(No Model.) 2 Sheets—Sheet 1.

H. CAMPBELL.

GAS MOTOR ENGINE.

No. 428,801. Patented May 27, 1890.

FIG. 1.

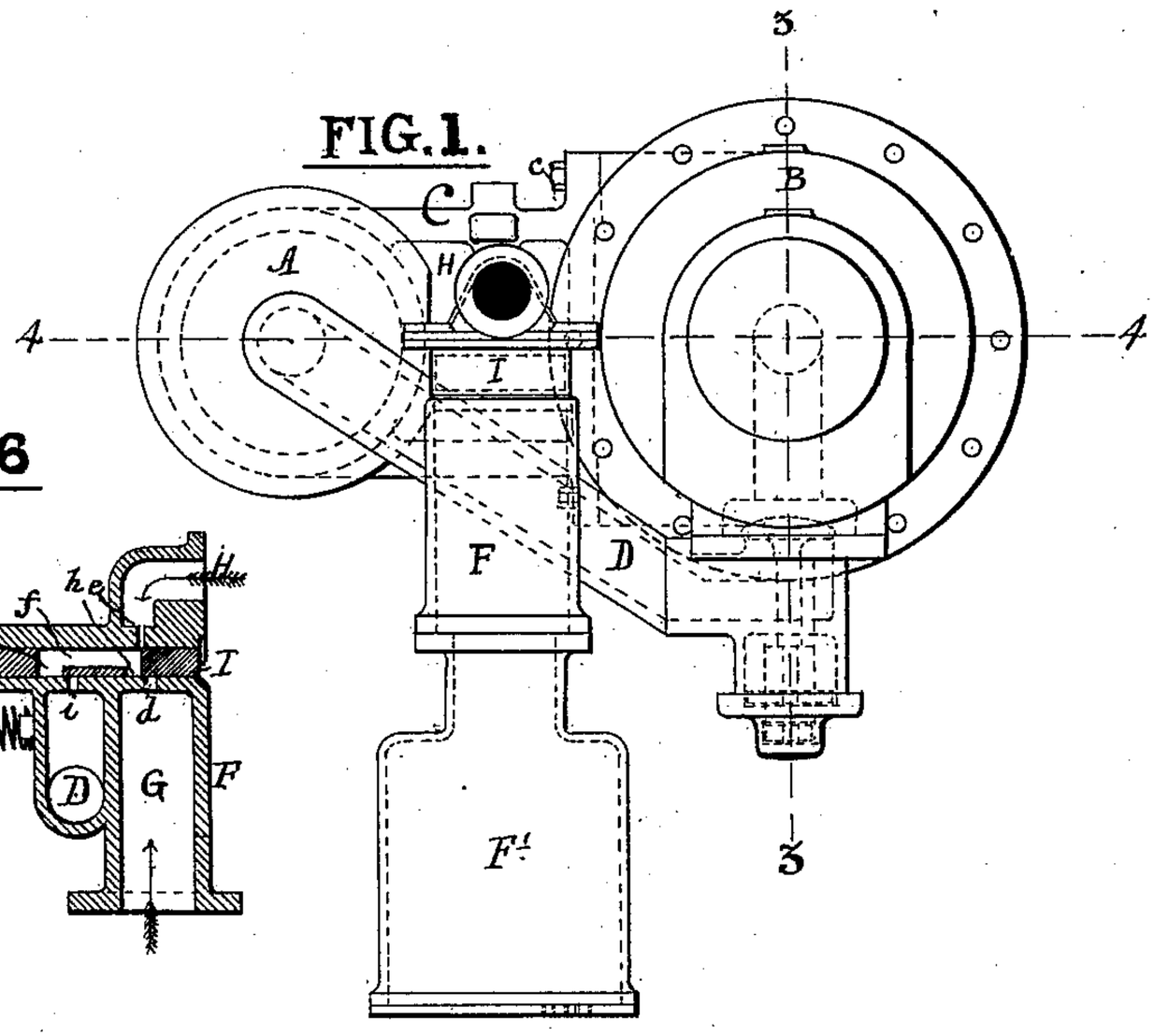


FIG. 6

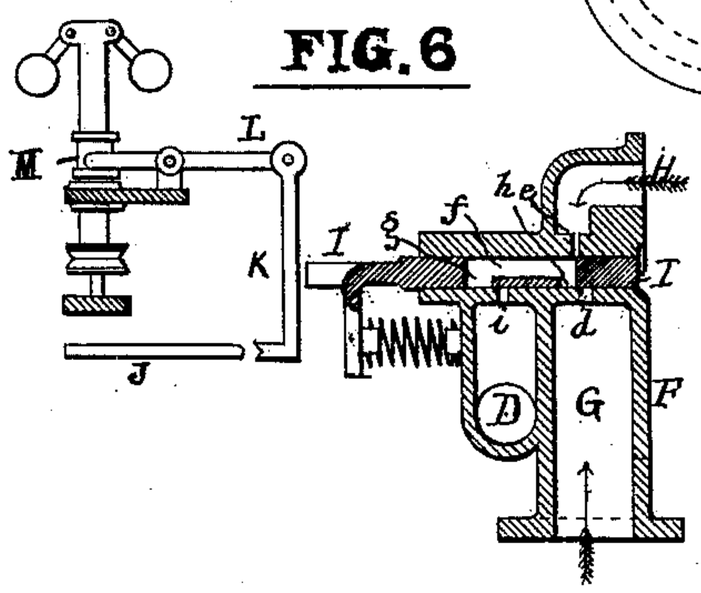
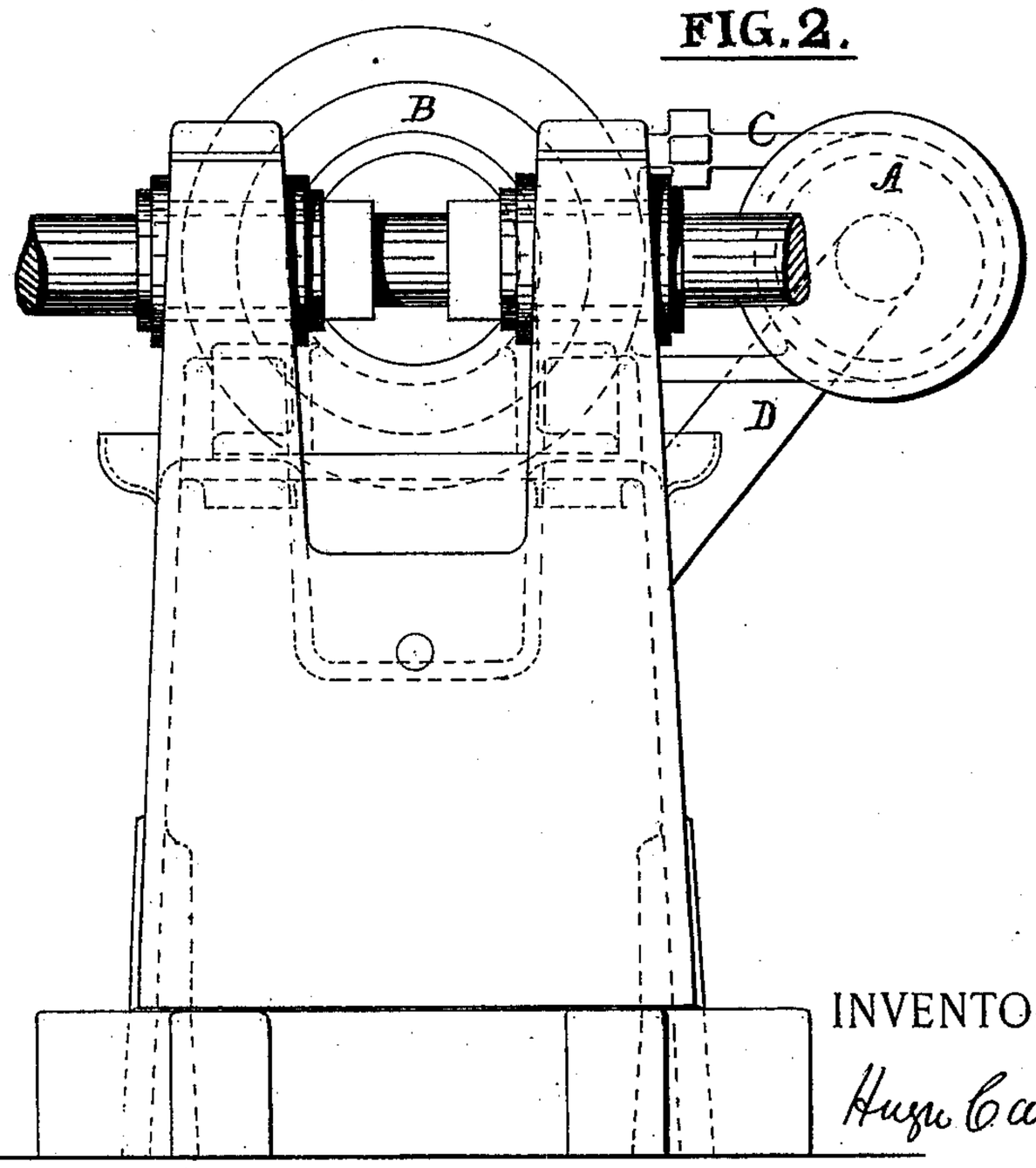


FIG. 2.



WITNESSES:

Arthur B Crosby

Ernest P. Newton

INVENTOR

Hugh Campbell.

By their Attorney,

Henry Connett

(No Model.) 2 Sheets—Sheet 2.

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FIG. 3.

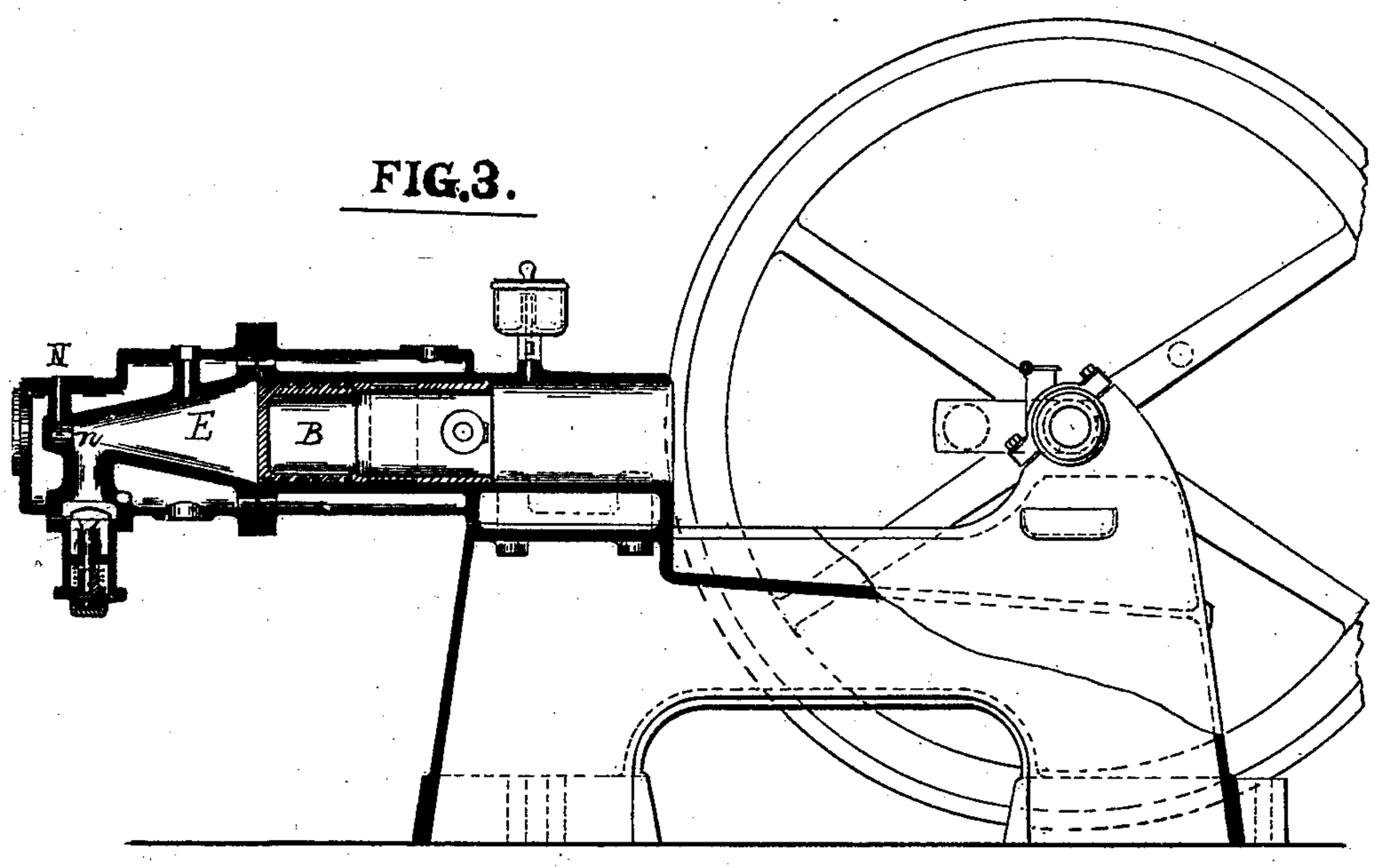
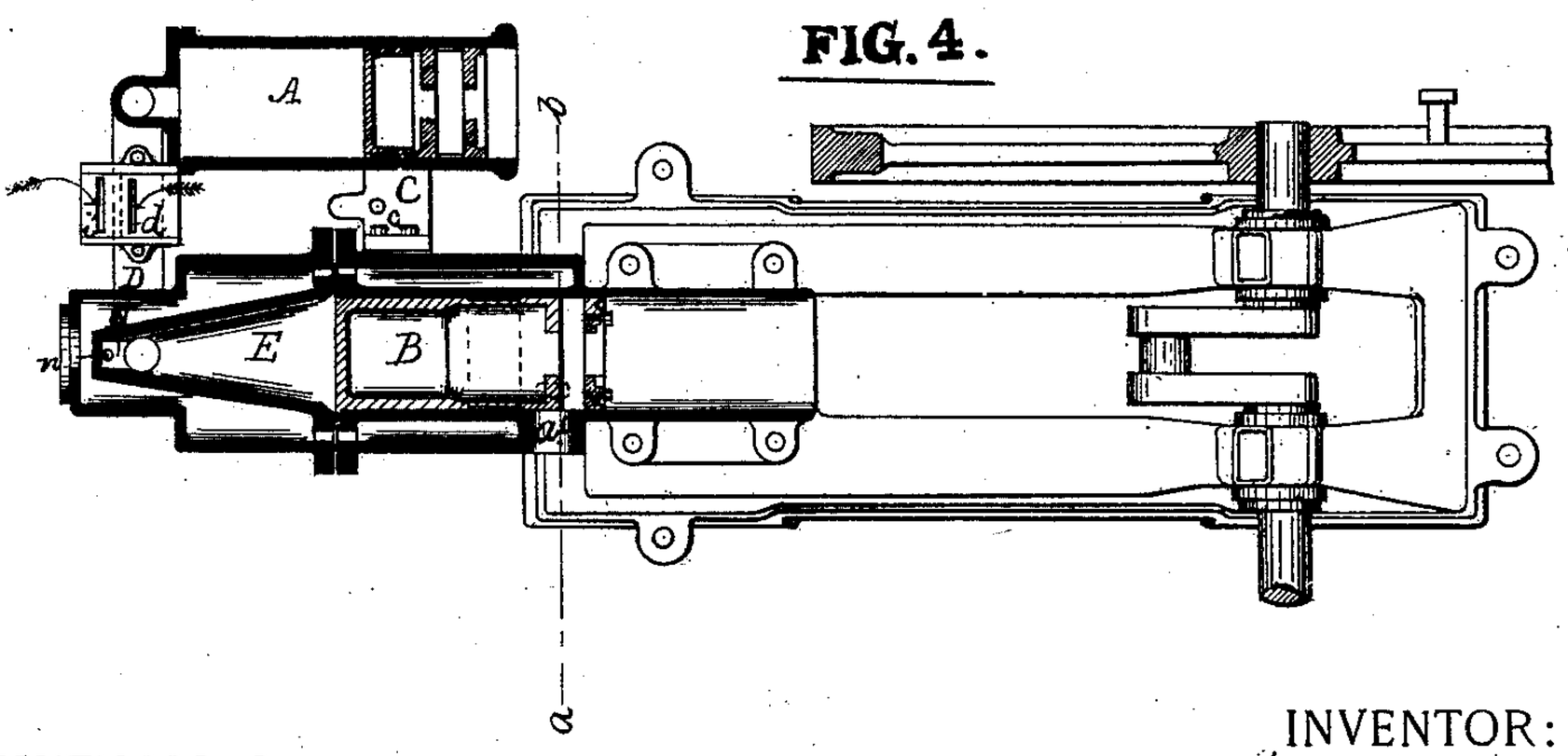


FIG. 5.

FIG. 4.



WITNESSES:
Arthur B Crosby
Ernest P. Newton

INVENTOR:
Hugh Campbell.
By his Attorney,
Henry Connett

UNITED STATES PATENT OFFICE.

HUGH CAMPBELL, OF HALIFAX, COUNTY OF YORK, ENGLAND.

GAS-MOTOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 428,801, dated May 27, 1890.

Application filed February 7, 1889. Serial No. 299,073. (No model.) Patented in England July 25, 1888, No. 10,748; in France January 7, 1889, No. 195,226; in Belgium January 9, 1889, No. 84,571, and in Austria-Hungary April 3, 1889, No. 3,293.

To all whom it may concern:

Be it known that I, HUGH CAMPBELL, a subject of the Queen of Great Britain, residing at Halifax, Yorkshire, England, have invented certain Improvements in Gas-Motor Engines, (for which patents have been granted in France, No. 195,226, dated January 7, 1889; in Great Britain, No. 10,748, dated July 25, 1888; in Belgium, No. 84,571, dated January 9, 1889, and in Austria-Hungary, No. 3,293, dated April 3, 1889,) of which the following is a specification.

My invention relates to that class of gas-engines wherein two cylinders are employed, arranged side by side, one of which is called the "pump-cylinder" and the other the "motor-cylinder," the function of the former being to supply at a given time the combustible mixture of air and gas to the latter cylinder, where it is afterward compressed, ignited, expanded, and exhausted.

My improvements in such engines relate, first, to the cylinders, which have hitherto been cast together; but it is now my intention to cast such cylinders separately and to couple them by an arm or bracket projecting, preferably, from the pump-cylinder, which bracket is fastened by bolts or otherwise to the jacket of the motor-cylinder, whereby I dispense with the necessity of having the compression-chamber and pump-cylinder cast together, as is now the case. Consequently greater simplicity and efficiency are obtained.

In order that the first part of my invention may be the better understood, I will refer to the accompanying drawings, wherein—

Figure 1 is an end elevation of such parts of a gas-engine as are necessary to illustrate my improvements. Fig. 2 is a view of the opposite end of the engine illustrated in Fig. 1. Fig. 3 is a sectional elevation, on a smaller scale than Figs. 1 and 2, taken along the line 3 3 in Fig. 1. Fig. 4 is a sectional plan, on the same scale as Fig. 3, taken at right angles to Fig. 3. Fig. 5 is a cross-section taken along the line *a b* in Fig. 4, showing the exhaust-ports; and Fig. 6 is a vertical section showing the charging-valves and governor in detail.

In the drawings, A represents the pump-cylinder, the function of which is to supply at a given time the combustible mixture to the motor-cylinder B, where it is compressed and ignited, and instead of these two cylinders forming one casting, as heretofore, I form on the pump-cylinder a bracket C, which by means of bolts *c* is attached and made secure to the jacket of the motor-cylinder A. Of course it is obvious that the bracket C may project from the jacket of the motor-cylinder and be attached by bolts to the pump-cylinder; but I prefer the bracket to project from the pump-cylinder. By making these two cylinders separately they are easier to be moved, and if one of the cylinders should chance to be faulty a new one may be set up in its stead without destroying both of them, which was formerly unavoidable.

My invention has reference, secondly, to the pipe which supplies the mixture of air and gas from the pump-cylinder to the motor-cylinder. Hitherto this admission-pipe has been made to branch from the bottom of the pump-cylinder to the motor-cylinder, and as a consequence when grease or other matter was lodging in the bottom of the pump-cylinder it would be forced through the admission-pipe into the compression-chamber. To obviate this defect, I place the admission-pipe at about the center of the pump-cylinder, or at any point above the bottom thereof, so that nothing but the explosive charge can be forced through the said pipe. This part of my invention is shown in Fig. 1, wherein A and B are respectively the pump and motor cylinders, and D is the branch pipe which conveys the charge to the motor-cylinder. This pipe D, it will be observed, is made to branch from the middle of the pump-cylinder, so that the grease or other matter which lies below the opening of the said pipe cannot make its way therethrough or into the motor-cylinder, by which means nothing but the charge, free from all impurities, can enter into the valves and motor-cylinder.

My invention refers, thirdly, to the means for supplying the charge to gas-engines, and this I accomplish by opening the gas and air

inlet valves, which I prefer to make of the slide type, rectangular or circular in section. Passages are formed in and through this slide-valve for the air and gas to be drawn by the action of the piston into the pump-cylinder. To permit this to be done, I form a recess in the back of the slide, and communicating with this recess I form the air and gas ports in such a manner that the air is drawn across the gas-ports, and on the gas issuing therefrom such air and gas would be thoroughly mixed. This part of my invention is illustrated in Fig. 1, which is an end elevation of the valve arrangement, and Fig. 6 a cross-section of the same. The valve-casing F is fixed upon the air-box F′, and G represents the air-inlet pipe, which passes through the port *d*. The gas-inlet is shown at H, the gas passing through a number of small apertures *e*. The slide-valve I is recessed at its back side, and this recess *f* communicates with two ports *g* and *h*, formed in said valve, so that when the ports in the slide-valve stand opposite the ports *i* and *d* the air and gas are admitted together and meet in the recessed part *f* of the valve, where they mix and blend together before passing through port *i* and into the pipe D to the pump-cylinder A. The slide I is pushed at the proper time by means of the rod J, which has a reciprocating motion communicated to it by an eccentric-cam or other means. The reciprocating rod strikes the lower end of the cranked rod K, connected to the forked lever L, the forked end of which passes around a sleeve M of the governor. By this means when the engine is running at the normal speed, the cranked rod K is immediately opposite the point of the reciprocating rod J, by which means the slide is pushed forward with exact regularity, thereby allowing a proper portion of the air and gas to be drawn into the motor-cylinder; but should the engine exceed the normal speed the governor would immediately open out, causing the sleeve M to rise, and in doing this the forked lever L would cause the lower end of the cranked lever K to descend beyond the reach of the point of the reciprocating rod J. Consequently the valve would not be operated, and therefore neither gas nor air would enter the cylinder; hence the engine would immediately stop.

The arrangement above described insures economy of gas, and there is also greater certainty of ignition, as by the use of the slide-valve I am better able to proportion the air and gas than has hitherto been possible. At the same time the arrangement herein described permits me to dispense with one valve hitherto used for this purpose.

My invention relates, fourthly, to the method of igniting the gas, and has reference to a prior patent granted to me in Great Britain, No. 6,990 of 1885; but instead of using the igniting-instruments for the purpose of igniting in two chambers by means of one bent red-hot tube I now propose to use only one red-hot tube for one cylinder. From practical experience I find that it is best to arrange the tube in a vertical position and the tube itself to be straight without any bends, and also the communicating passage between the tube and the compression-chamber should be as short in length and as small in diameter as possible. To effect this result I fix the ignition-tube on the top of the compression-chamber at one end and communicating therewith by a small hole. Prior to my invention the orifice of the ignition-tube was placed directly over the center of the admission-valve, where it was thought the combustible mixture would be strongest and ignition most sure; but in practice it is found that to place the tube in that position caused premature ignition of the charge, and therefore I form a chamber or recess in the end of the compression-chamber, in which I place the orifice of the tube. I also make that part of the end of the chamber where the tube is fixed of a reduced diameter, whereby I am enabled to use a much shorter ignition-tube. This part of my invention is shown in Figs. 3 and 4, wherein E represents the gas-compression chamber, one end of which I make tapered or less in diameter than the other, and in this tapered part I form a chamber *n*, into which is inserted the igniting-tube N. By this means I am enabled to dispense with the use of the bent tube hitherto employed, using instead thereof a straight tube without any bends. Consequently there is less length of tube to be heated, thereby diminishing the amount of fuel required to bring the tube into an incandescent condition.

By the employment of the apparatus as herein set forth the number of working parts and consequent wear and tear thereon are reduced, and in engines of the type referred to herein at least four valves, with their attendant connections, have hitherto been employed for the proper working of the engine; but in gas-engines constructed according to my invention only two valves are required, which are of the simplest construction.

Having thus described my invention, I claim—

1. In a gas-motor engine, the combination, with the motor-cylinder and the compression-chamber connected with the same, provided with an inlet for the explosive charge, of the small igniting-chamber *n*, communicating with the compression-chamber back of the said inlet for the explosive charge, and the igniting-tube N, which projects into said chamber *n*, substantially as and for the purposes set forth.

2. In a gas-motor engine, the combination, with the motor-cylinder B and the tapered or conical compression-chamber E, annexed

thereto and provided with a laterally-arranged inlet for the combustible charge at its contracted end, of the ignition-chamber *n*, communicating with the said chamber E back of the inlet for said combustible charge, and the vertically-arranged ignition-tube N, which projects into said chamber *n*, substantially as and for the purposes set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HUGH CAMPBELL.

Witnesses:

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