M. BERLIET.

EXPLOSIVE ENGINE.

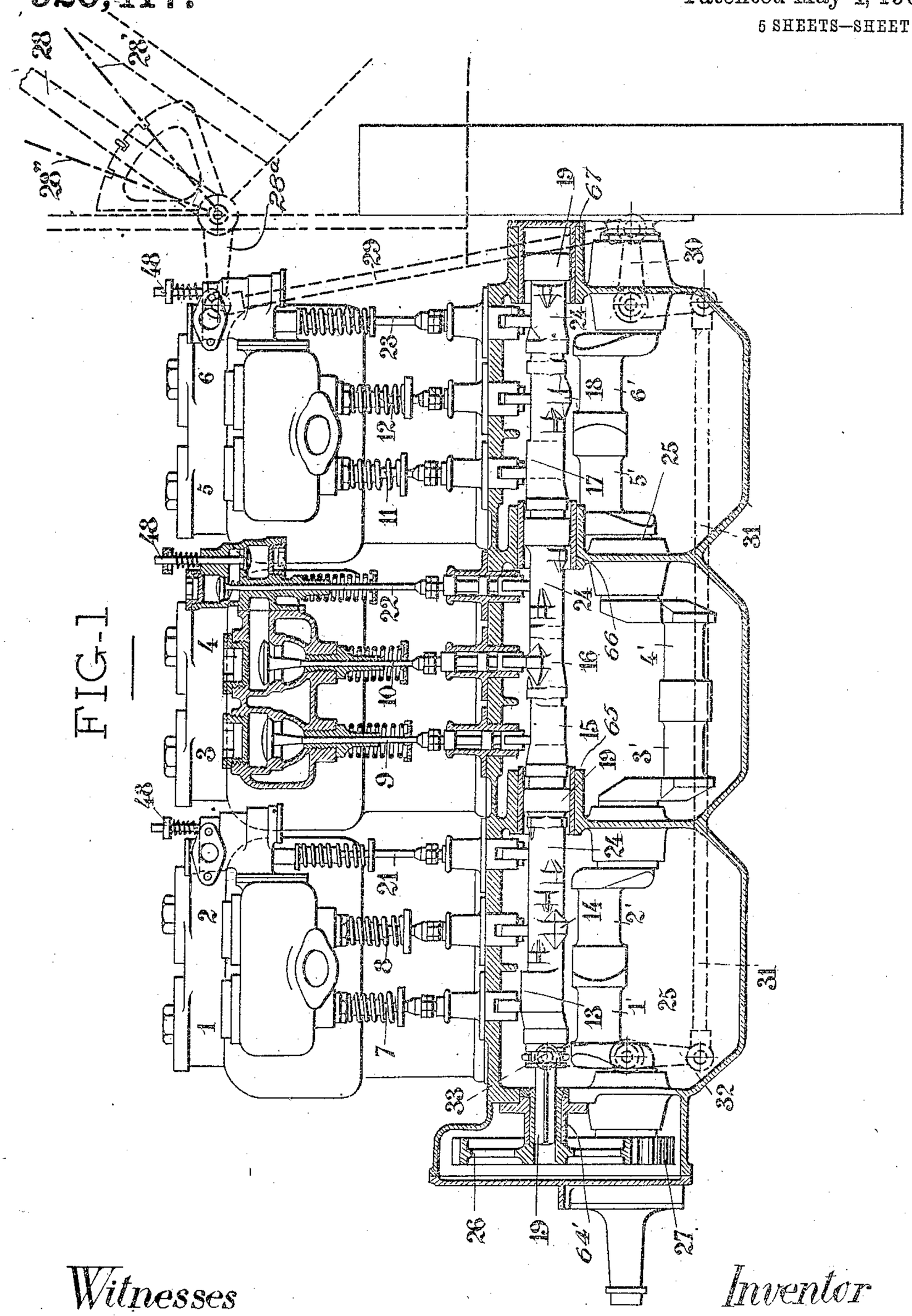
APPLICATION FILED JULY 12, 1906.

920,417.

Patented May 4, 1909.

5 SHEETS—SHEET 1.

FIG-1



Witnesses

Jean Germain

Guillaume Dioche

Inventor

Marius Berliet

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5 SHEETS—SHEET 2.

FIG-3

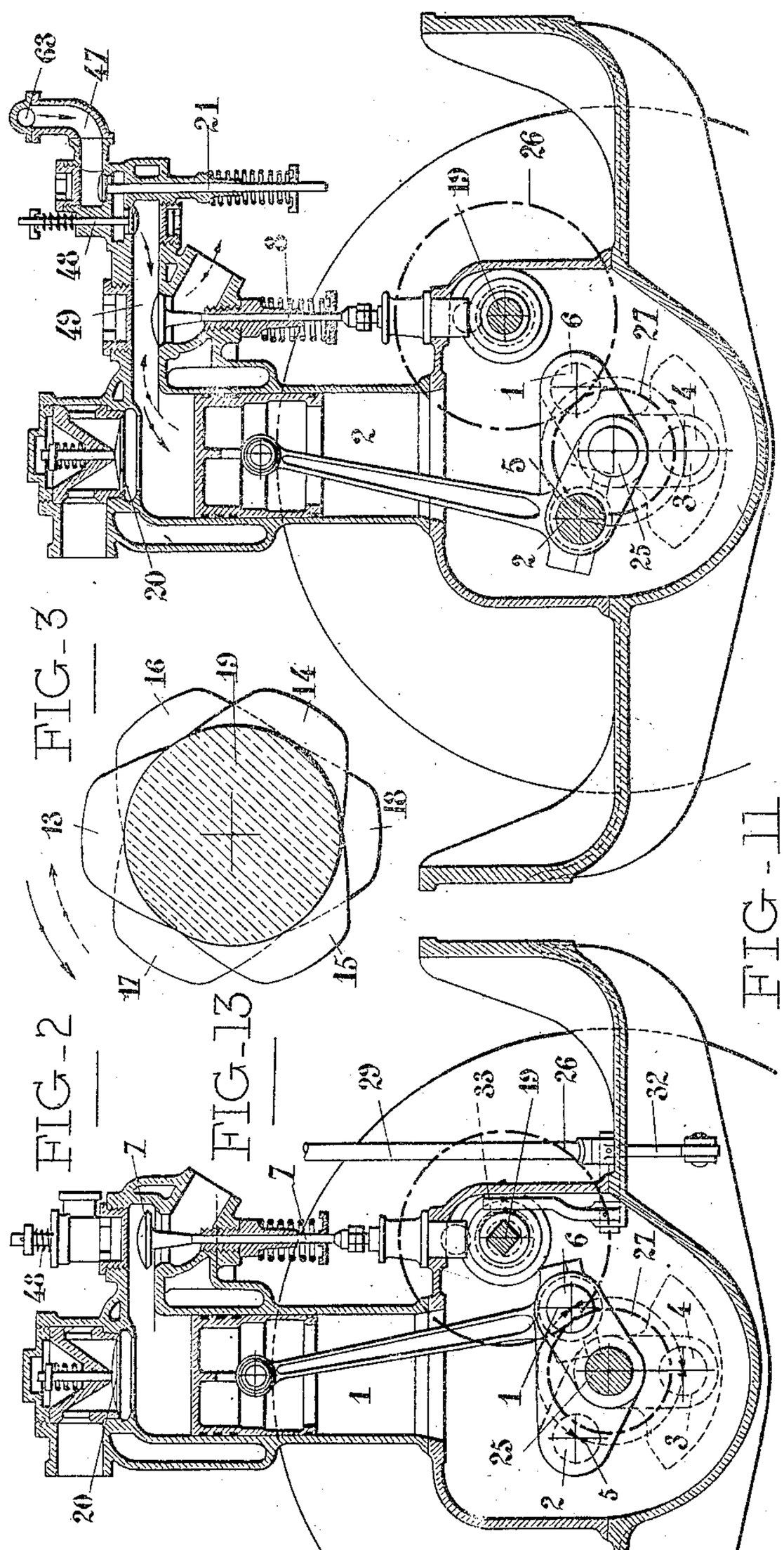


FIG-2

FIG-13

FIG-11

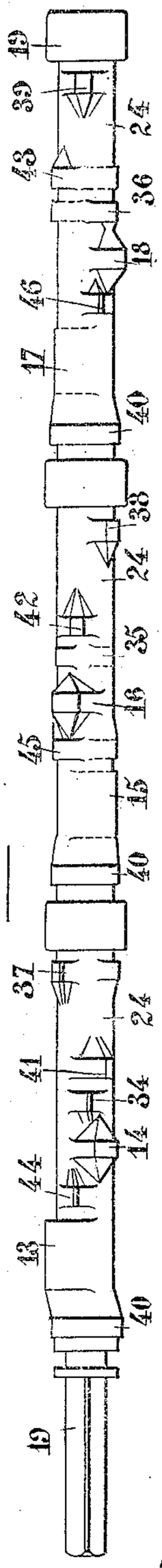
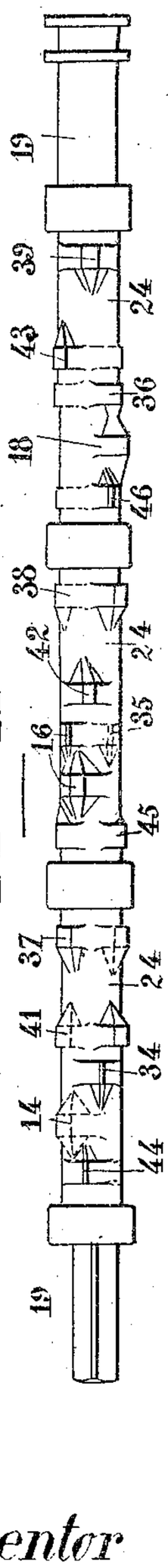


FIG-12



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5 SHEETS—SHEET 3.

FIG. 4

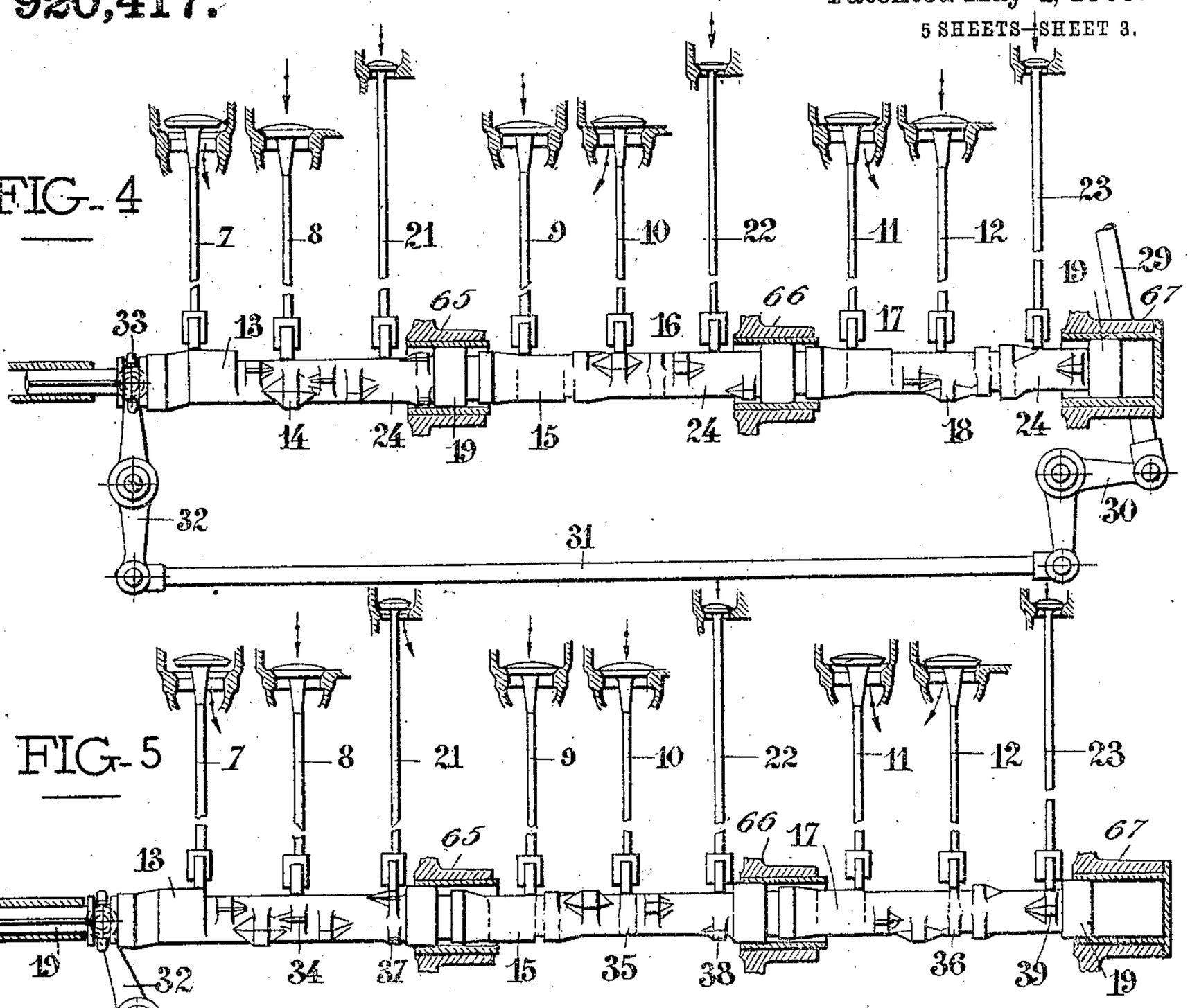
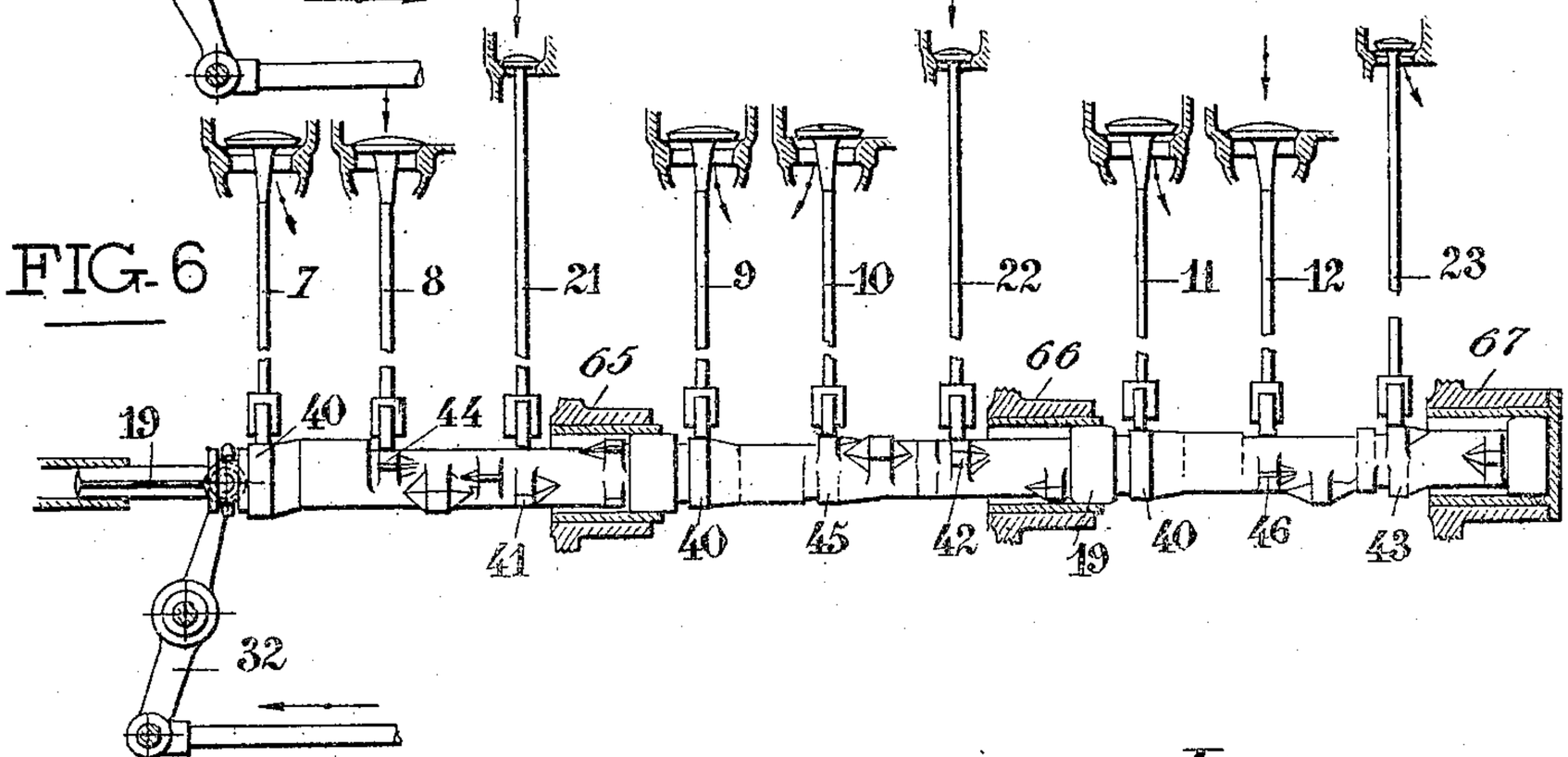


FIG. 5

FIG. 6



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Jean Germain

Guillaume Pioche

Inventor

Marius Berliet

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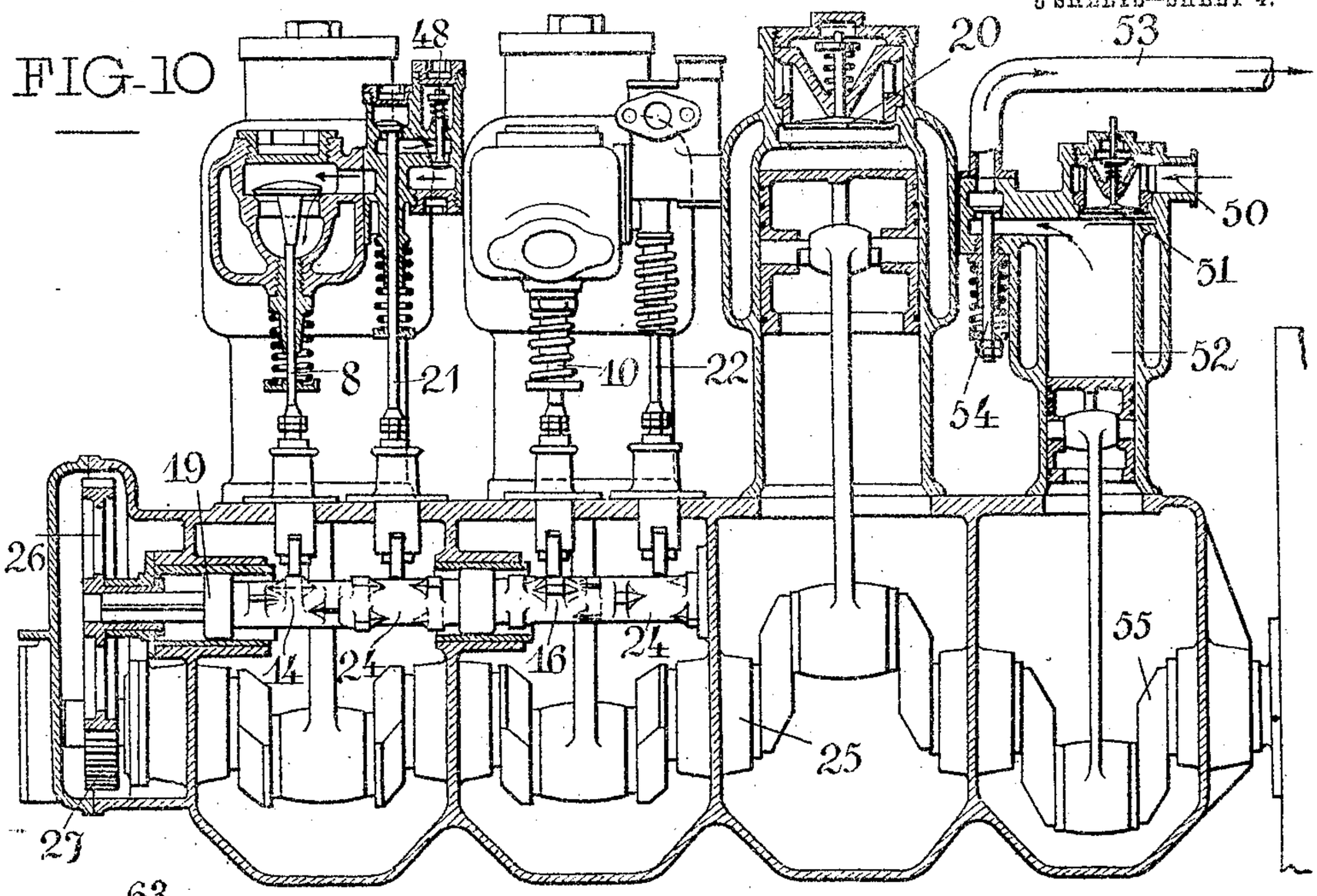
5 SHEETS—SHEET 4.

FIG-10



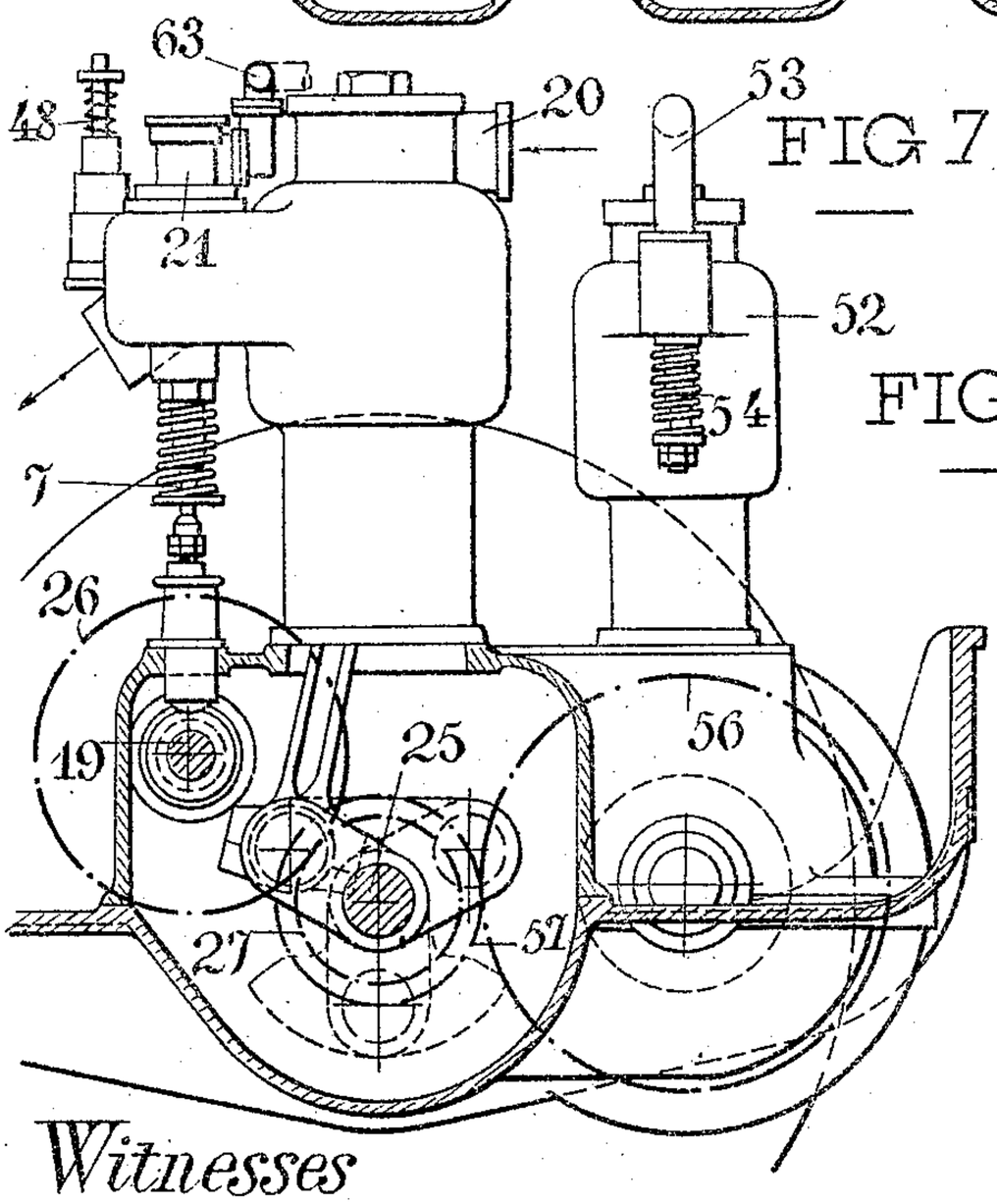


FIG 7

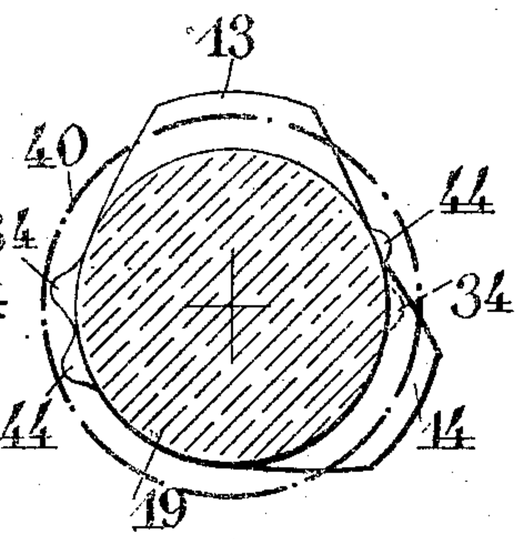


FIG-14

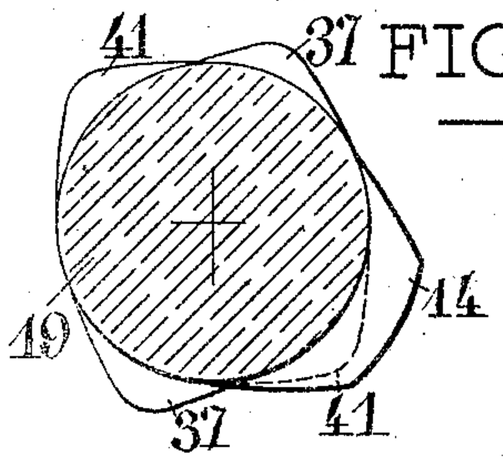


FIG-15

Witnesses

Jean Germain

Guillaume Lioche

Inventor

Marius Berliet

M. BERLIET.

EXPLOSIVE ENGINE.

APPLICATION FILED JULY 12, 1906.

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5 SHEETS—SHEET 5.

FIG-17

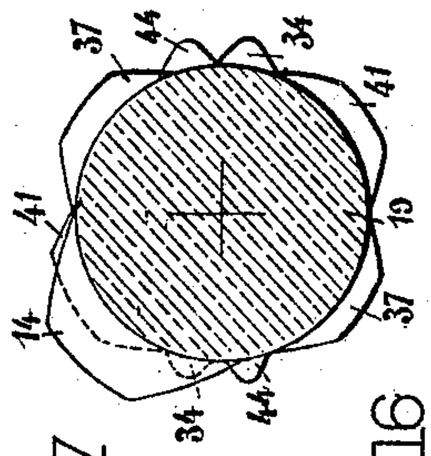

FIG-16

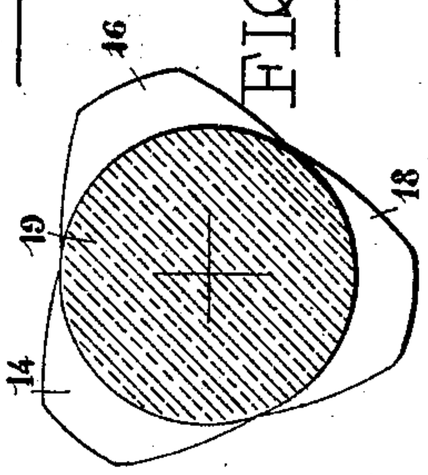

FIG-9

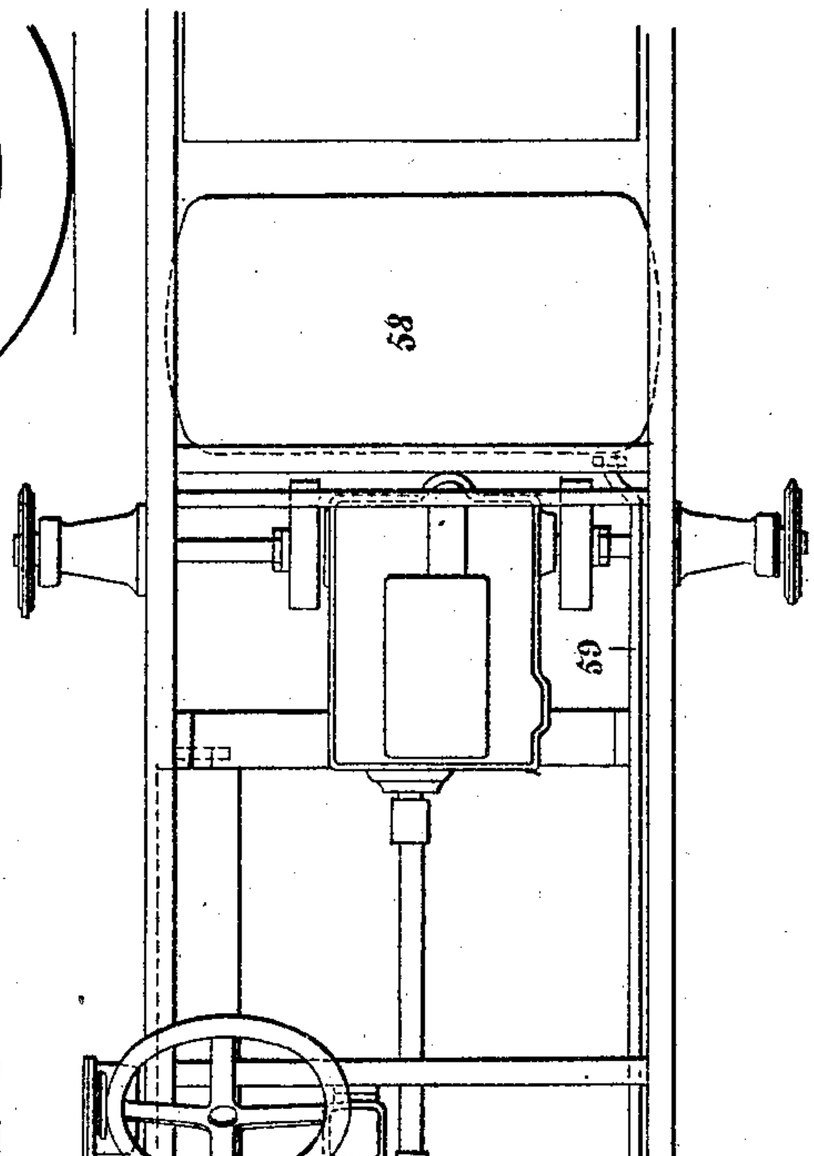

FIG-8

Witnesses

Jean Germain

Guillaume Fioche

Inventor

Marius Berliet

UNITED STATES PATENT OFFICE.

MARIUS BERLIET, OF LYON, FRANCE.

EXPLOSIVE-ENGINE.

No. 920,417. Specification of Letters Patent. Patented May 4, 1909.

Application filed July 12, 1906. Serial No. 325,897.

To all whom it may concern:

Be it known that I, MARIUS BERLIET, a citizen of the French Republic, residing at 12 Chemin des Quatre Maisons, Lyon, France, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification.

This invention relates to improvements in explosive engines and has to do more particularly with an improved valve arrangement and operating mechanism therefor.

One of the objects of the invention is the provision of an engine of this character equipped with means for supplying and controlling an auxiliary operating or motive fluid other than the explosive fluid and supplying the same to the engine when starting and if desired during the operation of the engine in which latter case the auxiliary motive fluid is utilized to develop increased power.

The invention also contemplates the provision of means whereby the auxiliary motive fluid may be used for reversing the engine and operating the same backward.

The invention will be more fully described in connection with the accompanying drawings and will be more particularly pointed out and ascertained in and by the appended claims.

In the drawings:—Figure 1 is a side view partly in section of an engine embodying the main features of my invention. Fig. 2 is a sectional view taken on line 2—2 of Fig. 9. Fig. 3 is a sectional view taken on line 3—3 of Fig. 9. Fig. 4 is a fragmentary side elevation of means for controlling the valves for the explosive and auxiliary motive fluids showing an adjustment of said means in which only the explosive fluid is used. Fig. 5 is a similar view showing an adjustment wherein the explosive and auxiliary fluids are used. Fig. 6 illustrates an adjustment wherein the engine is reversed and operated backward by means of the auxiliary motive fluid. Fig. 7 is an end elevation partly in section showing means for supplying the auxiliary fluid, such as a compressor when the auxiliary fluid consists of air. Fig. 8 is a side elevation of a motor vehicle showing the application of the device of my invention thereto. Fig. 9 is a plan view of the vehicle shown in Fig. 8. Fig. 10 is a side elevation partly in section of a modified form of the invention. Fig. 11 is a detached detail view of controlling means in the form of a cam shaft adapted for use in connection with the preferred embodiment of the invention. Fig. 12 is a detached view of the cam shaft adapted for use in connection with the modified form of the invention shown in Fig. 10. Figs. 13, 14, 15, 16 and 17 are detail sectional views of the cam shafts.

Like numerals of reference designate similar parts throughout the different figures of the drawings.

Referring to Fig. 1 which illustrates the preferred embodiment of the invention there is shown a combustion engine comprising six cylinders designated 1, 2, 3, 4, 5 and 6 respectively. The pistons thereof are connected with a crank shaft 25, mounted in suitable bearings, the crank portions to which said pistons are connected being numbered 1′, 2′, 3′, 4′, 5′ and 6′. Said crank shaft is so arranged, with respect to the crank portions, that the pistons operate in pairs as will be readily seen by reference to Figs. 1 to 3 inclusive. Each of the cylinders 1 to 6 inclusive is provided with an automatically acting intake valve 20, communicating with a suitable source of supply as will be seen by reference to Figs. 2 and 3. Each of the cylinders 1 to 6 inclusive is provided with an exhaust valve and the same are numbered 7, 8, 9, 10, 11 and 12 and are normally maintained in a closed position by springs as shown. In the present embodiment cylinders 1, 3 and 5 and the pistons thereof are adapted to be operated only by an explosive fluid and when the engine is reversed the said cylinders are designed to run empty. The pistons of cylinders 2, 4 and 6 are adapted to be operated either by an explosive fluid or by an auxiliary fluid such as air although it will be understood that any auxiliary fluid other than air may be used if desired and while the means for supplying and utilizing air will hereinafter be described in connection with this fluid it will be understood that such reference to air and air controlled means is not to be construed as an essential feature of the invention. Air valves 21, 22 and 23 which as shown are intake spring pressed valves are associated with cylinders 2, 4 and 6 and desirably communicate with and operate the pistons therein through a passage 49 (Fig. 3). Non-return valves 48 are desirably interposed between said air valves and the passages 49.

I will next describe the means shown for supplying air for the purposes hereinafter more fully described.

Referring to Figs. 3, 8, 9 and 10, 52 designates an air compressor which as shown in Fig. 7 is provided on its crank shaft with a gear 56, indicated by broken lines, which meshes with a gear 57 on the crank shaft 25. However the compressor may be connected directly to the crank shaft 25 as shown in Fig. 10. Air is admitted to the compressor 52 through inlet 50, valve 51 to the cylinder and is discharged through valve 54 and pipe 53 (Fig. 10). Pipe 53 discharges to a connecting pipe 62 which communicates at one end with a pipe 59 leading to a reservoir 58 (Fig. 9) and which will hereinafter be termed a reservoir pipe. At its other end said pipe 62 communicates with a feed pipe 63 which discharges at 47 (Fig. 3) to the air valves 21, 22 and 23. A cut off valve 61 is conveniently interposed between pipes 62 and 63 and as shown is controlled by a foot lever 60. This cut off as will hereinafter more fully appear is for the purpose of controlling communication between the air supply and the cylinders 2, 4 and 6. A valve 64 is conveniently interposed between pipes 62 and 59 and may if desired be a three way valve adapted to make connection between pipes 53 and 59 or cut off said connection and open communication between the compressor and the outer air. When it is desired to fill the reservoir 58 communication will be established between the compressor and said reservoir by said valve and when the desired pressure is obtained in the reservoir the valve 64 will be thrown in a position to discharge the compressed air to the atmosphere. In practice mechanism may if desired be provided for throwing the compressor out of service when predetermined pressure has been attained in the reservoir but inasmuch as such mechanism forms no part of the present invention it has not been herein shown.

I will next describe the controlling means for operating the exhaust and air valves of the cylinders 1 to 6 inclusive hereinbefore described which means as shown consists of a shiftable cam shaft and I will also describe the specific form of shifting or operating mechanism herein shown for adjusting said cam shaft in a manner to cause the devices hereinbefore described to perform the various desired functions.

As shown the cam shaft is designated by 19 and is mounted to rotate and be shifted longitudinally in bearings, 64′, 65, 66 and 67. In the bearing 64′ the shaft 19 is keyed to and slidably and non-rotatably mounted in the sleeve of a gear wheel 26 which meshes with a gear wheel 27 on the crank shaft 25 and thereby serves to communicate rotative motion from said crank shaft to said cam shaft. Referring to the specific means shown for shifting said cam shaft 19 (Figs. 1 and 8) 28 designates an operating lever associated with a quadrant whereby it may be fixed in three different positions as indicated in dotted lines. Said lever 28 is provided with an angular portion 28ª connected by a rod 29 with a bell crank 30 which latter is connected by a rod 31 to a pivoted lever 32 the opposite end of which is connected at 33 with the cam shaft 19. It will be obvious from the foregoing that as the lever 28 is shifted to the intermediate position and to extreme positions 28′ and 28″ a corresponding shifting movement will be communicated to the shaft 19.

Referring now to Figs. 4 to 6 inclusive Fig. 4 indicates the adjustment of the cam shaft 19 necessary when all of the cylinders 1 to 6 inclusive communicate and have their pistons operated by the explosive fluid. For convenience this will be termed "gas adjustment". Fig. 5 shows the adjustment necessary when the pistons of cylinders 1, 3 and 5 are driven by the explosive fluid and the pistons of cylinders 2, 4 and 6 are driven by air which adjustment will be termed the "gas-air adjustment". Fig. 6 shows the adjustment necessary when the engine is to be driven reverse to its normal direction of operation wholly by air and this adjustment will be termed the "air adjustment".

Referring now specifically to Fig. 4 the exhaust valves 7, 9 and 11 of cylinders 1, 3 and 5 are operated by members which as shown are in the form of cams 13, 15 and 17 respectively which are formed integral with the shaft 19. Each of these cams is of sufficient length to permit shifting of the shaft 19 into the gas-air adjustment shown in Fig. 5 without becoming disassociated with said valves. The cam members 13, 15 and 17 will be hereinafter termed "normal gas cams or members" for the reason that the pistons of the cylinders controlled by these valves normally operate by gasolene and run empty when they are not so operated. The valves 8, 10 and 12 which control communication to cylinders 2, 4 and 6 are operated by cams or members 14, 16 and 18 which will hereinafter be termed "gas cams or members". The valves 21, 22 and 23 controlling air communication to the cylinders 2, 4 and 6 are in this adjustment closed by their springs and remain closed by reason of the cylindrical surfaces 24 which will hereinafter be termed "neutral air surfaces". It will thus be seen that in the adjustment shown in Fig. 4 all of the pistons of the cylinders 1 to 6 inclusive are operated by gasolene or other explosive fluid.

Referring now to Fig. 5 wherein the pistons of cylinders 1, 3 and 5 are driven by gasolene or other explosive fluid and the pistons of cylinders 2, 4 and 6 are driven by air it will be noted that the "normal gas cams"

13, 15 and 17 are still in operative relation with the valves of cylinders 1, 3 and 5. The valves 21, 22 and 23 controlling the admission of air to cylinders 2, 4 and 6 are operated by "air cams or members" 37, 38 and 39. Inasmuch as it is necessary to exhaust from cylinders 2, 4 and 6 air exhaust cams 34, 35 and 36 are provided and in this adjustment the same are in operative relation with valves 8, 10 and 12. It will thus be seen that the pistons of cylinders 1, 3 and 5 are operated by gasolene while the pistons of cylinders 2, 4 and 6 are operated by air. In this position the main operating lever 28 is in the position indicated by 28'.

Referring now to Fig. 6 which is the "air reverse adjustment" wherein the operating lever 28 is in the position indicated by 28" it will be obvious that the pistons of cylinders 1, 3 and 5 must run empty and to this end the shaft 19 is provided with "neutral gas surfaces" 40 which in the present construction serve to maintain the valves 7, 9 and 11 open. Inasmuch as in this adjustment it is necessary to operate valves 21, 22 and 23 to admit air to cylinders 2, 4 and 6 the shaft 19 is provided with "reverse air cams" 41, 42 and 43 for operating said valves 21, 22 and 23. It will also be necessary to exhaust from cylinders 2, 4 and 6 and to this end "reverse cams" 44, 45 and 46 are provided for operating valves 8, 10 and 12.

It will be understood that in the adjustment shown in Fig. 6 the exhaust valves 7, 9 and 11 being held open will prevent the establishment of suction in the cylinders 1, 3 and 5 and therefore the automatic intake valves 20 will not operate to admit the explosive mixture and the pistons in said cylinders 1, 3 and 5 will run idle. It will be noted that when the adjustment of Fig. 6 is effected the pistons in cylinders 2, 4 and 6 being forced downwardly by the admission of air to said cylinders the automatic intakes 20 of said cylinders will be maintained closed during the working stroke of said pistons and during the return stroke the air will be exhausted through the exhaust valves 8, 10 and 12 and therefore the automatic intakes cannot operate.

In Fig. 5 the adjustment shown will admit air to cylinders 2, 4 and 6 in substantially the same manner as in the adjustment shown in Fig. 6 and will prevent the admission of the explosive fluid so that in each case the control of the exhaust valves and air inlet valves will control or prevent the admission of the explosive fluid.

In Fig. 10 I have shown the device of my invention applied to a three cylinder engine wherein the compressor, as hereinbefore described, is operated direct from the crank shaft 25 by a crank 55. The means shown in the preferred construction for shifting the cam shaft 19 may be employed in this construction but is not shown in connection therewith.

For convenience in designating the several cylinders in the claims, cylinders 1, 3 and 5 the pistons of which are only operated by gasolene or other explosive fluid will be termed "gas cylinders", while cylinders 2, 4 and 6 the pistons of which are operated by both gas and air will be termed "gas-air cylinders".

I claim:—

1. An explosive engine comprising in combination, a plurality of cylinders for gas and for gas or air, pistons therefor, inlet means for said cylinders, exhaust valves for said cylinders, air inlet valves for said gas or air cylinders, and means controlling said exhaust and air inlet valves and serving to effect operation of the pistons of all of said cylinders solely by an explosive fluid or to effect operation of said gas cylinder pistons solely by an explosive fluid and said gas air cylinder pistons solely by air or to cause said gas cylinder pistons to run idly and effect reversal of said engine by means of air admitted to said gas or air cylinders.

2. An explosive engine comprising in combination, a plurality of cylinders for gas and for gas or air, pistons therefor, inlet means for said cylinders, exhaust means for said cylinders, air inlet means for said gas or air cylinders, and means serving to effect operation of said gas and gas or air cylinder pistons solely by an explosive fluid or serving to effect operation of said gas or air cylinder pistons solely by air or serving to reverse the direction of operation of said engine by air acting on said gas or air pistons, said means causing said gas cylinder pistons to run idly during such reversal.

In testimony whereof I have affixed my signature in presence of two witnesses.

MARIUS BERLIET.

Witnesses:
JEAN GERMAIN,
GUILLAUME PIOCHE.