E. BUSS.
Gas-Engine.

No. 226,972. Patented April 27, 1880.

FIG. 1.

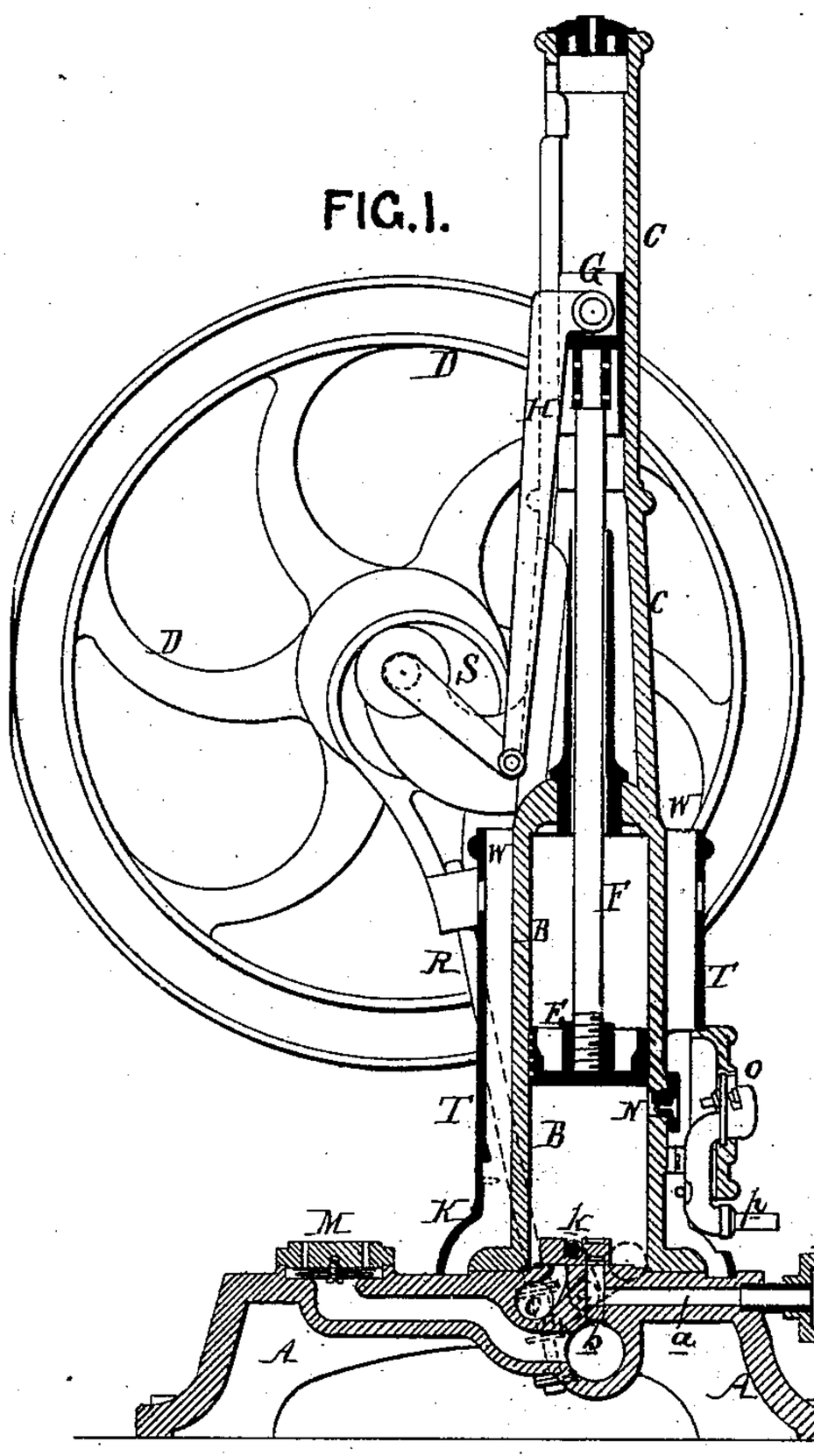

FIG. 3.

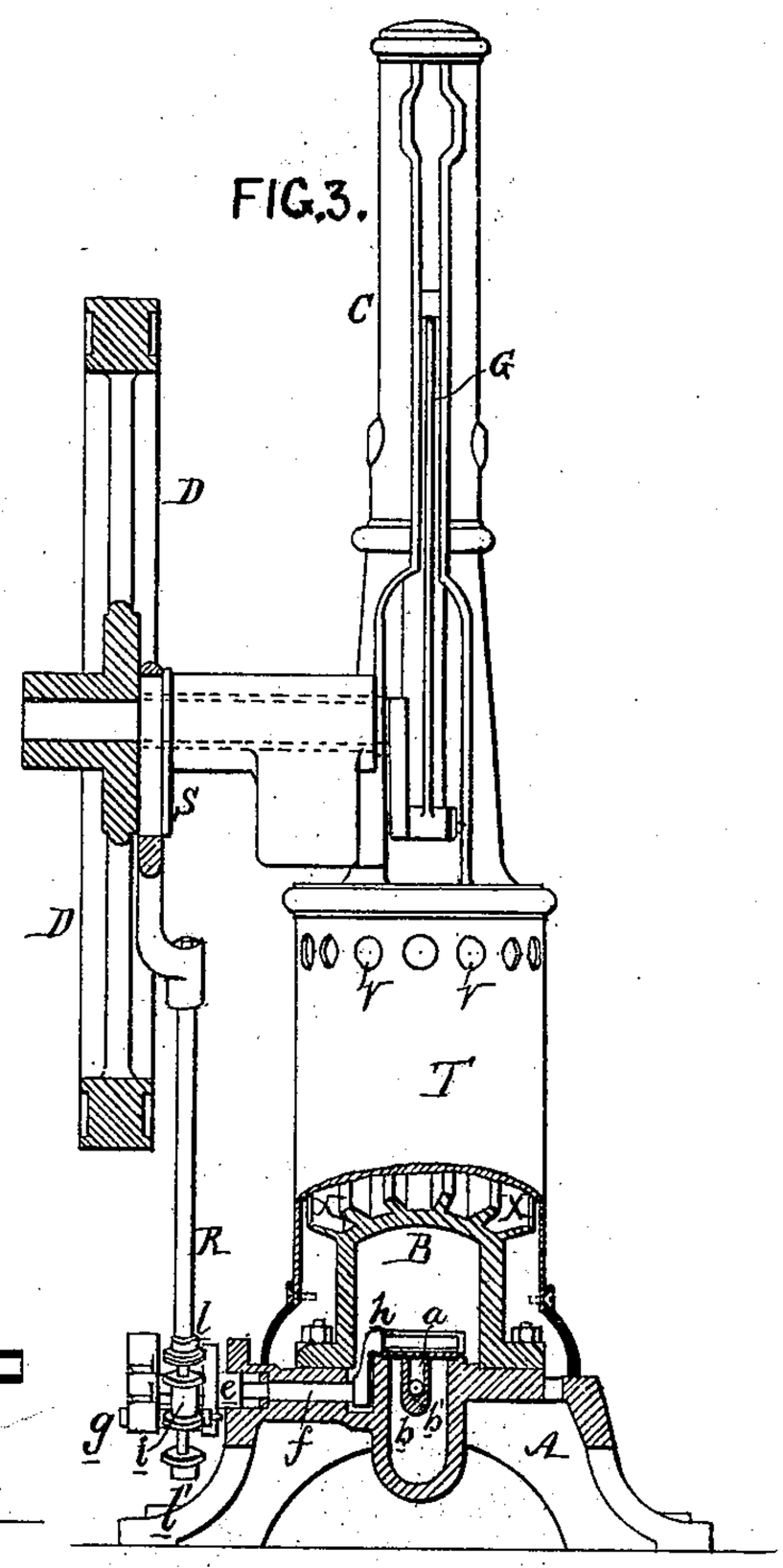

FIG. 2.

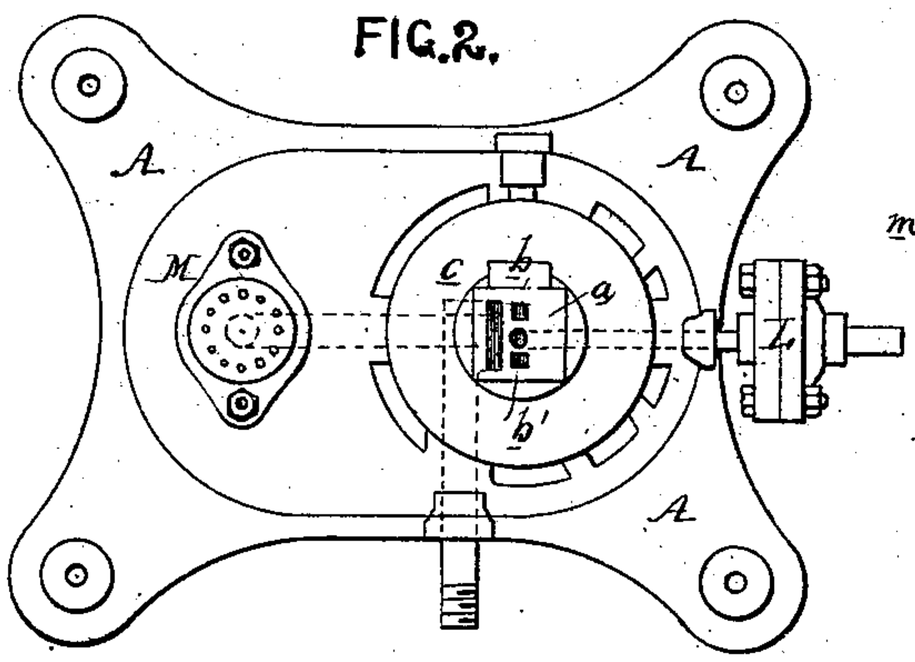

FIG. 4.

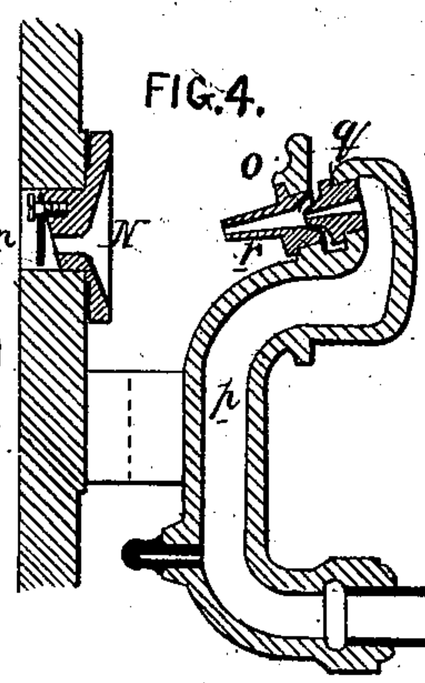

FIG. 5.

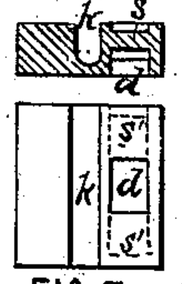

FIG. 7.

FIG. 6.

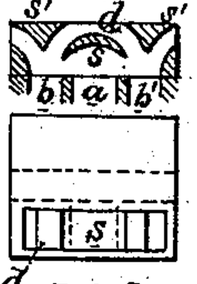

FIG. 8.

Witnesses.
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UNITED STATES PATENT OFFICE.

EDWARD BUSS, OF ARBON, SWITZERLAND, ASSIGNOR TO CHARLES MAX SOMBART, OF MAGDEBURG, PRUSSIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 226,972, dated April 27, 1880.

Application filed January 31, 1880. Patented in Germany March 23, 1879.

To all whom it may concern:

Be it known that I, EDWARD BUSS, of Arbon, Canton of Thurgau, Switzerland, have invented new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to an engine in which the force developed by the ignition of explosive gaseous mixtures is employed as the motive power. This engine is provided with a piston working in a cylinder, as in the case of steam-engines, the said piston being connected to the crank through the intervention of a suitable cross-head and connecting-rod. The engine is single-acting, and is provided with a corresponding valve-motion, which places the space on one side of the piston only alternately in communication with the feed and with the exhaust. The engine is supplied with a gas that is capable of burning in atmospheric air—such, for example, as coal-gas, evaporated gasoline, and the like—by means of an india-rubber or other suitable tube.

A mixture of atmospheric air and inflammable gas is first drawn into the cylinder by the forward motion of the piston, and this mixture is then suddenly ignited by apparatus provided for that purpose. The gaseous mixture, being suddenly and greatly expanded by its combustion, then forces the piston to the end of its stroke, and the return of the piston expels the products of combustion from the cylinder.

In order that the said invention may be fully understood, I shall now proceed more particularly to describe the same, and for that purpose shall refer to the several figures on the annexed sheet of drawings, the same letters of reference indicating corresponding parts in all the figures.

Figure 1 is a vertical section. Fig. 2 is a plan of the bottom part; and Fig. 3 is an elevation, partly in section, of an engine constructed according to this invention. Fig. 4 is drawn to a larger scale, showing the arrangement of the igniting apparatus; and Figs. 5, 6, 7, and 8 represent the slide-valve.

The engine is provided with a slide-valve and arranged as hereinafter described.

The valve-seat (shown detached in Fig. 2) is formed by a low rectangular raised surface on the upper side of the bottom part, A, and is provided with a port, *a*, for the admission of gas, two ports, *b* and *b'*, for the admission of air, and a port, *c*, for the escape of the products of combustion.

The slide-valve is shown in detail in Figs. 5, 6, 7, and 8, and consists of a rectangular iron or metal plate, in which is formed an elongated orifice, *d*, divided in the middle by a transverse piece, *s*, and interrupted at both sides of the back by the two triangular-shaped pieces *s' s'*. During the upward motion of the piston the valve assumes a position in which the elongated orifice *d* coincides with the ports *a* and *b* and *b'* for the admission of gas and air, and the port for the escape of the products of combustion is covered by the solid part of the valve. The passages communicating with the ports for the admission of gas and air are provided with india-rubber valves L and M, which allow gas and air to pass freely into the cylinder, but prevent them from returning, as the pressure resulting from the ignition of the mixture of gas and air in the cylinder causes these valves to close as soon as the ignition is effected. During the downward motion of the piston the slide-valve assumes a position in which the inlet-ports for the admission of gas and air are covered by the solid part of the valve, while the port *c* for the escape of the products of combustion is completely uncovered, the form of the piece of metal *s* dividing the stream of gas as it issues from the port into two halves, which meet the streams of air entering the cylinder through the two ports *b* and *b'*, provided for that purpose, as hereinbefore described, and become intimately mixed therewith.

The requisite reciprocating motion is imparted to the valve by means of a rocking shaft, *f*, passing through a stuffing-box, *e*, Fig. 3, in the bottom part of the engine. This shaft is provided with a crank at each end, one of which, *h*, situate inside the cylinder, works in a recess, *k*, formed in the back of the slide-valve, and the other, *g*, outside the cylinder, engages with two wide flanges formed on a

sleeve, *i*, capable of sliding within certain limits upon the lower end of a rod, R, to which a reciprocating motion is imparted by means of an eccentric, S, upon the main shaft of the engine.

Two collars, *l* and *l'*, are fixed upon the rod above and below the sleeve, and are provided with cushions of leather or other soft material. When the eccentric has passed either of its dead-points the rod slides through the sleeve *i* until one of the collars *l* and *l'* comes in contact with one end of the said sleeve and causes it to move with the rod. An intermittent motion is thus imparted to the slide-valve, which remains stationary for a certain period between each two strokes of the eccentric-rod.

The eccentric is fixed upon the shaft in such a position relatively to the crank of the engine as to cause the slide-valve to move simultaneously with the passage of the crank over its dead-points and to remain stationary during and for a certain period after the explosion.

When this arrangement of the slide-valve is employed the valve is pressed against its seat by the pressure of the gas, and also by its own weight when in a horizontal position, so that it is not liable to leak after continuous use. In case it appears advisable to increase the pressure upon the valve a suitable spring may be employed for this purpose.

The valve-seat and corresponding surface of the valve may be formed by a portion of a cylinder, if required.

The igniting apparatus consists of an orifice fitted with a valve, N, provided in the side of the cylinder, and a gas-burner, O, Fig. 4. The ignition is effected in consequence of the jet of flame from the burner being drawn into the interior of the cylinder through the orifice in the side as soon as the piston has passed the said orifice in its upward stroke.

When a single burner with a cross-shaped opening is employed for the jet, as in the case of known gas-engines, the ignition of the contents of the cylinder only takes place under certain conditions—namely, when the gaseous mixture is capable of being readily ignited and at the same time is raised to a very high temperature. Even when both these conditions are complied with the igniting apparatus with an ordinary burner still has the disadvantage of being liable to fail to effect the ignition precisely at the proper moment to obtain the best effect with the engine, but frequently causes the ignition to take place at a considerably later period. Moreover, as such igniting apparatus will only effect the ignition of a heated gaseous mixture, they involve the necessity of heating the engine before it can be started.

In order to remedy all these defects a gas-burner is employed constructed as represented in Fig. 4, and which is arranged in part according to the principle of a Bunsen burner and in part according to the principle of the suction apparatus, consisting of a steam and mixing nozzle, which forms part of a Giffard injector.

The pipe *p*, supplying the igniting apparatus with gas, is provided at the upper end with a conical nozzle, *q*. Axially at some little distance before this nozzle is a disk, cast in one piece with the pipe *p*, which supports a tube, *r*, having a trumpet-shaped end. The nozzle *q*, entering a little the trumpet-shaped end of the tube *r*, allows the gas to flow into this tube. The atmospheric air also flows into this tube *r* by passing between the open space left by the part of the pipe carrying the nozzle *q* and the disk which supports the tube *r*.

The gas flows with great velocity out of the nozzle *q* and draws the atmospheric air, which has very little resistance to overcome, forcibly with it. In consequence of the deflection of the current of air on entering the trumpet-shaped end of the tube *r*, it is directed toward the center of the tube and compelled to mingle intimately with the gas. An intimate mixture of gas and air thus flows out of the small end of the tube with great velocity. For regulating the supply of gas to the nozzle *q* a clip or stop-cock on the india-rubber pipe supplying the pipe *p* is sufficient.

In order to maintain the cylinder B in a sufficiently cool condition, it is provided with a sheet-metal or cast-iron jacket, T, Figs. 1 and 3, so arranged that sufficient space is left between the cylinder and the jacket to allow of the passage of air. The jacket T being prevented from becoming displaced longitudinally or laterally by ribs X X, cast on the cylinder, the warm air consequently rises in the spaces formed by the cylinder ribs and jacket, and escapes at the upper part, either through holes V V in the jacket, or if cylinder, with or without jacket and upper part, (chimney,) be cast in one piece, which may be done, the warm air escapes through openings W W, corresponding with the spaces formed by the cylinder ribs and jacket, and in reality being nothing but a prolongation of these openings. The bottom part, Fig. 2, is provided with holes U U, and the warm air, rising up the cylinder and escaping at its upper part, draws in cold air through these holes U U, thereby keeping up a rapid circulation, and consequently cooling the cylinder as required.

I claim as my invention—

1. The combination of a gas-engine cylinder having an igniting-orifice with the igniter or burner, consisting of a combined burner and an air-inducing nozzle, substantially as set forth.

2. The combination of the slide-valve of a gas-engine with the cranked rock-shaft and operating-rod provided with collars and sliding sleeve, substantially as and for the purpose described.

3. The combination of a gas-engine cylinder provided with external ribs, X, with a jacket adapted to fit around said ribs and form therewith a series of cold-air passages

about the cylinder, all substantially as specified.

4. The combination of a gas-engine cylinder having a gas-inlet port and air-inlet ports on each side thereof with a slide-valve having an orifice with a central transverse piece, *s*, and pieces *s' s'*, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWARD BUSS.

Witnesses:

ADOLPH SAUSER,

A. J. DEZEZH.