No. 844,458. PATENTED FEB. 19, 1907.

C. H. MORGAN & A. J. GIFFORD.

VALVE GEAR FOR EXPLOSIVE ENGINES.

APPLICATION FILED JAN. 2, 1903.

4 SHEETS—SHEET 1.

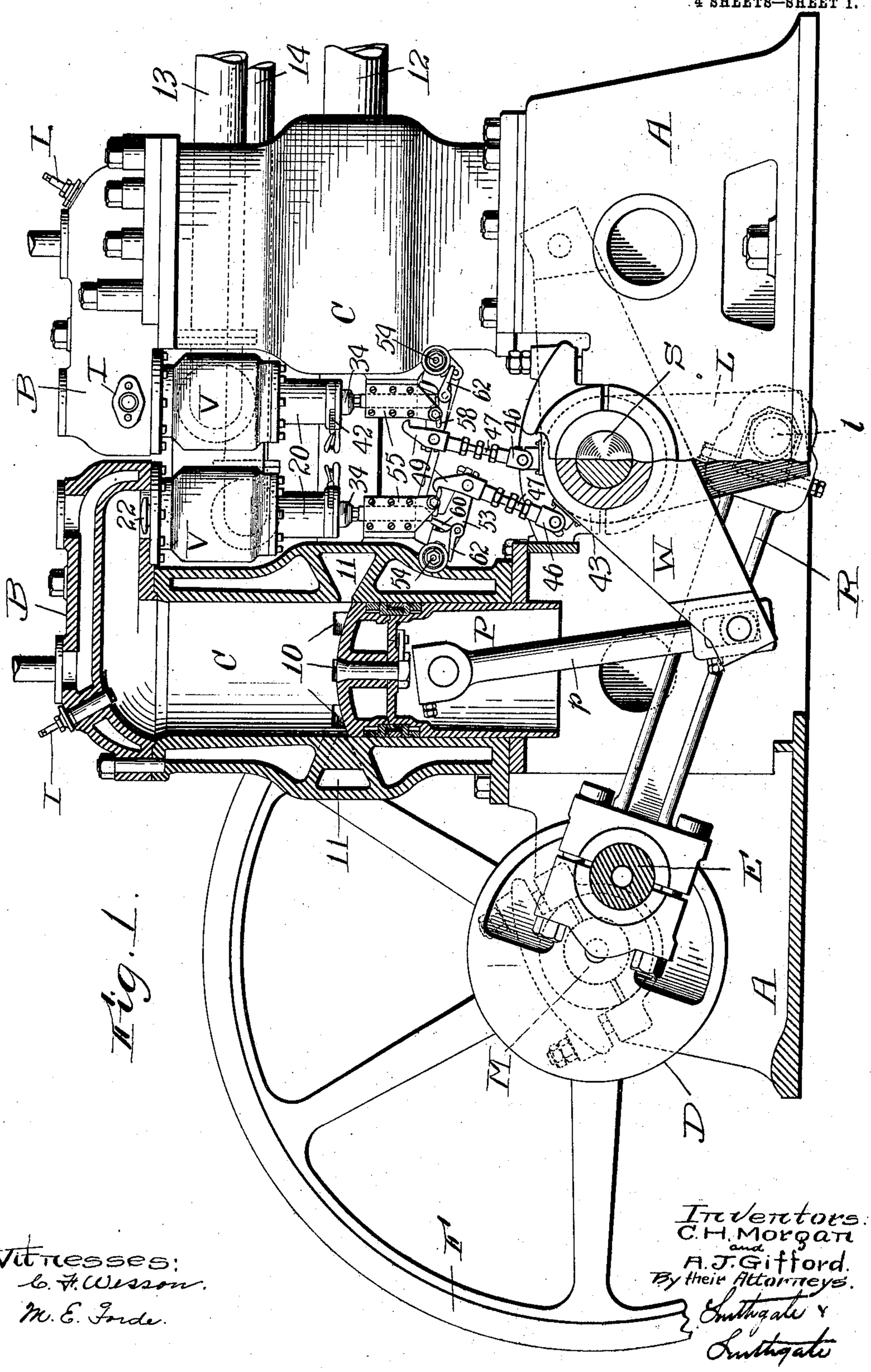

Fig. 1.

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4 SHEETS—SHEET 2.

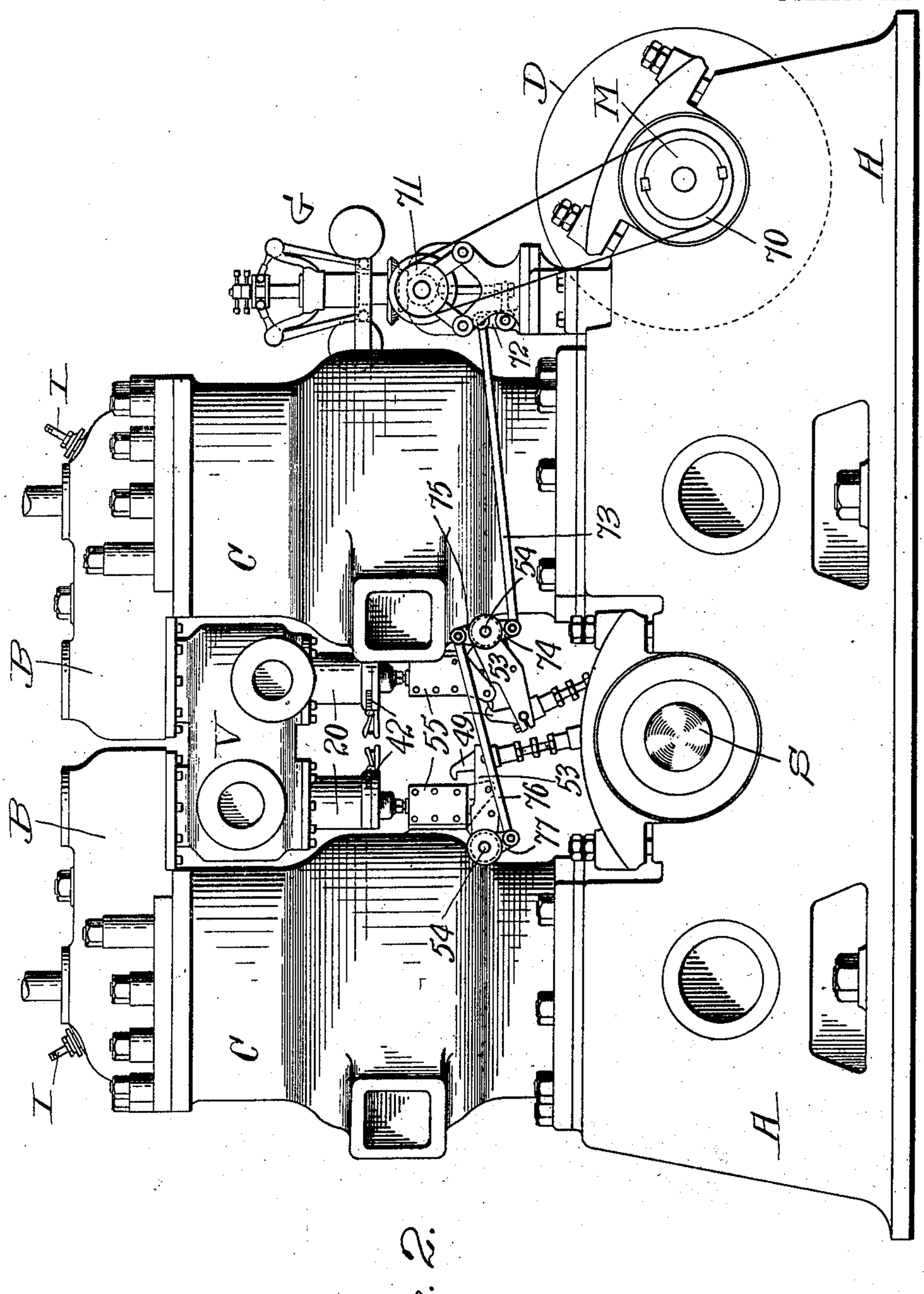

Fig. 2.

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4 SHEETS—SHEET 3.

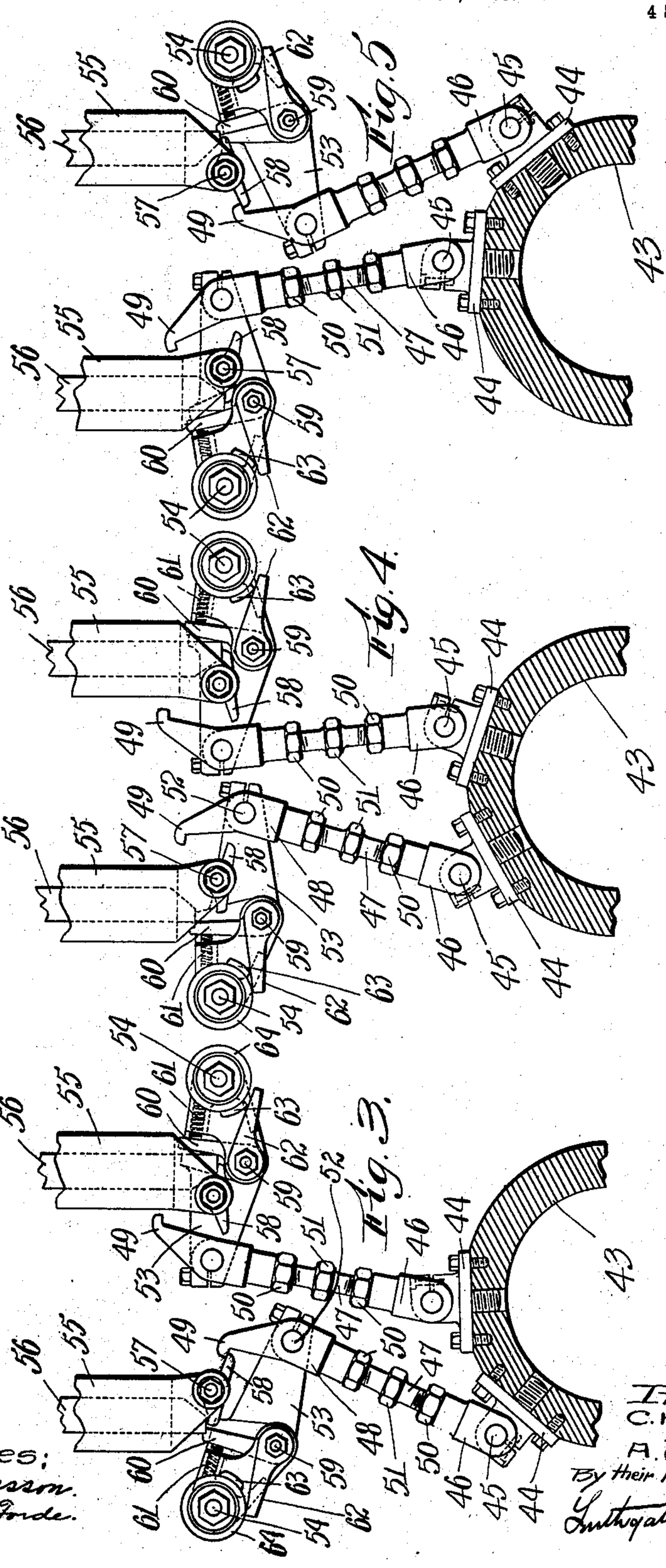

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

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4 SHEETS—SHEET 4.

Fig. 8.

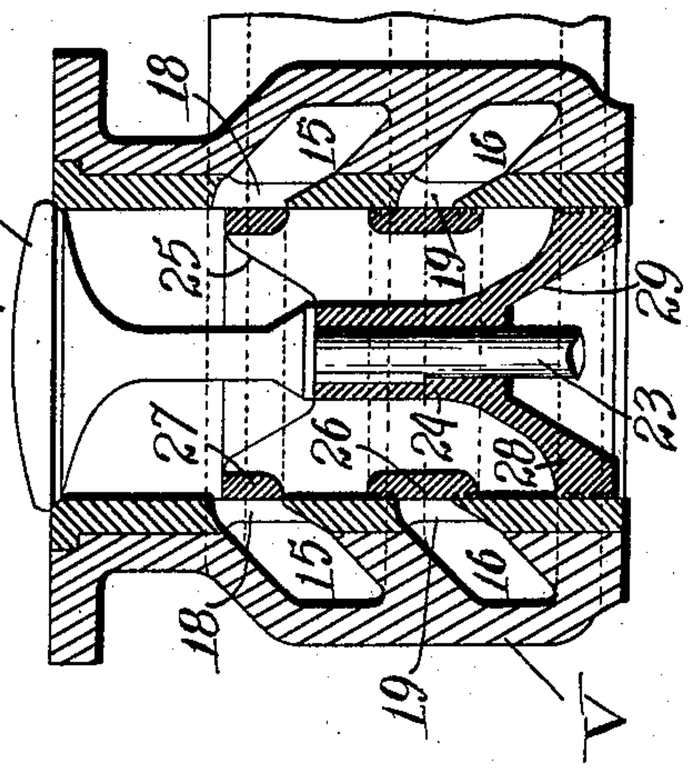


Fig. 10.

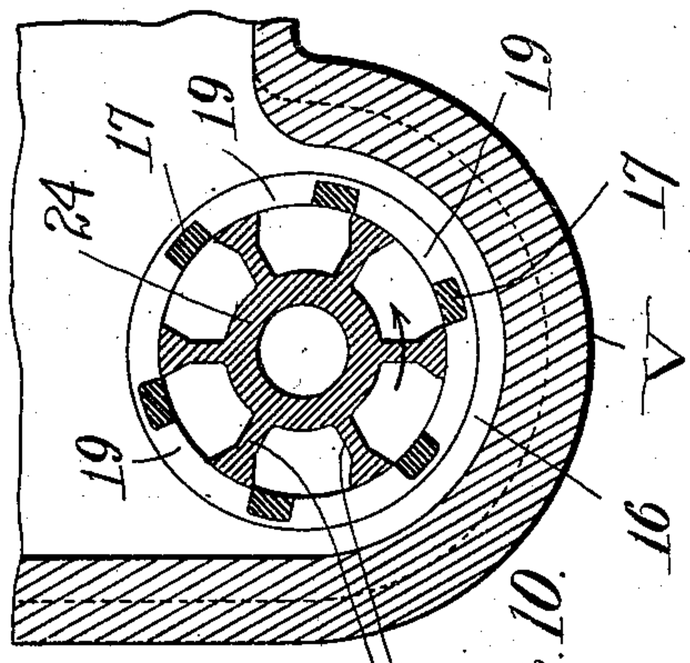


Fig. 7.

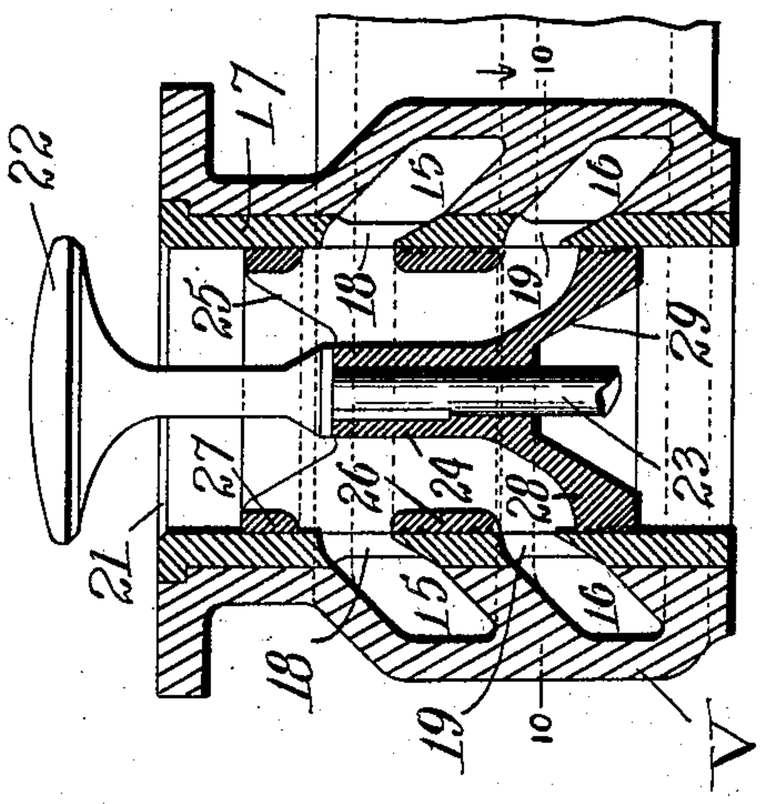


Fig. 9.

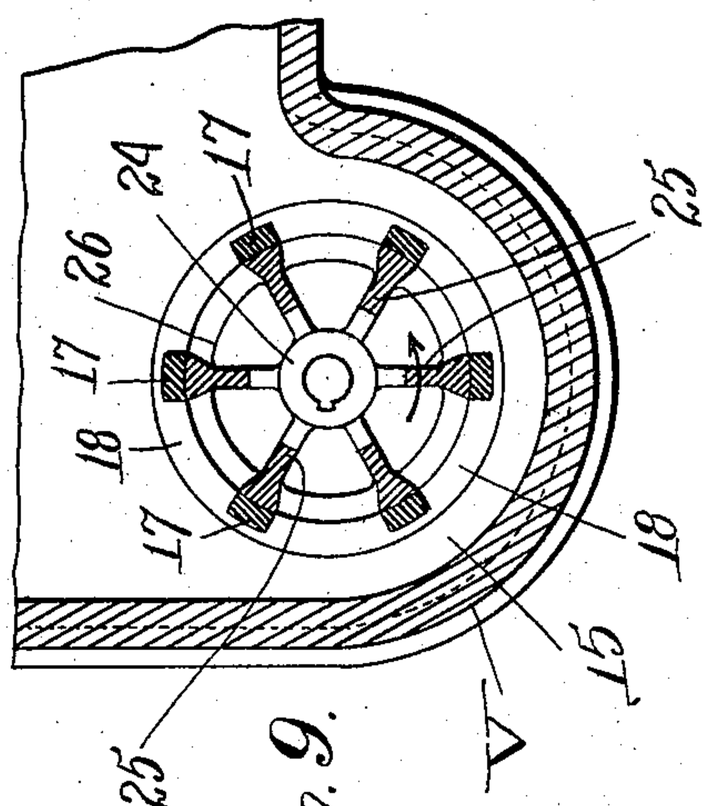
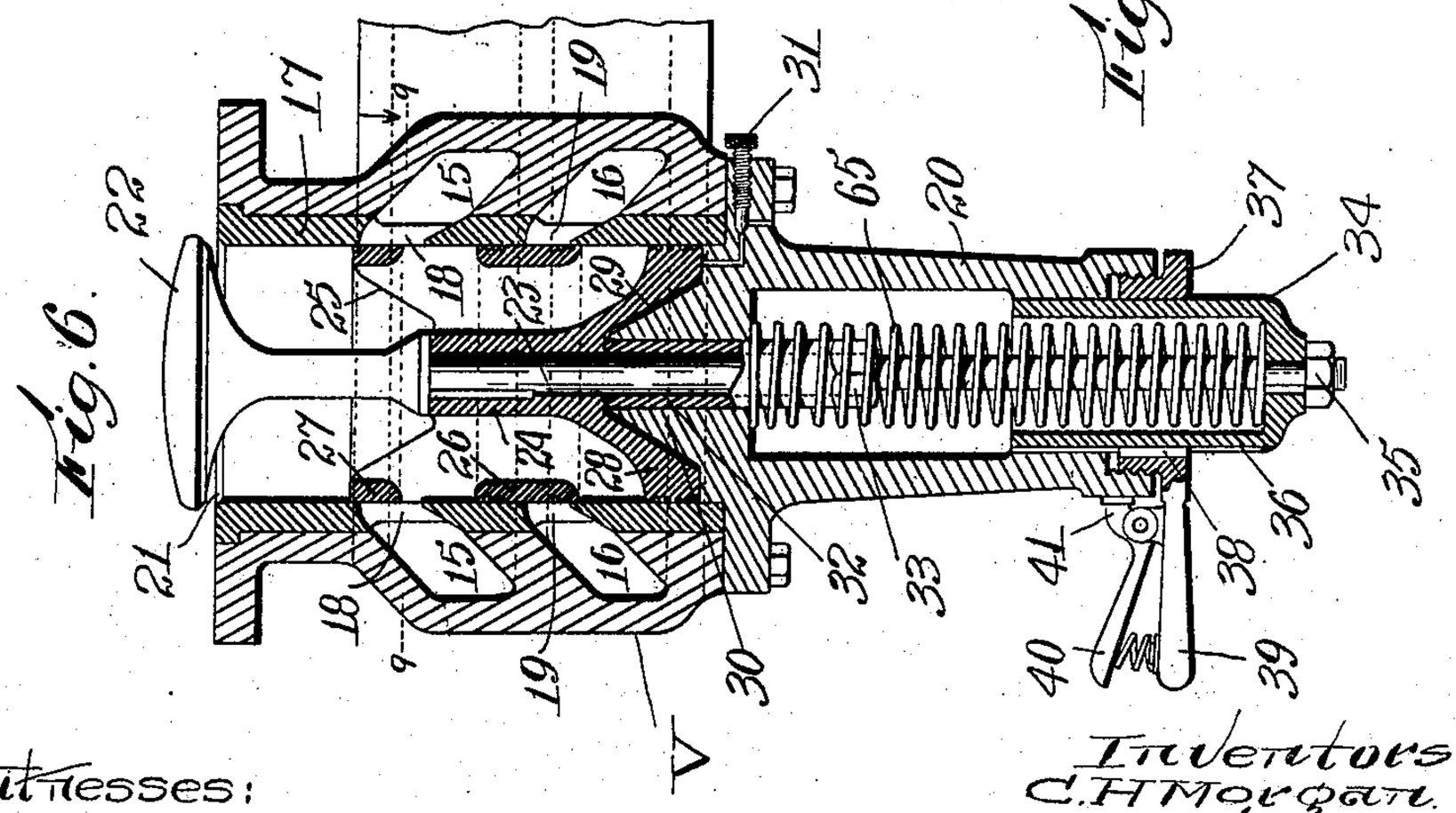


Fig. 6.



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UNITED STATES PATENT OFFICE.

CHARLES H. MORGAN AND ALBERT J. GIFFORD, OF WORCESTER, MASSACHUSETTS; SAID GIFFORD ASSIGNOR TO SAID MORGAN.

VALVE-GEAR FOR EXPLOSIVE-ENGINES.

No. 844,458. Specification of Letters Patent. Patented Feb. 19, 1907.

Application filed January 2, 1903. Serial No. 137,473.

To all whom it may concern:

Be it known that we, CHARLES H. MORGAN and ALBERT J. GIFFORD, citizens of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Valve-Gear for Explosive-Engines, of which the following is a specification.

The object of this invention is to provide a new and improved system of valves and valve-operating connections for explosion or internal-combustion motors.

The improvements have been especially designed for use in connection with the two-cycle system of gas-engine, in which the piston is forced forward on one movement by the combustion or explosion of a compressed mixed charge of air and gas, in which the exhaust takes place as the piston reaches the end of this movement and in which the products of combustion remaining in the cylinder are blown out by a blast of air under pressure, so that a fresh charge of air and gas can be introduced and compressed as the piston makes its backward movement, whereby a fresh impulse is obtained on each forward movement of the piston.

In this application for patent we have shown the improvements applied to a two-cylinder type of motor substantially the same in structural arrangement as the four-cylinder motor shown in the application for patent filed by Charles H. Morgan, August 14, 1901, Serial No. 71,978, although it is to be understood that the improvements can be applied to any form of motor of this class.

Referring to the accompanying four sheets of drawings, forming part of this application for patent, Figure 1 is a side elevation, partly in section, of a gas-engine with the improvements applied thereto, the governor connections being omitted, so that the other parts can be seen. Fig. 2 is an elevation of opposite side with the fly-wheels removed. Figs. 3 to 5, inclusive, are partial views, on an enlarged scale, illustrating the operation of the valve-operating connections. Fig. 6 is a sectional elevation of one of the valves and its parts. Figs. 7 and 8 are similar views of the valve, illustrating the same in different positions. Fig. 9 is a cross-sectional view of the valve, taken on the line 9 9 of Fig. 6, and Fig. 10 is a cross-sectional view of the valve, taken on the line 10 10 of Fig. 7.

Referring to the drawings and in detail, A represents the framework of the machine.

C designates the cylinders, which are shown as arranged in vertical position. Working in each cylinder is a piston P. Each piston connects by a piston-rod *p* to a walking-beam W, secured on a shaft S, which is journaled in the framework. Secured on the shaft S is a lever L, which carries a crank-pin *l*, which connects by a rod or link R to a crank-pin E, secured to crank-disks D, arranged on the main shaft M. This main shaft M is journaled in suitable bearings in the frame and carrier the usual fly-wheels F. By these connections as the pistons are reciprocated in their cylinders the fly-wheels will be rotated. Secured on the top of each cylinder is a head B, which overhangs at one portion of the cylinder, so that a valve-casing V can be secured to both heads parallel with the cylinders. This forms a simple and compact arrangement. The walls of the cylinders and cylinder-heads are made hollow, so that they can be water-jacketed in the usual manner. One or more igniters I are arranged in each cylinder-head. Two igniters of the electric or spark form are preferably employed in each head. Each cylinder is provided with a series of exhaust-ports 10, which are uncovered as the piston approaches the limit of its downward movement. These ports 10 communicate with an annular chamber 11, and an exhaust-pipe 12 connects with each of these chambers.

13 designates the air-supply pipe, and 14 the gas-supply pipe. The air-pipe 13 connects to a chamber 15 in the casing V common to the two valves for the two cylinders, and the gas-pipe 14 connects to a similar common chamber 16. As each of the valves is the same in construction, a description in detail of one will suffice.

A lining 17 is driven in or secured to the valve-casing V. This lining has a series of slots 18 formed or cut therein to register with the chamber 15 and a series of slots 19 to register with the chamber 16. Bolted to the bottom of the valve-casing V is a head or cap 20. The top of the lining 17 is turned or ground to form a valve-seat 21, coöperating with which is a valve 22. This valve is made in the form of a puppet-valve and is accurately ground to fit the seat 21. Depending from the valve 22 is a stem 23. Keyed

onto the stem is a cylindrical valve-body 24. This valve-body has projecting ribs 25, which carry valve-rings 26 and 27. The ribs also are important means or factors for securing the more perfect mixture of air and gas before entering the cylinders. The lower end of the valve-body 24 is formed into a ring 28, into which the ribs 25 join. The rings 27 and 28 may have suitable packing therein, so as to fit tightly to the lining 17. The rings 26 and 27 are used to control the air and gas ports. The lower ring 28 is turned out so as to have a conical depression 29. This coacts with a cone-shaped hub 30, formed on the cap 20 so as to form a dash-pot, which is conical in shape and which extends up inside the valve, so that the pressure will be exerted in a manner tending to keep the lower valve-ring tight on the lining. The action of this dash-pot is controlled by a valve 31, arranged in a small passage communicating from the atmosphere into the space between the cone 30 and the ring 28. The valve-stem 23 has a bushing 32 placed thereon bearing against the cylindrical valve and held in place by a nut 33, threaded on the valve-stem 23. On the end of the valve-stem is secured a cup-shaped guiding-piece 34. This piece is keyed to the end of the valve-stem 23 and is held in place thereon by a nut 35. A keyway 36 is cut in the guiding-piece 34. The cup-shaped guiding-piece fits in a bearing formed in the lower part of the cap 20. The lower rim of the cap 20 is screw-threaded, and threaded into the same is a hub 37, which has a key 38 engaging the keyway 36, formed in the guiding-piece 34. The hub 37 has a projecting handle 39, pivoted on which is a spring-pressed spoon 40, having a knife-edged ear 41, which can engage any one of a series of notches 42, formed at the bottom of the cap 20. By this arrangement the entire valve and its appurtenances can be turned and set in adjusted position. The purpose of this is as follows: The slots 18 in the lining 17 are offset relatively to the slots 19. The air passes in from the annular chambers 15 through the slot 18, and the gas passes from the chamber 16 through the slots 19, and the air and gas mix and pass up between the ribs 25. Hence the position of the ribs 25 relatively to the ribs which remain in the lining 17 after the slots 18 and 19 are cut therein will determine or limit the size of the air and gas supply ports as the richness or leanness of gas requires. As shown in Fig. 9, the air-openings up through the valve-body 24 are adjusted to their widest extent and the gas-openings, as shown in Fig. 10, are adjusted to their smallest extent. If now the valve should be slightly turned by means of the handle 39 in the direction indicated by the arrows in Figs. 9 and 10 the air-openings would be diminished in size and the gas-openings increased. By this means as the air-supply passages are diminished the gas-supply passages are increased in area, and vice versa. This provides an admirable adjustment for the purpose named, and by this adjustment the proper relative proportion between the gas and air supply can be accurately obtained.

Referring now to the connections which are used to actuate the valves, 43 designates an enlarged central portion of shaft S, which forms, in effect, a wrist-plate. Each valve is operated from this wrist-plate, and as the connections are the same the description of one set will suffice. Bolted on the wrist-plate is a bearing or bracket 44, which carries a wrist-pin 45, engaging which is a head 46. This head is connected by a bolt 47 to a head 48, which has extending therefrom a catch 49, usually made in the form of a hook, although a roll is sometimes used. The bolt 47 is oppositely threaded into the heads 46 and 48, and check-nuts 50 are arranged thereon, as shown. The bolt 47 has a bolt-head 51. This provides for an adjustment between the heads 46 and 48. The head 48 is pivoted on a pin 52, which projects laterally from an arm 53, loosely arranged on a shaft 54.

Attached to the side of each cylinder-casing is a guideway 55, in which is arranged a slide 56, the upper end of which engages the end of the valve-stem 23. Pivoted on a stud 57, mounted at the lower end of the guideway 55, is a small lever 58, one end of which is arranged in position to coöperate with the catch or hook 49, and the other end of which is arranged in position to bear on the lower end of the slide 56.

Mounted on a shaft 59, journaled in the arm 53, is a trigger 60, the end of which is arranged in position to engage the lower end of the slide 56. A spring 61 is employed to keep the trigger in position normally to engage the lower end of the slide 56. Also secured on the shaft 59 is an arm 62, which is arranged in position to strike on a projection or cam 63, extending from a hub 64, secured to the shaft 54. The shaft 54 is controlled by a governor, as hereinafter described, so that the cam 63 has its position controlled or adjusted by the governor.

To follow the operation of these parts, the left-hand cylinder shown in Fig. 1 should be considered. As the piston approaches the end of its downward movement the same uncovers the exhaust-ports 10. When the parts approach this position, the hook or catch 49 engages the lever 58 and operates the same to lift the valve 22 slightly, so that the same will assume the position shown in Fig. 6. This will allow a current or blast of air to sweep through the cylinder and drive the products of combustion remaining in the cylinder out through the exhaust-ports 10. As the piston reaches the extreme of its

downward movement the trigger 60 snaps under the slide 56. Then as the piston commences its upward movement the upward motion of the arm 53 will lift the puppet-valve 22 and the cylindrical valves to the position shown in Fig. 7. This will allow a mixed charge of air and gas to flow over into the cylinder. The valves will remain in this position until the arm 62 engages the governor-controlled cam 63, as shown in Fig. 4, when the continued upward movement of the arm 53 will cause the trigger to move from under the end of the slide 56, thus allowing the valves to return to their normal position. (Illustrated in Fig. 8.) This release of the trigger is illustrated in Fig. 5. The puppet-valve will come properly and easily to its seat by reason of the dash-pot arrangement previously described. A spring 65 is usually arranged in the cap 20 between the top thereof and the guide-piece 34 to force the valves to normal position. In addition the pressure of explosion will keep the valve 22 on its seat. This valve mechanism will thus provide a governor-controlled quick-acting cut-off for the supply of air and gas. After the supply of air and gas has been cut off in this way the continued upward movement of the piston will compress the mixed charge contained in the cylinder until the piston reaches its highest point, when the igniters will explode the charge, and thus force the piston on its downward or positive movement.

It will be noted after the catch 49 has given the valve 22 its initial opening movement that as the arm 53 makes its upward movement the catch will move away from the lever 58, as illustrated in Fig. 4, so that the same will not interfere with the quick closing of the valves when the trigger 60 is released.

The upper valve-ring 27 is made short, so as not to quite cover the air-inlet passages 15 when in normal position. This is done so that when the valve 22 is given its initial opening there will be a quick flow of the air and thereafter a continued flow, the amount of which is regulated by the distance the ports 18 are uncovered when the parts assume the position shown in Fig. 6.

The valve-ring 26 is made larger than the port 16, so as to shut off the supply of gas positively, both when the valves are in their normal position, as shown in Fig. 8, and when the valve 22 is given its initial movement to allow the air to sweep out the cylinder, as shown in Fig. 6. The gas-inlet passages are only open when the valve is lifted by the action of the trigger mechanism, as shown in Fig. 7.

The governor connections which control the position of the cams 63 may be of any desired form. In the drawings, 70 designates a pulley secured on the main shaft M of the engine and belted to a pulley 71 of a governor G. This governor has its actuating-rod connected by a bell-crank lever 72 and link 73 to an arm or lever 74, secured on one of the shafts 54. Also extending from this shaft 54 is a lever 75, which connects by link 76 to a lever 77, oppositely arranged on the other shaft 54. By these connections each of the cams 63 will be properly moved by the governor.

The action of the valves and valve connections in connection with the right-hand cylinder is substantially the same as that previously described in connection with the left-hand cylinder and need not be again gone over.

It is obvious that the improvements forming this invention—to wit, the improved form of valves and valve-actuating connections—can be applied to any form of single or multiple cylinder two-step-cycle gas-engine, and while we have shown the same as applied and as well adapted for one form of multiple-cylinder gas-engine we do not wish to be limited to the application thereof to this particular form chosen to illustrate our invention.

The general organization of the cylinders, valve-casings, and valve-operating mechanisms shown herein are not claimed in this application for patent, as the same are claimed in a division of this application for patent filed by us May 19, 1903, Serial No. 157,771.

The details and arrangements herein described may be widely departed from by a skilled mechanic without departing from the scope of our invention as expressed in the claims.

Having thus fully described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a valve-actuating mechanism, the combination of an oscillating wrist-plate, a connection therefrom carrying a hook or catch, a lever for initially opening the valve which said hook or catch engages, an oscillating lever operated by said connection, and connections therefrom for further opening the valve.

2. In a valve-actuating mechanism, the combination of an oscillating wrist-plate, a connection extending therefrom, an oscillating lever actuated thereby, a catch and a lever arranged to impart an initial opening to the valve as the wrist-plate reaches its limit of motion in one direction, and connections from said oscillating lever for further opening the valve on the other movement of the oscillating lever.

3. In a valve-actuating mechanism, the combination of an oscillating wrist-plate, connection therefrom, an oscillating lever actuated thereby, a catch and a lever for imparting the initial opening to the valve, and a governor-controlled trigger mounted on said

oscillating lever for imparting the further or principal opening movement to the valve.

4. In a valve-actuating mechanism, the combination of an oscillating wrist-plate, a connection therefrom, a lever oscillated by said connection, a hook and a lever for imparting the initial movement to the valve, a trigger on the oscillating lever for imparting the principal movement to the valve, and a governor-controlled cam for releasing the trigger.

5. In a valve-actuating mechanism, the combination of an oscillating wrist-plate, a connection extending therefrom, a lever oscillated thereby, a catch and lever for imparting the initial opening movement to the valve, a spring-pressed trigger for imparting the principal movement to the valve, and a governor-controlled cam turning on the axis of the oscillating lever for releasing the trigger.

6. In a valve for explosion-motors, the combination of the valve-casing, annular air and gas supply chambers therein, a valve-lining having air-supply ports and gas-supply ports formed therein, the two sets of ports being staggered relatively to each other, a valve-stem carrying a puppet-valve and ring-valves connected by ribs, a cap secured to the valve-casing, a cup arranged on the valve-stem and having a keyway cut therein, an adjusting piece or hub having a key engaging said keyway, and means whereby said hub can be turned and set at different points.

7. In a valve mechanism for explosion-motors, the combination of a valve-casing having a puppet-valve and ring-valves working therein for changing the relative proportion of air and gas, an oscillating disk, a connection extending therefrom, a lever oscillated by said connection, a catch and lever and connections whereby the puppet-valve will be slightly raised from its seat to allow an initial entrance of air and then fully raised from its seat with the gas and air supply ports opening to allow for the changing of the cylinder, and trigger connections for allowing said valves to return to normal position.

8. In a valve mechanism for explosion-motors, the combination of a valve-casing having a puppet-valve and ring-valves working therein for changing the relative proportion of air and gas, an oscillating disk, a connection extending therefrom, a lever oscillated by said connection, a catch and lever and connections whereby the puppet-valve will be slightly raised from its seat to allow an initial entrance of air and then fully raised from its seat with the gas and air supply ports opened to allow for the charging of the cylinder, trigger connections for liberating said valves and allowing them to return to their normal position, and governor-actuated connections for releasing said trigger mechanism.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

CHAS. H. MORGAN.
ALBERT J. GIFFORD.

Witnesses:
LOUIS W. SOUTHGATE,
R. L. MORGAN.