(No Model.) 3 Sheets—Sheet 1.

H. S. BRISTOL.

GAS ENGINE.

No. 575,326. Patented Jan. 19, 1897.

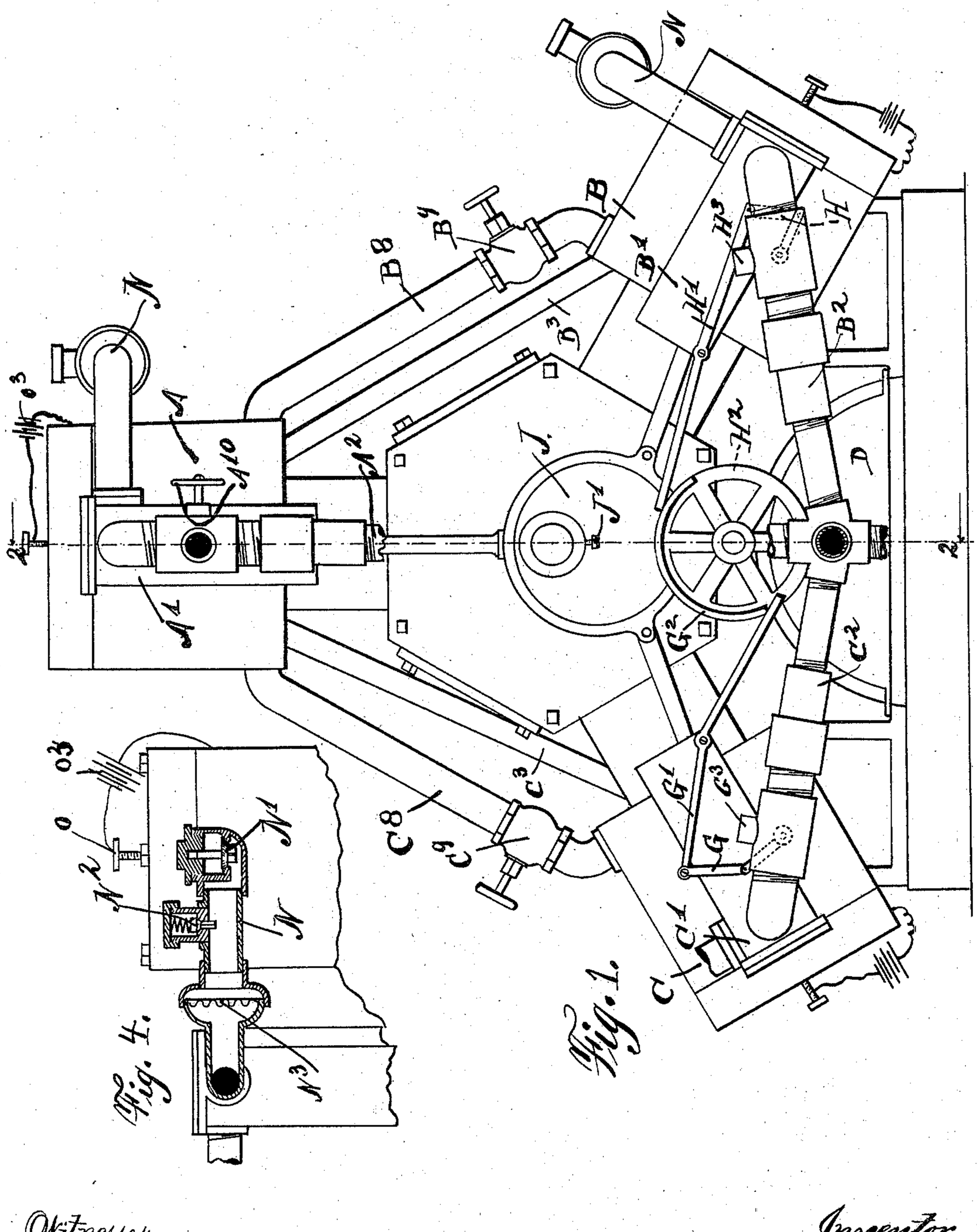

Fig. 1.

Fig. 4.

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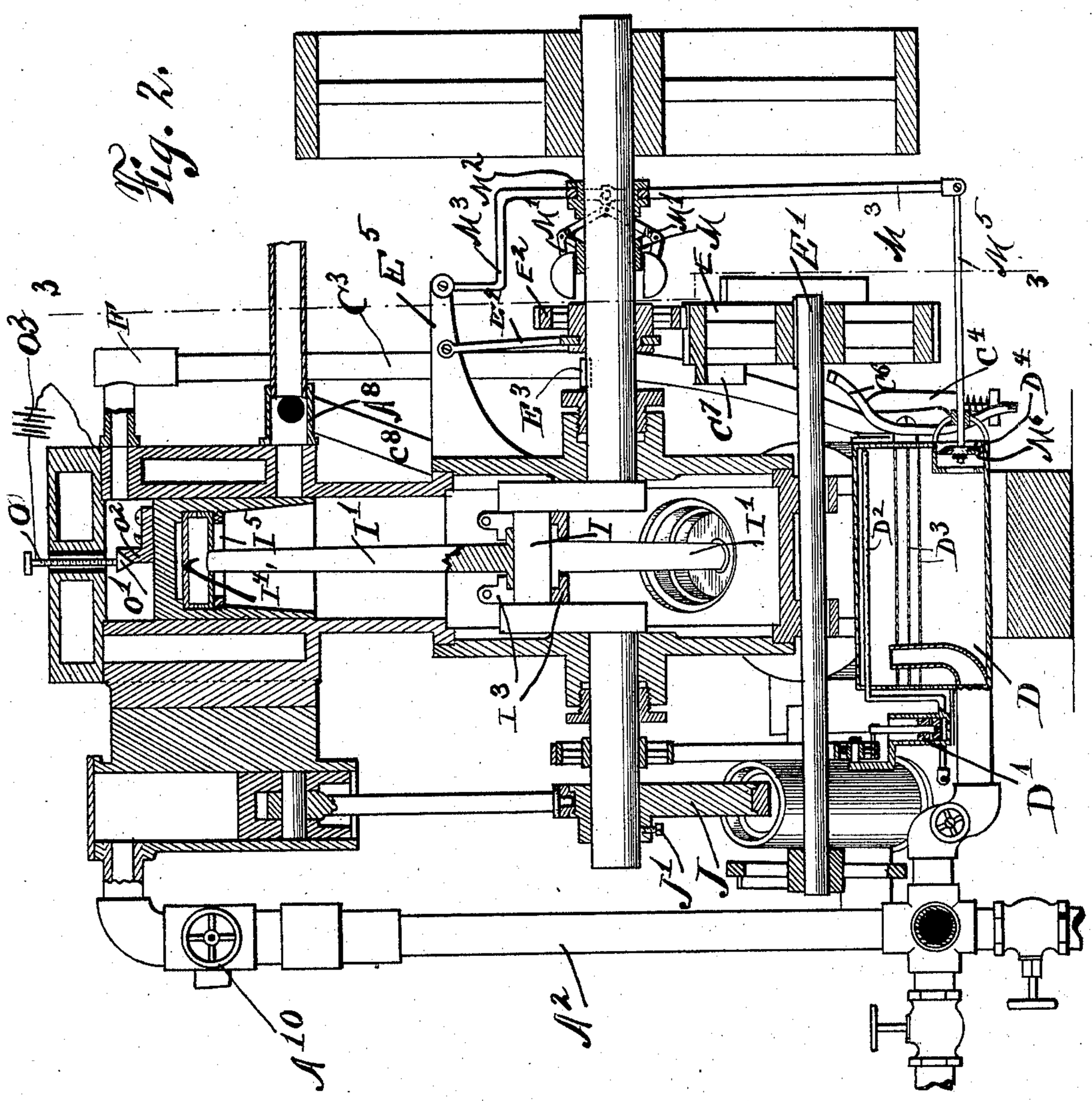
Fig. 2.



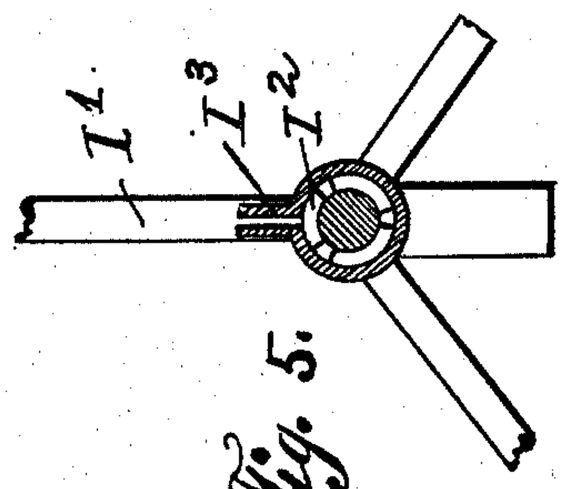


Fig. 5.

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(No Model.) 3 Sheets—Sheet 3.

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GAS ENGINE.

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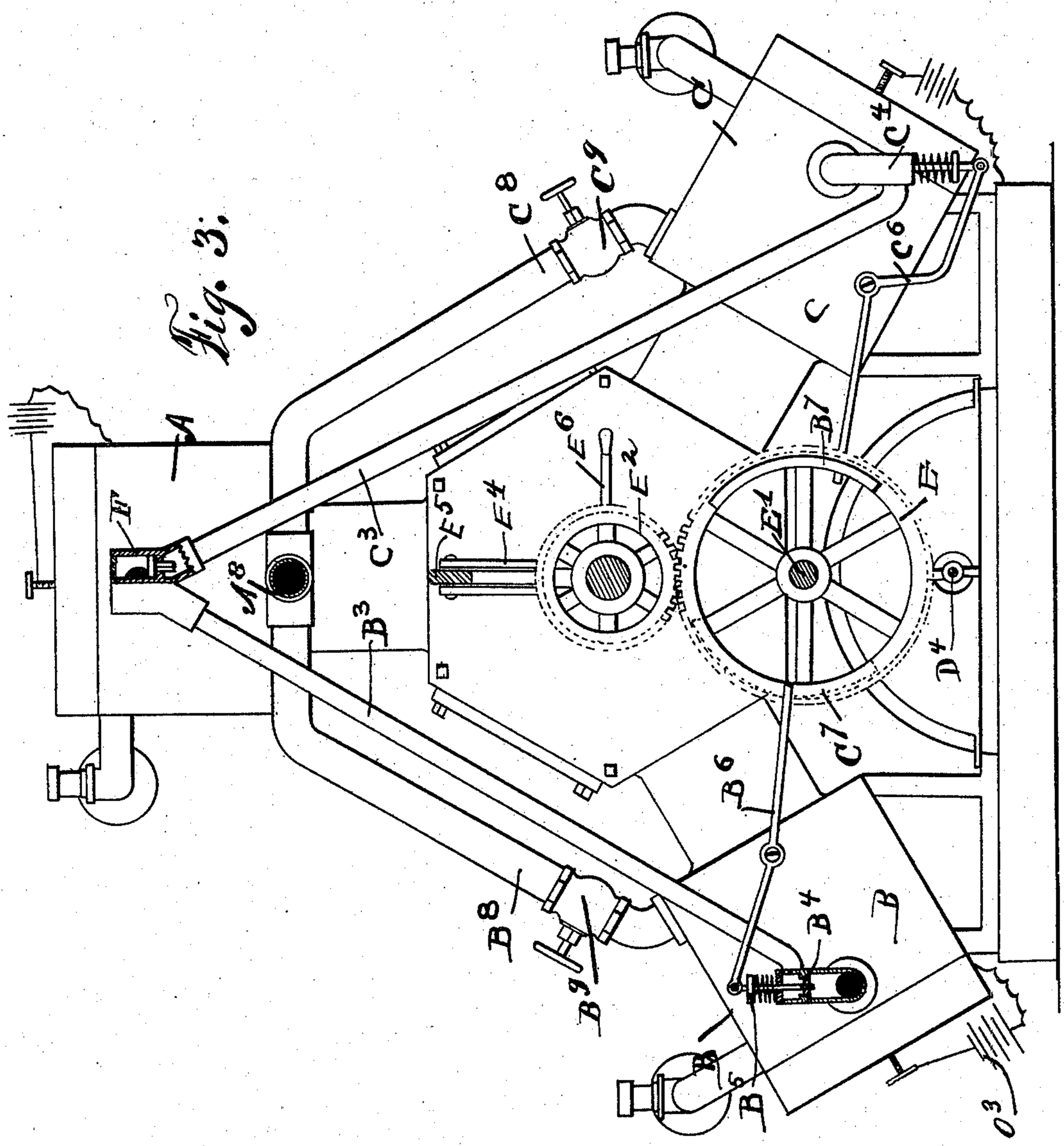
Fig. 3.



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UNITED STATES PATENT OFFICE.

HARVEY S. BRISTOL, OF CHICAGO, ILLINOIS.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 575,326, dated January 19, 1897.

Application filed September 7, 1895. Serial No. 561,725. (No model.)

To all whom it may concern:

Be it known that I, HARVEY S. BRISTOL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Gas-Engines, of which the following is a specification.

My invention relates to gas-engines, and has for its object to produce a new and improved engine, of which the following is a description, reference being had to the accompanying drawings, wherein—

Figure 1 is a front elevation of the engine. Fig. 2 is a vertical section on line 3 3, Fig. 1. Fig. 3 is a section on line 3 3, Fig. 2. Fig. 4 is a detail in part section, showing the connection between the working cylinders and the compressors. Fig. 5 is a detail showing the connection of the piston-rods to the crank.

Like letters refer to like parts throughout the several figures.

I have constructed this engine so that it may be made to operate by an explosion in each cylinder for every revolution of the crank, explosions occurring successively in the three cylinders. By manipulating a few valves I may change the working of the engine so that there are explosions in the two lower cylinders only. In such event the explosions will occur first in one cylinder and then in the other, each cylinder having only one explosion for every two revolutions of the crank. The gas is exhausted from these cylinders into the upper cylinder and its force is utilized in driving the piston of such cylinder and is then exhausted into the air. By this arrangement I get practically a noiseless exhaust and at the same time utilize the force of the gas in the noise-destroying device to aid in driving the shaft of the engine.

I have shown in the drawings three working cylinders A B C, disposed about a common center, such cylinders being provided with compressors A′, B′, and C′, which are used to force the charge of gas into the cylinder. These compressors are connected with the evaporator D by means of the pipes A^2, B^2, and C^2. The gasolene is forced into this evaporator by means of the pump D′. The pipe D^2, through which the gasolene is forced, is provided with a number of perforations, as shown. The gasolene falls upon the wire-gauze D^3, which breaks it up and allows it to evaporate more rapidly. Air is admitted into the evaporator through the opening D^4. When the engine is run by means of the explosions in the cylinders B and C, the exploded gas is exhausted into the cylinder A through the pipes B^3 and C^3. The pipe B^3 is provided at its lower end with the valve B^4, which is held against its seat by the spring B^5. The stem of this valve is connected to one end of the pivoted lever B^6, the other end of said lever being placed in the path of the projecting lug B^7 on the face of the wheel E. Said wheel is connected with the shaft E′ and is operated by means of the gear E^2 on the engine-shaft. The gear E^2 is adapted to slide along the engine-shaft and is connected so as to rotate therewith by the feather E^3. A bifurcated arm E^4 is connected with the support E^5, the lower ends engaging a groove in the hub of the gear E^2, and an arm E^6 is connected to said bifurcated arm so that the gear E^2 may be moved along the shaft by means of said arm. By this construction the shaft E′ may be thrown out of engagement with the engine-shaft by moving the pinion E^2 out of engagement with the feather E^3.

The wheel E is preferably twice the diameter of the gear E^2, and the lug B^7 is of such size and so positioned that it engages the end of the lever B^6 while the piston of the cylinder B is making its downward stroke. When the end of the lever B^6 is in engagement with the lug B^7, said lever is moved so that the valve B^4 is opened and the gas in cylinder B is exhausted through pipe B^3 into cylinder A. The pipe C^3 is provided at its lower end with a similar spring-actuated valve C^4, having its stem connected to one end of the pivoted lever C^6, the other end of said lever being placed within the path of a lug C^7 on the rear side of the wheel E, said lug being shown in dotted lines. The pipes B^3 and C^3 are each provided at their upper end with a check-valve F. The compressors B′ and C′ are each provided with a three-way valve, which is operated by mechanism similar to that which operates the valves B^4 C^4. These valves are connected by means of the links G and H to the pivoted levers G′ H′. The ends of these levers are placed within the paths of the lugs G^2 H^2 on the opposite faces of the wheel E^7, rigidly con-

nected to the shaft E′. These three-way valves are so constructed that the compressors can be connected with the evaporator or with the atmosphere by means of the pipes G^3 H^3.

Since the cylinders C and B only receive a charge of gas at every other revolution of the crank, the mechanism which operates these valves is so constructed that the compressors will be connected with the evaporator during one stroke of the engine and with the atmosphere during the next stroke. The pipes A^2, B^2, and C^2 are each provided, in addition, with a check-valve. The pipe A^2, which connects with the compressor A′, is provided with a three-way valve controlled by the hand-wheel A^{10}.

The cylinders A, B, and C are provided, respectively, with the exhaust-pipes A^8, B^8, and C^8, which are connected together and which lead the exploded gases away. These pipes are used when the engine is operated by exploding the gas in each cylinder. The pipes B^8 and C^8 are provided with a valve B^9 and C^9, which are closed when the engine is operated by explosions in the two cylinders B and C. The pistons of the cylinders A, B, and C are connected to the engine-crank I by means of connecting-rods I′ I′. This connection may be in any convenient manner, but I prefer to have the connecting-rods of brass, in which event they will each be provided with an enlarged end I^2, which bears against the crank-shaft and will be held in place by means of the split rings I^3 I^3, which encircle the ends thereof, as shown in Figs. 2 and 5. The connecting-rods I′ are fastened at their outer ends to the pins I^4 I^4, which are held in position in the hollow piston by means of the screw-threaded ring I^5. (See Fig. 2.)

The pistons of the compressors are connected with the engine-shaft by means of the eccentric J. This eccentric is rigidly connected to the shaft by means of the set-screw J′, and hence its position may be varied by loosening said set-screw. The governing device for the engine consists of a sleeve M, rigidly connected to the engine-shaft, (see Fig. 2,) to which is pivoted the weighted arms M′ M′. These arms engage the loose sleeve M^2 in the ordinary manner of a clutch-shifting device. A pivoted arm M^3 is connected with the sleeve M and with the supporting-arm E^5, and is connected by arm M^5 with a valve M^6, associated with the opening D^4 in the evaporator D. The parts are so constructed that as the weights on the ends of the levers M′ move away from the engine-shaft the valve M^6 will be moved so as to close the opening D^4 and thus shut off the supply of gas to the engine.

The compressors are each connected with the working cylinders by the pipes N N, a detail of one of which is shown in Fig. 4. Each of these pipes N is provided with a check-valve N′, a safety-valve N^2, and the piece of wire-gauze N^3, which extends across the pipe, as shown. This gauze is to prevent the passage of the explosion from the working cylinder to the compression-cylinder, and the safety-valve is adapted to relieve the pressure in pipe N should the explosion get past the valve N′.

Each of the pistons A, B, and C is provided with some suitable igniting device. As shown in the drawings, this device consists of the rod O, inserted through the top of each cylinder, but insulated therefrom, said rod being provided at its end with a cone-shaped contact O′. Each of the pistons is provided with a contact-piece O^2, said pieces each having a curved contact-surface adapted to come in contact with the contact O′ when the piston is at the end of its stroke. The rod O is connected with the battery O^3, the other pole of said battery being connected with the cylinder.

I have omitted in the above description many of the details of the engine, as I do not consider their explanation necessary to the understanding of my invention.

It is evident that the various parts of my engine may be greatly varied in form, construction, and arrangement without departing from the spirit of my invention, and I therefore do not wish to be limited to the construction herein shown and described.

I have not stated the exact moment at which the exhaust-valves of the cylinders B and C will be opened and closed, as that will of course depend upon the engine and will be regulated so as to produce the best results.

The use and operation of my invention are as follows:

When it is desired to have the engine work by exploding in the two lower cylinders B and C, the shaft E′ is connected with the engine-shaft by moving the gear E^2 in engagement with the feather E^3. In this case the compressor A′ is not used, and the hand-wheel A^{10} is turned so as to cut off communication with the evaporator and to connect said compressor with the air. The valves C^9 C^9 in the exhaust-pipes C^8 B^8 are also closed. The explosions occur alternately in the cylinders B and C, such explosions occurring every other revolution of the engine-shaft. It will therefore be seen that there will be one explosion during each revolution of the engine-shaft. Suppose, for example, that the piston in cylinder B is at the lower end of its stroke and is just beginning to move upward. When the contact on the piston leaves the contact O′, a spark will occur, which ignites the gas in the cylinder. The explosion of the gas forces the piston upwardly. The three-way valve in the pipe B^2 is normally in such position that the compressor B′ is in communication with the evaporator D. The mechanism which operates this valve is so constructed that the valve will be moved so as to connect the compressor B′ with the atmosphere when the piston in the cylinder B is at the downward limit of its stroke, or, in other words, in the position it was at the beginning of this description. The lugs H^2 and G^2 are of such length that these valves are held open for a complete revolution

of the engine-shaft, and hence the compressor simply draws in and forces out a charge of the air during such revolution of the engine-shaft. As the piston in the cylinder B begins to move upwardly the valve B^4 (see Fig. 3) is opened by the lug B^7 coming into engagement with the lever B^6 and the exploded gas is forced through the pipe B^3 into cylinder A. When the piston in cylinder B reaches the downward limit of its stroke, all of the exploded gas is forced out of the cylinder. The lever B^6 now becomes disengaged from the lug B^7 and the spring B^5 closes the valve B^4. At the same time the lever G′ associated with the compressor becomes disengaged from the lug G^2, and the three-way valve, which is a spring-actuated valve, is moved so as to connect the compressor with the evaporator. As the piston in cylinder B moves upwardly it draws in a charge of gas, the compressor doing likewise, and as the two pistons again return the charge is compressed in the end of the cylinder. When the piston in cylinder B again moves downwardly, so as to disengage the two electrical contacts within the cylinder, a spark is produced and the charge is ignited. The operation as described above is then repeated. The supply of gas which is exhausted into the cylinder A is utilized to force the piston of such cylinder downward. When the upper edge of said piston passes below the opening of the exhaust-pipe A^8, said gas is exhausted into the air. The check-valves F prevent the gas that remains in the cylinder from being forced back into the cylinders B and C.

The operation in cylinder C is the same as that described with relation to cylinder B. The explosion in such cylinder will of course not occur at the same time as the explosion in cylinder B, but will be regulated so that there will be one explosion in said cylinder during one revolution of the engine-shaft and one explosion in cylinder B during the next revolution of the engine-shaft. The pistons of the compressors may be set by means of the set-screw J′ and the eccentric J, so as to have any desired relation with the pistons of the working cylinders.

If it is desired to have the engine operate by the explosion in each of the cylinders during each revolution, such result may be brought about by opening the valves C^9 C^9 and disengaging the gear-wheel E^2 from the feather E^3 on the engine-shaft. The mechanism which operates the valves B^4 and C^4 is now stationary and said valves remain closed. The three-way valves in the pipes B^2 C^2, associated with the compressors, will also remain stationary and will be in such a position that the compressors are in communication with the evaporator. The hand-wheel A^{10} is also moved so as to connect the compressor A′ with the evaporator. The operation will then be as follows: Suppose, for example, that the piston in cylinder A is at the upper end of its stroke. As it moves downwardly the two electrical contacts will be separated and a spark will be produced, which will explode the gas within the cylinder. The piston is now forced downwardly and when it reaches the lower limit of its stroke the mouth of the exhaust-pipe A^8 is open and the charge of exploded gas passes therethrough. The piston of the compressor preferably bears such relation to the piston of the working cylinder that it will move upwardly before the piston of the working cylinder begins to move upwardly, and will thus force the gas into such cylinder and cause the exploded gas to be forced out of the exhaust-pipe. It is of course evident that this relation can be made such that the exhaust-pipe will not be closed until substantially all of the exploded gas is forced therethrough. As the piston in the cylinder A moves upwardly the piston of the compressor also moves upwardly and the charge of gas is compressed in the upper part of the cylinder. Such charge is again exploded as the cylinder begins to move downwardly and the operation above described is repeated. The operation of the other two cylinders is similar to that just described, the exploded gas being exhausted through the pipes B^8 C^8. If the engine-shaft is rotated at too high a speed, the weights on the ends of the arms M′ M′ move outwardly and the opening D^4 is closed, so as to shut off the supply of gas to the cylinder. The speed will then be reduced, and when it becomes normal the opening D^4 will be opened, so as to again admit gas into the cylinder.

I claim—

1. The combination in a gas-engine of three cylinders mounted around a common center, a compressor associated with two of such cylinders and connected with the source of gas-supply, so that said cylinders may be charged with gas, a connecting device associated with each of said cylinders, pipes or passages connecting the three cylinders together, said pipes or passages so constructed and arranged that the exploded gas is conducted from the two cylinders into the third so as to be utilized in operating the piston of said third cylinder, a series of valves in said connecting-pipes provided with operating-arms, one or more wheels or disks operatively connected with the engine-shaft and provided with projecting lugs adapted to engage said disks and to operate the valves at predetermined times.

2. A gas-engine comprising three cylinders arranged around a common center, each cylinder provided with connections by which it may be connected with the source of gas-supply and adapted to have a charge of gas exploded therein at each revolution of the engine-shaft, connections between said cylinders, said connections provided with controlling-valves and so arranged that the engine may be easily and quickly changed from a simple triple-expansion engine to one in which there will be an explosion in each of the two cylinders at every other revolution of the engine-shaft, the exploded gas being exhausted

through the third cylinder, substantially as described.

3. A gas-engine comprising three cylinders arranged around a common center, exhaust-pipes leading from two of said cylinders to the third, a valve associated with each of said exhaust-pipes and a valve-operating mechanism associated with said valves and actuated by the engine-shaft, whereby the exploded gas is alternately conveyed from the two cylinders to the third substantially as described and a disk-connecting device between said valve-operating mechanism and the engine-shaft whereby said mechanism may be rendered inoperative.

4. A gas-engine comprising three cylinders arranged around a common center, a compressor for two of said cylinders adapted to force gas therein, exhaust-pipes leading from said two latter cylinders to the third, a valve associated with each of said exhaust-pipes and with each of said compressors, and a valve-operating mechanism associated with each of said valves and actuated by the engine-shaft so as to open them at a predetermined point substantially as described.

5. A gas-engine comprising three cylinders arranged around a common center, an exhaust-pipe leading from the inner end of each cylinder, a compressor associated with each cylinder and connected with a source of gas-supply, a valve associated with each of said compressors, a valve-operating mechanism connected with each of said valves adapted to operate them at a predetermined point, an exhaust-pipe leading from the outer end of said latter two cylinders to the outer end of the third cylinder, a valve associated with each of said pipes, a valve-operating device connected with each of said valves and adapted to open them at a predetermined point, and a series of valves associated with the various cylinders whereby the engine may be operated as a triple-explosion engine or as an engine having an explosion every alternate revolution of the engine-shaft in two of its cylinders, the exploded gas being exhausted through the third cylinder, substantially as described.

Signed at Chicago, Illinois, August 15, A. D. 1895.

HARVEY S. BRISTOL.

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