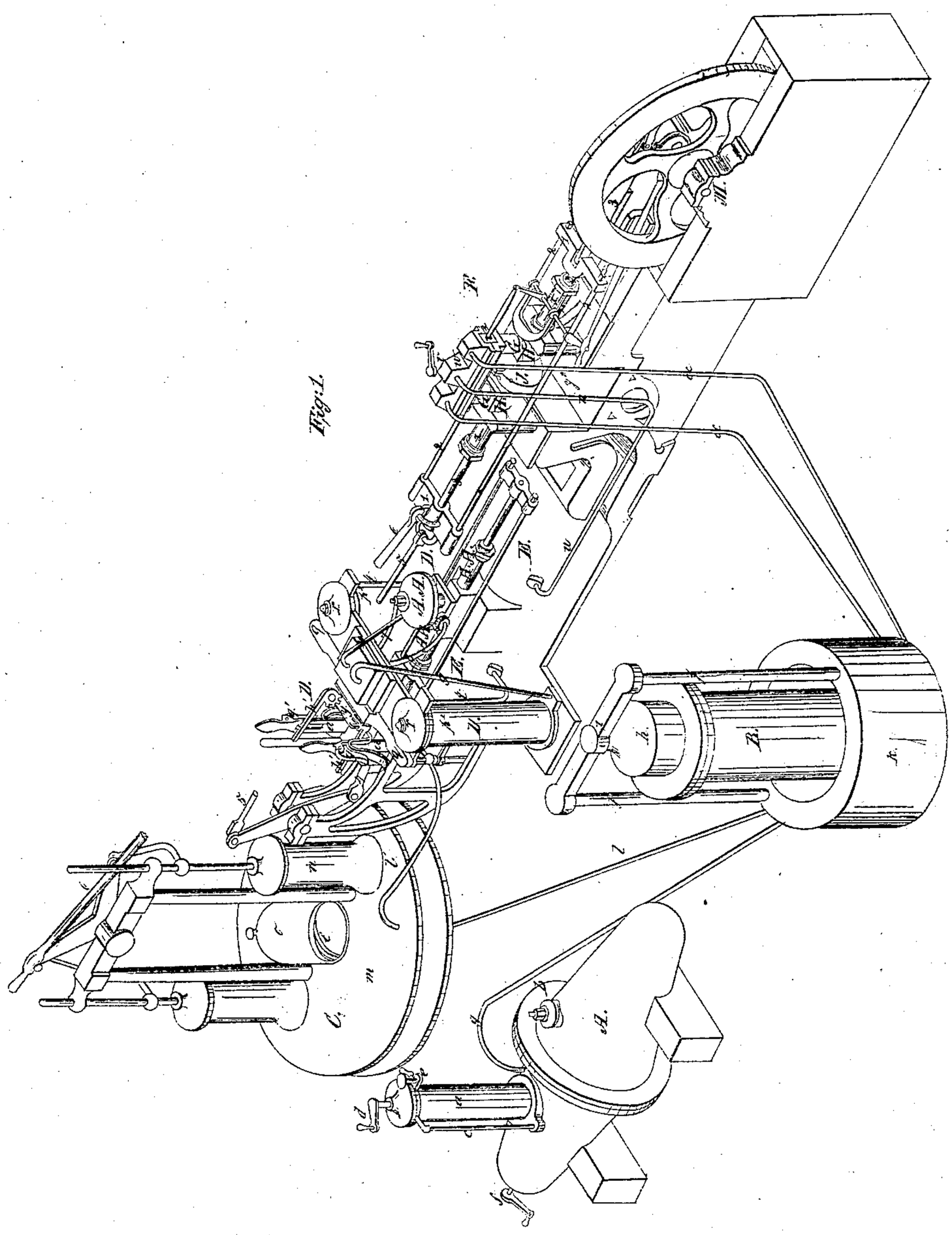
(No Model.) 2 Sheets—Sheet 1.

J. C. F. SALOMON.

GAS ENGINE.

No. 8,577. Patented Dec. 9, 1851.



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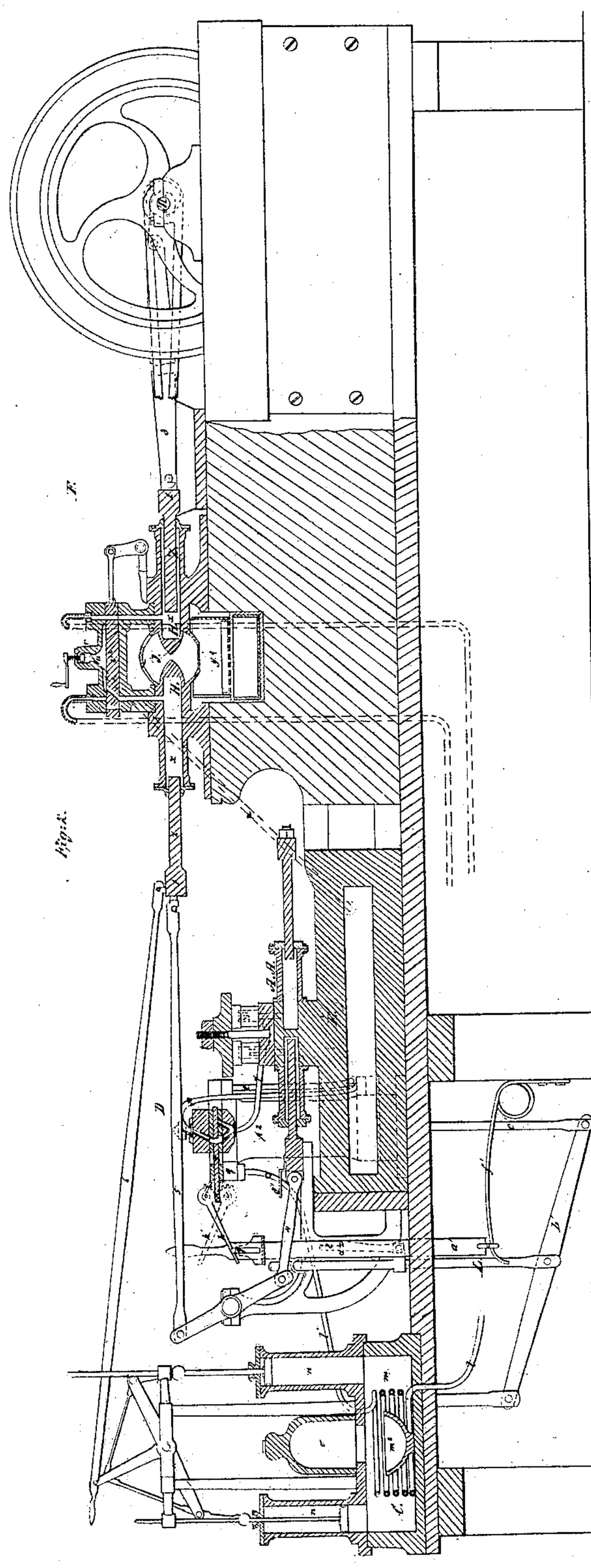

Fig: 2.

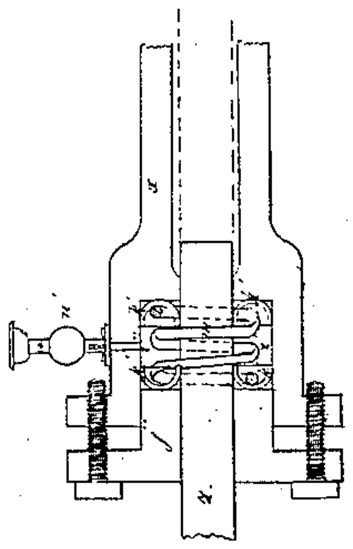

Fig: 6.

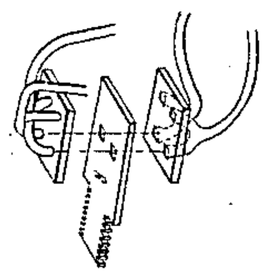

Fig: 4.

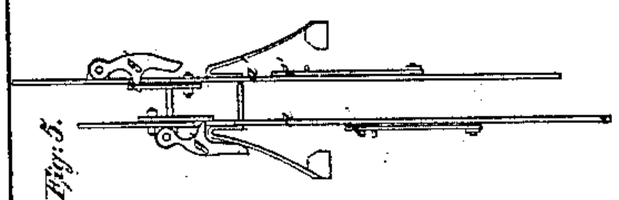

Fig: 5.

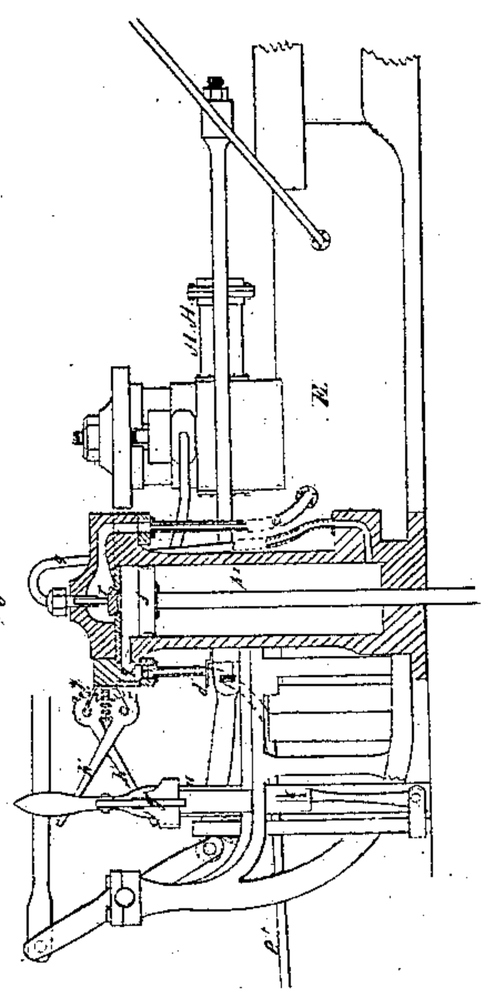

Fig: 3.

UNITED STATES PATENT OFFICE.

JOHN C. FR. SALOMON, OF CINCINNATI, OHIO.

IMPROVED CARBONIC-ACID-GAS ENGINE.

Specification forming part of Letters Patent No. **8,577**, dated December 9, 1851.

To all whom it may concern:

Be it known that I, JOHN CHARLES FREDERICK SALOMON, of Cincinnati, in the county of Hamilton, in the State of Ohio, have invented a new Thermo-Mechanic Motor; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making part of this specification.

Figure 1 is an isometrical perspective of the entire machine arranged for operation. Fig. 2 is a vertical longitudinal section. Fig. 3 is a vertical section of one of the hydrostatic cylinders and elevation of the receiver, force-pumps, and valve-box, and mechanism for operating the alternating valve. Fig. 4 is a perspective view of the four branched waterways of the slide-valve *y* of the hydrostatic pumps, as also the slide-valve *y*. Fig. 5 is a vertical sectional view of the pendent catches with rising and falling plates for actuating the segment-rack levers to operate the alternating water-valve *y*. Fig. 6 is a sectional view of one of stuffing-boxes and packing therein.

The nature of my invention consists in a new and useful mode of application of liquefied carbonic acid gas as a thermo-mechanic motor.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation, viz:

A is the generator in which the gas is generated. (See Fig. 1.)

B is the gasometer which receives the gas from the generator.

C is the refrigerator in which the gas is cooled. (See Figs. 1 and 2.)

D is the condensing apparatus for condensing the gas. (See Figs. 1, 2, and 3.)

E is the receiver for the liquefied gas.

F is the engine for propelling machinery and for working the apparatus for cooling and condensing.

A A are the force-pumps for the hydrostatic press.

L are two vertical rods connected with levers *b'* for raising plates *a'*.

M is the fly-wheel shaft; *a*, vessel for sulphuric acid, called the "charger," (see Fig. 1;) *b*, opening for charging the generator A with carbonate and water; *c*, glass tube to gage the sulphuric acid in the charger; *d*, crank-shaft for opening the valve to let the acid into the generator; *e*, a funnel for conveying acid into the charger; *f*, crank by which to turn the stirrer in the generator for agitating the charge; *g*, pipe by which gas is discharged from the generator into the gasometer; *h*, moving part of the gasometer or inverted hollow cylinder; *i*, cross-head for connecting-rods, connecting the weights to the cylinder *h*; *j*, connecting-rods just named; *k*, weights to balance pressure of gas against the inverted cylinder *h*, Fig. 1; *l*, pipe conveying the gas to and through the refrigerator, (see Figs. 1 and 2;) *m*, refrigerator containing a coil of seventy-five feet of the pipe *l*, and a glass bowl, m^2, with diluted sulphuric acid, from which vessel the atmosphere is exhausted by air-pumps *n* operated by the engine. (See Fig. 2.)

o is a glass bell for covering the opening in the refrigerator.

l' is a continuation of the pipe *l* leading from the gasometer through the refrigerator to the condensing-cylinders p' p^2.

q is a receiving-valve between the pipe *l'* and the condensing-cylinders *p*. (See Fig. 3.)

r is a valve to prevent the return of condensed gas from the receiver to the cylinders *p*. (See Fig. 3.)

s is a piston working through the cylinder p' for forcing the gas into the receiver E. (See Fig. 3.)

t is a pipe conveying the gas from the cylinder p' to the receiver E.

u is a gas-pipe leading from the receiver E to the throttle-valve *v* in chamber *w*.

v^2 is a common slide-valve, (see Fig. 2;) *x*, two cylinders in which the liquid is alternately expanded.

y is the slide-valve for changing the passage of the water from cylinder p' to cylinder p^2, and back alternately. (See Figs. 2 and 4.)

y^2 is the furnace for expanding the liquefied gas. (See Figs. 1 and 2.)

z are the pistons in cylinders for actuating the crank on fly-wheel shaft; *c c*, the pipes for conveying the exhausted gas back from the cylinders into the gasometer. (See Fig. 1.)

a' are two vertical plates operated on by the piston-rods c' in cylinders p' and p^2 by means of levers b' and rods L, and catches e' attached to rods L operating on plates *a* actuating the slide-valve *y* by means of the segment-levers h' h', (see Fig. 2;) b', two levers for raising said

plates alternately; c', piston-rods in cylinders p' and p^2 connected with levers b', (see Figs. 2 and 3;) d', two points on the cross-head of pumps A A, for liberating the vertical plates a' when sufficiently elevated; e', two catches on vertical rods L, by which the vertical plates a' are raised by levers b' and liberated by points d' therefrom; f', springs to bring vertical plates a' down instantaneously, (see Fig. 2;) g', two jointed catches on vertical plates a', which depress the segment-rack levers h' in falling, (see Fig. 5;) h', two segment-rack levers for alternating the slide-valve y. (See Figs. 2 and 3.)

i' is the packing-chamber at head of the cylinders x; j', the cover of said chamber.

k' are two crimped leather washers round the plunger in packing-chamber. (See Fig. 6.)

m' is a spiral spring in said chamber for keeping one of the leather washers k' at the top and the other at the bottom of the chamber.

n' is a lubricating-funnel for admitting oil into the packing-chamber.

1 are cross-heads, and 2 parallel side rods connecting the two pistons z z, (see Fig. 1;) 3, the pitman connecting the cross-head 1 of pistons with the crank on fly-wheel shaft M.

4 and 5 are connecting-rods from the other cross-head, 1, to the force-pumps A A.

6 is a connecting-rod from same cross head to work the air-pumps n.

7 is the suction-pipe of force-pumps A A; 8, the forcing-pipe of the same.

9 is the pipe connecting cylinder p' with the cover of the chamber of the slide-valve y.

10 is the pipe connecting cylinder p^2 with same cover.

Operation of the entire machine: Put the chalk or carbonate and water into the generator A at the aperture b, and the sulphuric acid into the charger a, and thence let it into the generator, where they are to be agitated by turning the crank f of the stirrer, and the carbonic-acid gas is then evolved. The gas thus generated passes through the pipe g into the gasometer B, beneath the hollow plunger h, where it is, in the aeriform state, submitted to a pressure of one hundred pounds to the square inch, (more or less, as found desirable,) which pressure is caused by the weight k, which is suspended to the plunger h. From this gasometer the gas passes through the pipe l, coiled in the refrigerator C, in which is a bowl, m^2, containing diluted sulphuric acid, which evaporates slowly in vacuum, and while such evaporation is going on takes up heat from bodies with which it may be in contact, according to a well-known law concerning evaporation. The refrigerator C is now exhausted of the atmospheric air by the air-pumps n, for the purpose of cooling the gas passing through the coil of pipe placed in vacuum in said refrigerator, and when sufficiently cooled, which may be as near the freezing point (32°) as possible, according to the degree of evaporation in vacuum, it continues onward through the pipe l', through the receiving-valve q, to the condensing-cylinders p' and p^2, wherein it is condensed by the hydrostatic pumps in the following manner, viz: The pistons s in cylinder p' must first be raised, the cylinder filled with water, and the piston returned to its place upon the surface of the water in the cylinder, the alternating slide-valve y being so placed as to bring the pipe No. 9, leading from the bottom of the cylinder p' to the top of the valve-box in which is the slide-valve y, in connection with the suction-pipe No. 7 of the pumps A A, which are worked by the connecting-rods Nos. 4 and 5 from the cross-head 1 of the piston z. The pumps being then put in action, they exhaust the water from cylinder p', through the pipes Nos. 7 and 9, and force it into cylinder p^2 through the pipes Nos. 8 and 10, at the same time filling the upper part of the cylinder p', through the pipe l' and valve q, with gas from the refrigerator. By the pressure of the gas and the suction of the piston s descending, the piston p^2 in rising is made to raise a vertical shaft or plate, a', by means of a lever, b', connected with the piston-rod c', which passes through the lower head of the cylinder p^2, which vertical plate a', having attained its full elevation, is liberated from the catch e' of the bar L, connected to the piston-lever b' by a point, d', on the cross head of the pump. Striking against the catch e' thereon it (a') immediately drops by its own weight or the aid of a spring, f', and being provided with a jointed catch, g', which hooks on the segment-rack lever h', working into the upper side of the slide-valve y, depresses the rack-lever and gives the valve an inward motion, thereby changing the current of water to the pumps out of cylinder p', to be forced into cylinder p'. The piston in cylinder p^2 now descending, the upper part of said cylinder will be filling with gas, as before described in cylinder p', while the piston s in cylinder p' is ascending by the pressure of the water forced in below the piston. The gas above it is thus compressed and expelled through the valve v and pipe t into the receiver E for use. When the piston of cylinder p' has been raised to its full height, carrying with it, by means of another lever, b', connected with its piston rod c, another vertical plate, a', like the one described before, the point d' on pump cross-head strikes the spring e' thereon, and the vertical plate a' drops, depressing another segment-rack lever, h', which works into the under side of the slide-valve plate y, giving the valve an outward motion, and so alternately changing the current of water through the pumps A A from one cylinder p to the other, and at the same time receiving the gas from the refrigerator C in the upper half of them alternately and forcing it into the receiver E, where it becomes liquid at the pressure of five hundred and forty pounds to the square inch and between 30° and 45° Fahrenheit, or as near the freezing-point as possible.

In first charging a new engine with condensed liquid-gas the hydrostatic press has to be worked by hand until the receiver E is fully charged, which, for an engine of twenty-five horse-power, will take about four hours. This being once done, the engine is always charged and ready to be put in operation at any moment.

The liquefied gas is forced by its own expansive property (of five hundred and forty pounds pressure to the square inch, as above stated) from the receiver E through the pipe *u* into a chamber, *w*, wherein is placed a throttle-valve, *v*, which is adjusted to allow the fluid to pass in proper quantity through the openings in the slide-valve v^2, worked in the said chamber by the rocker-shaft and eccentric on the fly-wheel shaft, alternately admitting the fluid in proper quantities into the expanding-chambers H through the pipes G, wherein it is expanded to any desired extent by the heat applied to the spherical heater J, every 35° Fahrenheit increased temperature doubling its pressure and forcing the pistons *z* alternately from said heater, which is placed over or in the furnace or fire-chamber y^2. After driving the piston to the extent of its stroke, the fluid escapes from chambers H alternately (by the action of the slide-valve v^2 and return of the piston) into the gasometer B, through the pipes *c c* against a pressure of one hundred pounds to the square inch, (more or less, as found desirable,) at a temperature quite immaterial, this being regulated by the amount of heat used for expanding in the chambers H, whence it undergoes the same process of cooling, condensing, and liquefying for reuse. The two pistons *z*, acting in this manner alternately, have a reciprocatory movement, as in a common steam-engine, of immense power at a very moderate expense of fuel, and the liquid being admitted in small jets, as above described, obviates any danger of explosion. The machinery is very simple and of much less cost, bulk, and weight than the ordinary steam engine, and the carbonic-acid gas being susceptible of being used over and over again as long as it is kept confined renders it a very cheap and efficient agent for motive power.

I will now describe the operation of the packing in the stuffing-boxes of cylinders *x*. The leather washer being cut of larger diameter than the chamber, and the hole in center of it of less diameter than the plunger, it is crimped up until it will pass over the plunger and into the chamber. It is then inserted in the bottom thereof, forming a circular gutter round the plunger. (Represented by the section thereof at *k'*.) The spiral spring *m'* is then inserted, and another washer, *k'*, like the former one, inverted on the top of the spring. The cover *j'* is then screwed in its place on the top of the leather. I then, by means of the funnel *n'*, fill the chamber *i'* with oil. It will thus be seen that the greater the pressure in the cylinder is the tighter the edges of these leathers will press against the chamber and the plunger, while the spring keeps them in their respective places, and the oil prevents any escape through them.

The operation of saturating the cylinders, receiver, chambers, and other parts of the machine is performed by immersing them in boiling water until they are thoroughly heated. On taking them out of the water, (being hot,) they quickly evaporate all the water on or in the pores thereof. I then supply them internally with as much beeswax as they will take up.

I do not claim the invention of carbonic-acid gas in its liquefied or aeriform character as a motive power; neither do I claim the use of the hydrostatic press for liquefying the gas, as these principles have long been known and commented upon by Sir Humphry Davy, Faraday, Brunel, and others; but

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A carbonic-acid-gas engine in which said fluid passes from a reservoir, where it exists in a liquid state, through suitable valves into a heated cylinder, thence into a refrigerator, where it is cooled, and thence through pumps, where it is condensed by hydrostatic pressure and forced back again to the reservoir before named, the said engine being constructed substantially as herein described.

2. The combination of crimped leather washers, a spiral spring or springs, and oil or any lubricant for packing the piston rods or plungers, as described.

In testimony whereof I have hereunto signed my name before two subscribing witnesses.

JOHN C. FR. SALOMON.

Witnesses:

WM. M. SMITH,

I. F. PRUCKNER.