

N° 16,072



A.D. 1893

Date of Application, 25th Aug., 1893—Accepted, 28th Oct., 1893

COMPLETE SPECIFICATION.

Improvements in the Method of Producing the Explosive Mixture in Hydrocarbon Engines.

I, WILHELM MAYBACH, of Cannstatt, in the Kingdom of Württemberg, German Empire, Engineer do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

5 My invention relates to hydrocarbon-engines, in which the explosive mixture is produced from air and a liquid hydrocarbon, as petroleum, ligroine, benzine, naphtha, or the like, and my improvements in the composing or forming of this mixture relate to the manner, in which the liquid hydrocarbon is moved and dispersed by, and thoroughly mixed with the air sucked by the working-piston into
10 the cylinder through a special feeding-channel, into which a nozzle supplying the hydrocarbon extends in any direction and at any place, and the object of my improvements is to produce a mixture of never-varying composition, irrespective of the speed of the engine as well as of that of the piston in different parts of the path of this latter.

15 In order to make my invention more clear, I refer to the accompanying drawing, in which similar letters denote similar parts, and in which:

Fig. 1 is a vertical section through the mixing- and feeding-device of a hydrocarbon-engine working according to my invention.

Fig. 2 is a modification of said device, and

20 Fig. 3 is a second modification of the same.

The liquid hydrocarbon is contained in the basin *a* and is led from this basin to the mixing channel *b* by the pipe *c*, at the end of which latter a nozzle *c*¹ is provided. The liquid in basin *a* is kept in the same height of level by a swimmer *d*, which admits the influx of fresh liquid through tube *e* in a manner easily to be
25 understood from the drawing. Thus, the level of the liquid contained in pipe *c*, below nozzle *c*¹, is constantly kept in the same or very nearly the same height, which forms a moment of utmost importance, as will be more clearly to be seen hereinafter.

The entrance of air into the cylinder *f* takes place through the inlet- or suction-
30 valve *g* and the channel *b b*¹, the part *b* of which latter forms the mixing-room already mentioned and the entrance of hydrocarbon into the mixing room *b* takes place through the nozzle *c*¹. The communication *b*² between *b* and *b*¹ is narrowed, and the dimensions of the communication *b*² and the nozzle *c*¹ correspond to the ratio of mixture of the two bodies employed air and hydrocarbon.

35 If, now, the engine is running, air is sucked by the piston into the cylinder through channel *b b*¹, and, on account of the narrowed communication *b*², a vacuum or partial vacuum is established within the mixing-room *b*. By reason of this vacuum, a certain quantity of the liquid hydrocarbon is sucked into chamber *b* out of nozzle *c*¹, and is squirted there at the opposite wall as well as by the air, the
40 latter flowing in with a velocity corresponding to the speed of the piston. Supposed, this speed is low, the rarefaction of the air will also be low, but will last a longer time, and, therefore, the injection of the liquid hydrocarbon will occur with little force, but with long duration. If, on the other hand, the speed of the piston is high, also the rarefaction will be high, and will last but a short time;
45 therefore, the injection of the liquid will occur with great force, and with short duration. Just the same accordance is existing with regard to the degree of rarefaction and the velocity of the piston in different parts of its path, and it is, consequently, the proportion between both the bodies forming the explosive

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mixture exactly the same under all conditions, and this the more, as the level of the liquid within nozzle *c* remains on the same height.

When employing heavy liquid hydrocarbons for the production of the explosive mixture, it is necessary to heat the wall of chamber *b*, against which the former is thrown, or to heat the whole of said chamber in order to effect a quicker reduction into vapour. This may be performed best by the construction shown in Fig. 3, in which the escaping hot combustion-gases are led against or around chamber *b* by the channel *h*, at the end of which the outlet-valve *i* is arranged.

Further, in order to regulate the engine, the passage for the air may be altered in such a manner, that either a part or the whole of the air takes another way, than through communication *b*², so that but a slight or no rarefaction at all is produced within the mixing-chamber, and consequently, but little or no hydrocarbon is sucked into it.

Such an arrangement is shown in Fig. 2, in which, besides the connection *b*², a second connection *b*³ is established between the parts *b* and *b*¹, which, under normal conditions, is closed by a valve *k*. This valve may be actuated automatically from the regulator by rod *l*, and also from hand by screw *m*, so that, by screwing this screw down onto valve *k*, the latter may be opened. The air, therefore, will not be rarefied and no liquid will be sucked into chamber *b*, so that no combustible or explosive mixture can be formed, and the engine stops.

I wish it to be understood, that I do not confine myself to the employment of but one nozzle, as *c*¹, or but one narrowed inlet as *b*², but I may use also several nozzles and several inlets, and also special inlets for air without nozzles, as for instance at *b*⁴ in Fig. 3.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon by the air sucked by the working-piston, substantially as described.
2. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working piston through a mixing-chamber *b*, substantially as described.
3. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ extending into a mixing-chamber *b* by the air sucked by the working piston through said mixing-chamber, substantially as described.
4. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ forming end of supply-pipe *c*, and extending into connection *b*² between air-inlet channel *b*¹ and mixing chamber *b*², said sucking being performed by the air sucked by the working-piston through said connection *b*², substantially as described.
5. The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹, fed from supply-basin *a* by pipe *c* and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*, said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, substantially as described.
6. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ fed from supply-basin *a* by pipe *c* and extending into connection *b*² between air-inlet-channel *b*¹ and mixing chamber *b*, said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, and the level of the hydrocarbon within basin *a* being kept on the same height by a swimmer-valve *d*, acting on the main-supply-tube *e*, substantially as described.

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7. The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working piston through a mixing-chamber *b*, the latter being heated by the combustion-gases, substantially as described.

5 8. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ extending into a mixing-chamber *b*, by the air sucked by the working-piston through said mixing-chamber, the latter being heated by the combustion-gases substantially as described.

10 9. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ forming end of supply-pipe *c* and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*, said sucking being performed by the air sucked by the working-piston through said connection *b*², the mixing-chamber being heated by the combustion-gases, substantially as described.

15 10. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ fed from supply-basin *a* by pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*, said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, the latter being heated
20 by the combustion-gases, substantially as described.

25 11. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ fed from supply-basin *a* by pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*, said sucking being performed by the air sucked by the working-piston
30 through said channel *b*¹, connection *b*², mixing-chamber *b*, the level of the hydrocarbon within basin *a* being kept on the same height by a swimmer-valve *d*, acting on the main-supply tube *e*, the mixing-chamber being heated by the combustion-gases, substantially as described.

35 12. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working piston through a mixing-chamber *b*, the latter having opening *b*³ with valve *k*, substantially as described.

40 13. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹, extending into a mixing-chamber *b* by the air sucked by the working-piston through said mixing-chamber, the latter having opening *b*³ with valve *k*, substantially as described.

45 14. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ forming end of supply-pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*, said sucking being performed by the air sucked by the working-piston
50 through said connection *b*², the mixing-chamber having opening *b*³ with valve *k*, substantially as described.

55 15. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ fed from supply-basin *a* by pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*², said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, the latter having opening *b*³ with valve *k*, substantially as described.

16. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ fed from supply-basin *a* by pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*², said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, the level of the hydrocarbon within basin *a* being kept on the same height by a swimmer-valve *d*, acting
55 on the main-supply-tube *e*, the mixing-chamber having opening *b*³ with valve *k*, substantially as described.

17. The method of producing the explosive mixture in hydrocarbon-engines,

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consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working piston through a mixing-chamber *b*, the latter being heated by the combustion-gases, and having opening *b*³ with valve *k*, substantially as described.

18. The method of producing the explosive mixture in hydrocarbon-engines, 5
consisting in sucking liquid hydrocarbon out of a nozzle *c*¹, extending into a mixing-chamber *b* by the air sucked by the working-piston through said mixing-chamber, the latter being heated by the combustion-gases, and having opening *b*³ with valve *k*, substantially as described.

19. The method of producing the explosive mixture in hydrocarbon-engines, 10
consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ forming end of supply-pipe *c*, and extending into connection *b*² between air-inlet channel *b*¹ and mixing-chamber *b*, said sucking being performed by the air sucked by the working-piston through said connection *b*², the mixing chamber being heated by the combustion-gases, and having opening *b*³ with valve *k*, substantially as described. 16

20. The method of producing the explosive mixture in hydrocarbon-engines, 16
consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ fed from supply-basin *a* by pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*², said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, the level of the hydro-carbon within basin *a* being kept on the same height by a swimmer-valve *d*, acting on the main-supply-tube the mixing-chamber being heated by the combustion-gases, the latter having opening *b*³ with valve *k*, substantially as described. 20

Dated this 21st day of August 1893.

WILHELM MAYBACH, 25

By Geo. H. Rayner,
37, Chancery Lane, London, W.C., Agent for the Applicant.

Fig. 1.

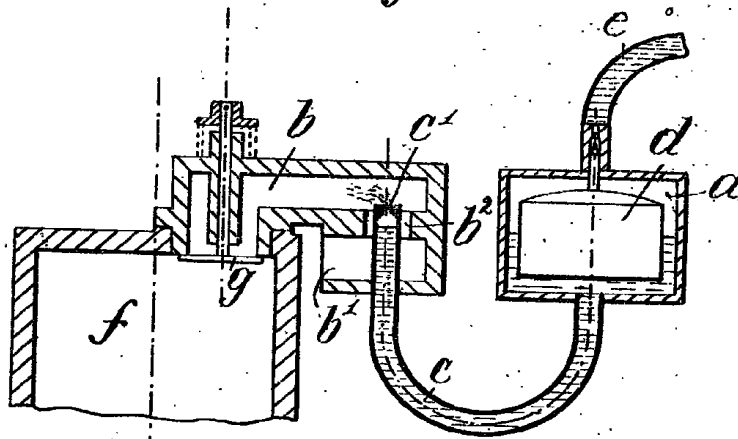


Fig. 2.

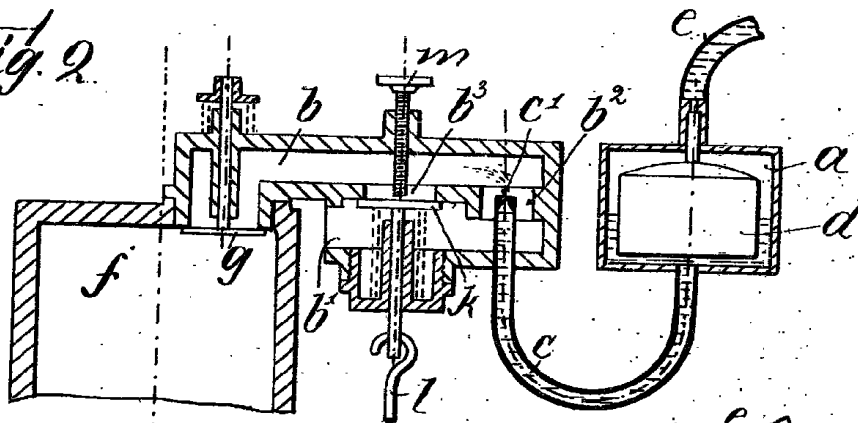
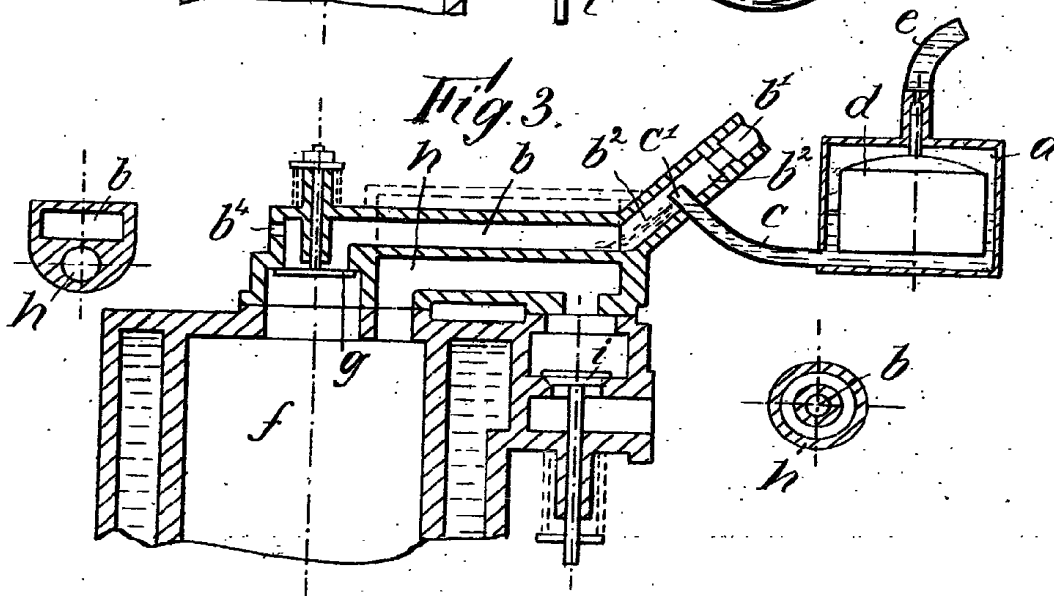


Fig. 3.



[This Drawing is a reproduction of the Original on a reduced scale.]

AMENDED SPECIFICATION.

Reprinted as amended in accordance with the decision of the Chief Examiner, dated the 27th day of February, 1900.

The Amendments are shown in erased and italic type.

N^o 16,072*



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Date of Application, 25th Aug., 1893—Accepted, 28th Oct., 1893

COMPLETE SPECIFICATION (AMENDED).

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10 a special feeding-channel, into which a nozzle supplying the hydrocarbon extends in any direction and at any place, and the object of my improvements is to produce a mixture of never-varying composition, irrespective of the speed of the engine as well as of that of the piston in different parts of the path of this latter.

In order to make my invention more clear, I refer to the accompanying drawing, in
15 which similar letters denote similar parts, and in which:

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Fig. 2 is a modification of said device, and

Fig. 3 is a second modification of the same.

20 The liquid hydrocarbon is contained in the basin *a* and is led from this basin to the mixing channel *b* by the pipe *c*, at the end of which latter a nozzle *c*¹ is provided. The liquid in basin *a* is kept in the same height of level by a swimmer *d*, which admits the influx of fresh liquid through tube *e* in a manner easily to be understood from the drawing. Thus, the level of the liquid contained in pipe *c*, below nozzle *c*¹,
25 is constantly kept in the same or very nearly the same height, which forms a moment of utmost importance, as will be more clearly to be seen hereinafter.

The entrance of air into the cylinder *f* takes place through the inlet- or suction-valve *g* and the channel *b b*¹, the part *b* of which latter forms the mixing-room already mentioned, and the entrance of hydrocarbon into the mixing room *b* takes
30 place through the nozzle *c*¹. The communication *b*² between *b* and *b*¹ is narrowed, and the dimensions of the communication *b*² and the nozzle *c*¹ correspond to the ratio of mixture of the two bodies employed air, and hydrocarbon.

If, now, the engine is running, air is sucked by the piston into the cylinder through channel *b b*¹, and, on account of the narrowed communication *b*², a vacuum or partial
35 vacuum is established within the mixing room *b*. By reason of this vacuum, a certain quantity of the liquid hydrocarbon is sucked into chamber *b* out of nozzle *c*¹, and is squirted there at the opposite wall as well as by the air, the latter flowing in with a

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velocity corresponding to the speed of the piston. Supposed, this speed is low, the rarefaction of the air will also be low, but will last a longer time, and, therefore, the injection of the liquid hydrocarbon will occur with little force, but with long duration. If, on the other hand, the speed of the piston is high, also the rarefaction will be high, and will last but a short time; therefore, the injection of the liquid will occur with great force, and with short duration. Just the same accordance is existing with regard to the degree of rarefaction and the velocity of the piston in different parts of its path, and it is, consequently, the proportion between both the bodies forming the explosive mixture exactly the same under all conditions, and this the more, as the level of the liquid within nozzle *c* remains on the same height.

When employing heavy liquid hydrocarbons for the production of the explosive mixture, it is necessary to heat the wall of chamber *b*, against which the former is thrown, or to heat the whole of said chamber in order to effect a quicker reduction into vapour. This may be performed best by the construction shown in Fig. 3, in which the escaping hot combustion-gases are led against or around chamber *b* by the channel *h*, at the end of which the outlet-valve *i* is arranged.

Further, in order to regulate the engine, the passage for the air may be altered in such a manner, that either a part or the whole of the air takes another way, than through communication *b*², so that but a slight or no rarefaction at all is produced within the mixing-chamber, and consequently, but little or no hydrocarbon is sucked into it.

Such an arrangement is shown in Fig. 2, in which, besides the connection *b*², a second connection *b*³ is established between the parts *b* and *b*¹, which, under normal conditions, is closed by a valve *k*. This valve may be actuated automatically from the regulator by rod *l*, and also from hand by screw *m*, so that, by screwing this screw down into valve *k*, the latter may be opened. The air, therefore, will not be rarefied and no liquid will be sucked into chamber *b*, so that no combustible or explosive mixture can be formed, and the engine stops.

I wish it to be understood, that I do not confine myself to the employment of but one nozzle, as *c*¹, or but one narrowed inlet as *b*², but I may use also several nozzles and several inlets, and also special inlets for air without nozzles, as for instance at *b*⁴ in Fig. 3.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon by the air sucked by the working piston, substantially as described.
2. The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working piston through a mixing chamber *b*, substantially as described.
3. The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ extending into a mixing chamber *b* by the air sucked by the working piston through said mixing chamber, substantially as described.
4. The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ forming end of supply pipe *c*, and extending into connection *b*² between air inlet channel *b*¹ and mixing chamber *b*, such sucking being performed by the air sucked by the working piston through said connection *b*², substantially as described.
5. The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹, fed from supply basin *a* by pipe *c* and extending into connection *b*² between air inlet channel *b*¹ and mixing chamber *b*, said sucking being performed by the air sucked by the working piston through said channel *b*¹, connection *b*² and mixing chamber *b*, substantially as described.

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6. 1. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 fed from supply-basin a by pipe c and extending into connection b^2 between air-inlet-channel b^1 and mixing-chamber b , said sucking being performed by the air sucked by the working-piston through said channel b^1 , connection b^2 and mixing-chamber b , and the level of the hydrocarbon within basin a being kept on the same height by a swimmer-valve d , acting on the main-supply-tube e , substantially as described.

7. ~~The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working-piston through a mixing-chamber b , the latter being heated by the combustion-gases, substantially as described.~~

8. ~~The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 extending into a mixing-chamber b , by the air sucked by the working-piston through said mixing-chamber, the latter being heated by the combustion-gases substantially as described.~~

9. ~~The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 forming end of supply-pipe c and extending into connection b^2 between air inlet channel b^1 and mixing-chamber b , said sucking being performed by the air sucked by the working-piston through said connection b^2 the mixing-chamber being heated by the combustion-gases, substantially as described.~~

10. ~~The method of producing the explosive mixture in hydrocarbon engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 fed from supply-basin a by pipe c , and extending into connection b^2 between air inlet channel b^1 and mixing-chamber b , said sucking being performed by the air sucked by the working-piston through said channel b^1 , connection b^2 and mixing-chamber b , the latter being heated by the combustion-gases, substantially as described.~~

11. 2. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 fed from supply-basin a by pipe c , and extending into connection b^2 between air-inlet-channel b^1 and mixing-chamber b , said sucking being performed by the air sucked by the working-piston through said channel b^1 , connection b^2 , mixing-chamber b , the level of the hydrocarbon within basin a being kept on the same height by a swimmer-valve d , acting on the main-supply tube e , the mixing-chamber being heated by the combustion-gases, substantially as described.

12. 3. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working-piston through a mixing-chamber b , the latter having opening b^3 with valve k , substantially as described.

13. 4. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 , extending into a mixing-chamber b by the air sucked by the working-piston through said mixing-chamber, the latter having opening b^3 with valve k , substantially as described.

14. 5. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 forming end of supply-pipe c , and extending into connection b^2 between air-inlet-channel b^1 and mixing-chamber b , said sucking being performed by the air sucked by the working-piston through said connection b^2 , the mixing-chamber having opening b^3 with valve k , substantially as described.

15. 6. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 fed from supply-basin a by pipe c , fed from c , and extending into connection b^2 between air-inlet-channel b^1 and mixing-chamber b , said sucking being performed by the air sucked by the working-piston through said channel b^1 , connection b^2 and mixing-chamber b , the latter having opening b^3 with valve k , substantially as described.

16. 7. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle c^1 fed from supply-basin a

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by pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*², said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, the level of the hydrocarbon within basin *a* being kept on the same height by a swimmer-valve *d*, acting on the main-supply-tube *e*, the mixing-chamber having opening *b*³ with valve *k*, 5 substantially as described.

17. 8. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon by, and mixing the same with, the air sucked by the working piston through a mixing-chamber *b*, the latter being heated by the combustion-gases, and having opening *b*³ with valve *k*, substantially as described. 10

18. 9. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹, extending into a mixing-chamber *b* by the air sucked by the working-piston through said mixing-chamber, the latter being heated by the combustion-gases, and having opening *b*³ with valve *k*, substantially as described. 15

19. 10. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ forming end of supply-pipe *c*, and extending into connection *b*² between air-inlet channel *b*¹ and mixing-chamber *b*, said sucking being performed by the air sucked by the working-piston through said connection *b*², the mixing chamber being heated by the combustion-gases, and having opening *b*³ with valve *k*, substantially as described. 20

20. 11. The method of producing the explosive mixture in hydrocarbon-engines, consisting in sucking liquid hydrocarbon out of a nozzle *c*¹ fed from supply-basin *a* by pipe *c*, and extending into connection *b*² between air-inlet-channel *b*¹ and mixing-chamber *b*², said sucking being performed by the air sucked by the working-piston through said channel *b*¹, connection *b*² and mixing-chamber *b*, the level of the hydrocarbon within basin *a* being kept on the same height by a swimmer-valve *d*, acting on the main-supply-tube the mixing-chamber being heated by the combustion-gases, the latter having opening *b*³ with valve *k*, substantially as described. 25

Dated this 21st day of August 1893. 30

WILHELM MAYBACH.

By Geo. H. Rayner, A. E. Ellen,
37, Chancery Lane, London, W.C., Agent for the Applicant.

Fig. 1.

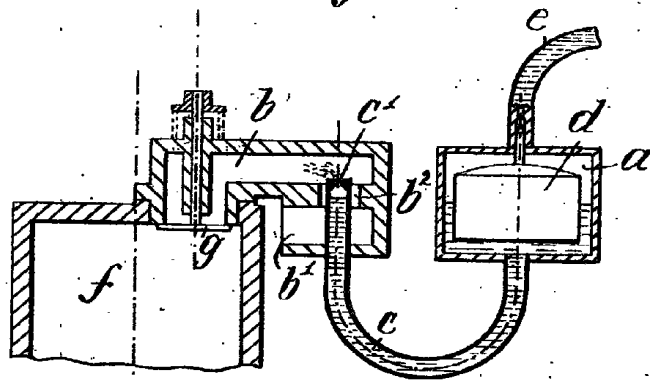


Fig. 2.

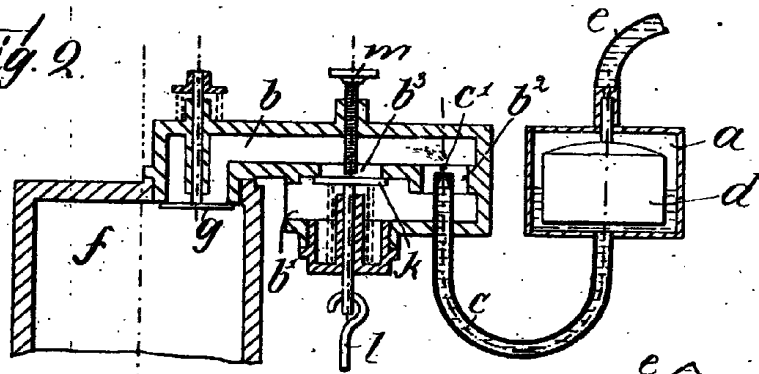
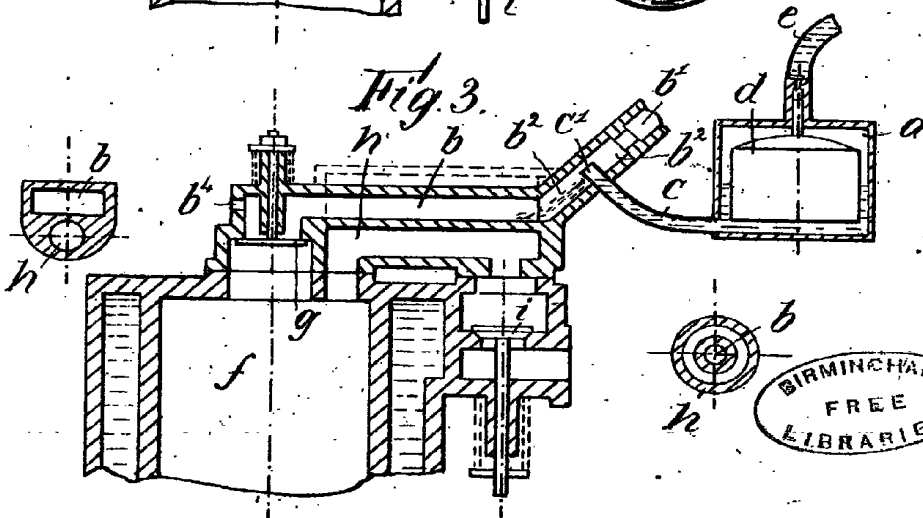


Fig. 3.



[This Drawing is a reproduction of the Original on a reduced scale.]

