure corresponding to the spring loading and allows a definite amount of protective gas to flow off into the collecting vessel at a pressure corresponding to the spring load.

As compared with the protective gas engine in Figure 1, in the engine according to Figure 4 the work performed is of course less owing to the lower pressures during the expansion period, the work performed by the engine can be regulated by adjusting the spring loading of the valve *k* in such a manner that the work performed is sufficient to compress the sucked in combustible gas mixtures properly. The two diagrams shown in Figures 5 and 6 illustrate the cycle.

In the case of a misfire the gas will not reach the pressure necessary to overcome the spring loading of the valve *k* and in consequence will be prevented from flowing off into the protective gas collecting vessel.

What I claim is:

1. An apparatus for the production of gas mixtures that are deficient in oxygen, comprising an internal combustion engine and means for delivering the exhaust gases from the working cylinder of the engine at a higher pressure than the pressure of the combustible gas mixture at the end of the compression stroke of the engine.

2. An apparatus for the production of gas mixtures that are deficient in oxygen, comprising in combination, an internal combustion engine, a collecting vessel and a pressure regulator for delivering the exhaust gases from the working cylinder of the engine into the collecting vessel at a higher pressure than the pressure of the combustible gas mixture at the end of the compression stroke of the engine.

3. A method for the production of gas mixtures that are deficient in oxygen which consists in compressing the burnt charge in the working cylinder of an internal combustion engine at the end of the expansion stroke to a higher pressure than the pressure of the combustible gas mixture at the end of the compression stroke and conveying the compressed gases from the working cylinder through a pressure regulator into a collecting vessel.

4. An apparatus for the production of gas mixtures that are deficient in oxygen, comprising in combination, the working cylinder of an internal combustion engine, two exhaust valves provided on the said cylinder, a collecting vessel, a pipe connecting the collecting vessel with one of the exhaust valves and means actuated by gas pressure for preventing the overflow of unburnt gases from the working cylinder to the collecting vessel.

5. An apparatus for the production of gas mixtures that are deficient in oxygen comprising in combination, the working cylinder of an internal combustion engine, two exhaust valves provided in the said cylinder, a collecting vessel, a pipe connecting the collecting vessel with one of the exhaust valves, a pressure regulator arranged behind the said exhaust valve and actuated by the combustion gases escaping through the said exhaust valve, and means cooperating with the pressure regulator for producing a pressure which is higher than the normal compression pressure of the working cylinder as and for the purpose set forth.

In testimony whereof I have signed my name to this specification.

JOSEF MUCHKA.

Witnesses:

HUGO KEIK,
ANTON KUBIK.