

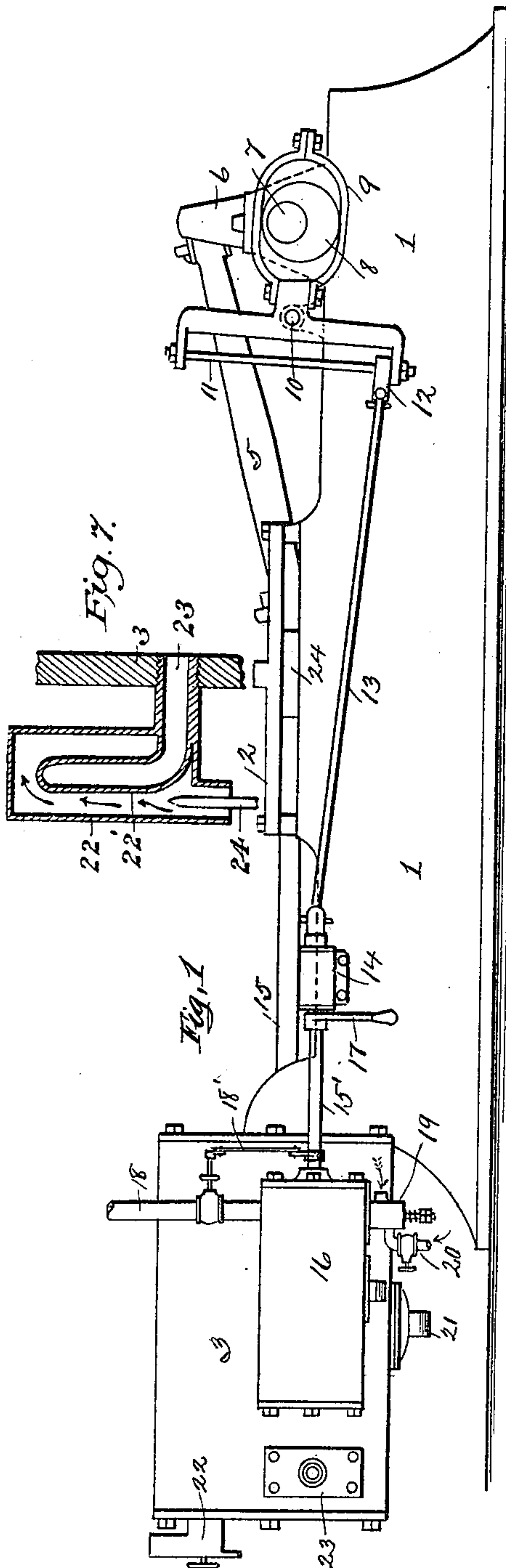
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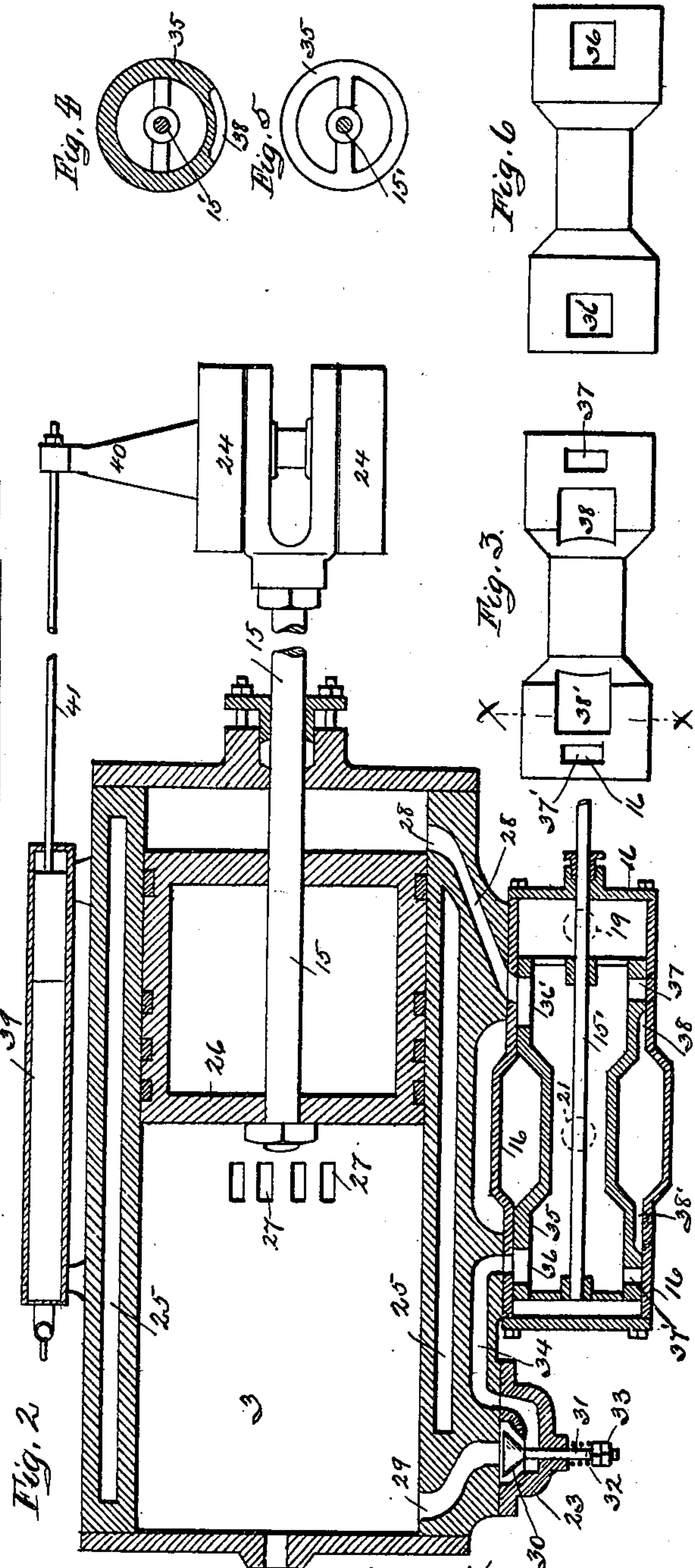
W. T. STRAIN & H. B. NICODEMUS.  
REVERSIBLE GAS AND STEAM ENGINE.

(Application filed Mar. 21, 1900.)

(No Model.)



Witnesses:  
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# UNITED STATES PATENT OFFICE.

WILLIAM T. STRAIN, OF McDONALD, AND HENRY B. NICODEMUS, OF ALLEGHENY, PENNSYLVANIA.

## REVERSIBLE GAS AND STEAM ENGINE.

SPECIFICATION forming part of Letters Patent No. 666,364, dated January 22, 1901.

Application filed March 21, 1900. Serial No. 9,602. (No model.)

*To all whom it may concern:*

Be it known that we, WILLIAM T. STRAIN, residing at McDonald, and HENRY B. NICODEMUS, residing at 274 Howard street, Allegheny, in the county of Allegheny and State of Pennsylvania, citizens of the United States of America, have invented certain new and useful Improvements in Reversible Gas and Steam Engines; and we do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form a part of this specification.

Our invention relates to an improved combined steam and gas engine; and it consists in the certain details of construction and combination of parts whereby the engine may be converted from steam-pressure to propulsion by gas-explosions, as will be fully described hereinafter.

Our invention also relates to an improved reversing-link, whereby the engine may be operated in either direction.

In the accompanying drawings, Figure 1 is a side elevation of our improved combined steam and gas engine, which is constructed and arranged in accordance with our invention. Fig. 2 is an enlarged detailed sectional plan view taken through the center of the cylinder and steam or valve chest. Fig. 3 is a side elevation of the valve, showing the arrangement of the steam-ports. Fig. 4 is a sectional end elevation of the same, the section being taken on the line *xx* of Fig. 3. Fig. 5 is an end elevation of the valve. Fig. 6 is a side elevation of the valve, showing the position of the gas-ports, the same being arranged on the opposite side from the steam-ports above mentioned. Fig. 7 is a detailed sectional elevation of the igniting device.

To put our invention into practice, we provide a base-plate 1, of a suitable size and form of construction, and arrange at one end thereof a cylinder 3 and at the opposite end a power-shaft 7, connected by a crank 6, a pitman 5, a cross-head 24, arranged in slides 2 to the piston-rod 15, and piston 26.

The above-mentioned parts are all of ordinary construction and the arrangement practically the same as those now in common use.

The cylinder 3 is formed with a water-jacket

25 to keep the same cool when using gas as the motive power and fitted with a suitable reciprocating piston 26 and at one side valve-case 16. This valve-case is cylindrical in form and is provided at each end with suitable heads and with ports registering with those leading from either end of the cylinder 3. Operating within this casing 16 is a cylindrical valve 35, open at each end and provided with an operating-rod 15, which is connected to an eccentric 7 in a manner hereinafter described. Entering the valve-case 16 is a steam-supply pipe 18, also a gas and air supply valve 19 and 20, which may be of any suitable design, will open by atmospheric pressure, and is held to its seat by the pressure within the cylinder and valve-casing 16. The operating-valve 35 consists of a hollow cylindrical shell formed at one side with large ports 36 and 36' to admit gas and air to the cylinder (see Fig. 6) and on the opposite side with steam 37 and 37' (see Figs. 3 and 5) and with recesses 38 and 38'. This valve is connected by a stem 15' to a suitable slide 14 and the said slide by means of a pitman 13 to a reversing-gear arranged in connection with the power-shaft 7. This reversing-gear consists of an eccentric 8, inclosed within an oval strap 9, and the said strap 9 is attached to an oscillating link arranged in a bearing 10 and provided with a rod 11, upon which the connection 12 of the pitman operates. The valve-stem 15' is fitted with a lever 17, which is operated by hand to turn the valve 35 to present either the gas-ports 36 36' or the steam-ports 38 38' to the ports 28 and 34, formed in the cylinder 3. This valve-rod 15' is also connected by a system of levers 18' to the valve controlling the admission of steam to the casing 16 in a manner that when the gas-ports are in the position shown at Fig. 2 the said valve 18' will be closed.

Arranged at one end of the cylinder 3 is a check-valve 30, which controls an inlet-port 29 to the cylinder and is held seated by the action of a spring 32, the tension of which is regulated by nuts 33, operating upon the threaded shank of the valve-stem 31. This valve is so constructed that the same may be held free from its seat when the engine is using steam as a motive power.



Connected to one end of the cylinder 3 is a suitable igniting device 22, which consists of an outer shell 22, an inner tube 22', having a passage 23 leading to the interior of the cylinder 3, and a gas-jet tube 24, by means of which the inner tube 22' is kept at a temperature sufficient to ignite the gas when forced into the tube by the movement of the piston, thereby providing a means for exploding the gas mixture in the cylinder 3.

The engine is fitted with a suitable pump 39, operated from the cross-head 24 by connections 40 and 41. The exhaust-ports 27 are arranged at or about the middle of the cylinder.

To operate the engine with gas, the steam-valve 18' is closed and the valve 35 in a position shown at Fig. 2 of the drawings. The gas is introduced together with air through the valves 19 20 into the casing 16, and upon the piston 26 moving to the left will draw by suction a charge through the ports 36' and 28 into the cylinder 3. Upon the return movement of the piston 26 the gas and air are forced back through the ports into the casing 16, through the ports 36, 34, and 29 into the opposite end of the cylinder 3, and the valve 30 will open under the pressure. The return movement of the piston (now moving to the left) will compress the gas and air, and at the proper moment is exploded by the igniter 22 and the exhaust passing out through the ports 27. The engine now being started will receive a charge of gas at each stroke of the piston.

To operate the engine by steam it is only necessary to shut off the gas-supply and revolve the valve 35 by means of the hand-lever 17 and bring the ports 37 and 37' opposite the ports 28 and 34, formed in the cylinder, and by the reciprocating movement of the valve 35 admit steam through the ports 38 and 38' to either end of the cylinder in a manner well known in the art.

To reverse the engine when at full speed and

propelled by gas-explosions, the lever 17 and the sliding block 12 of the link are elevated. These two movements open the steam-valve 18' and change the ports from gas to steam and also the position of the operating-valve 35, and the steam rushing into the opposite end of the cylinder from the explosion will instantly check the piston and move the same in an opposite direction.

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

1. In combination with a reversible gas and steam engine, the oscillating link 11 operated by an eccentric 7, and connected to the valve 35, having a reciprocating movement, and capable of being turned upon its axis, the said valve being formed with both gas and steam ports, to register with the ports leading into the cylinder, as described.

2. In combination with an engine of the character described, consisting of the cylinder 3, the valve 35 and its casing, the said valve being provided with steam and gas ports located opposite each other, the oscillating link 11 connected to the said valve, a means for turning the valve upon its axis, a gas and air inlet entering the valve-casing, a steam-pipe 18 and valve, operated to open and close by the rotatable movement of the operating-valve 35, the ports 28 29, one of which has a check-valve arranged therein to confine the exploded gas, means as described for shutting off the supply of gas, and a suitable igniter for firing the charge of air and gas, all arranged and combined for service, substantially as and for the purpose described.

In testimony whereof we have hereunto affixed our signatures in the presence of two subscribing witnesses.

WILLIAM T. STRAIN.  
HENRY B. NICODEMUS.

Witnesses:

JOHN GROETZINGER,  
H. M. LEVIS.