2 Sheets—Sheet 1.

F. F. SCHNAKE.

MECHANISM FOR UTILIZING THE EXHAUST OF AIR-ENGINES

No. 184,913. Patented Nov. 28, 1876.

fig. 3.

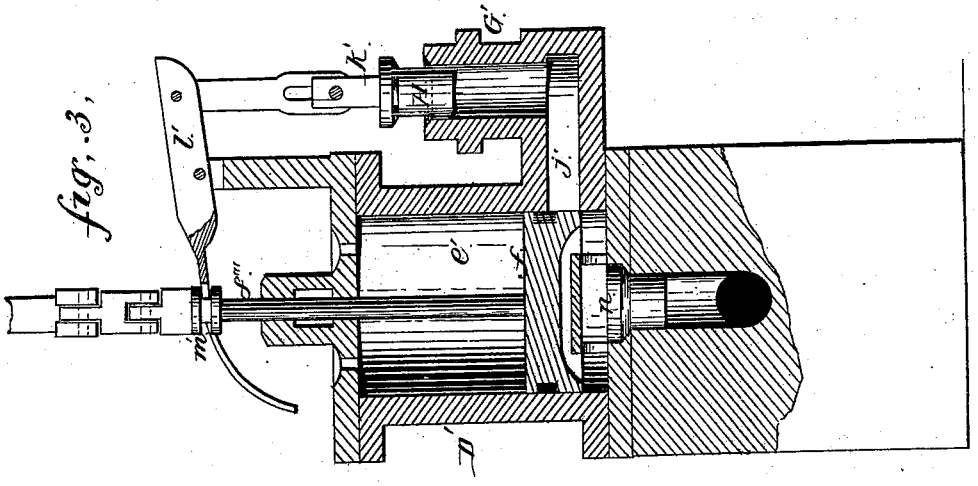
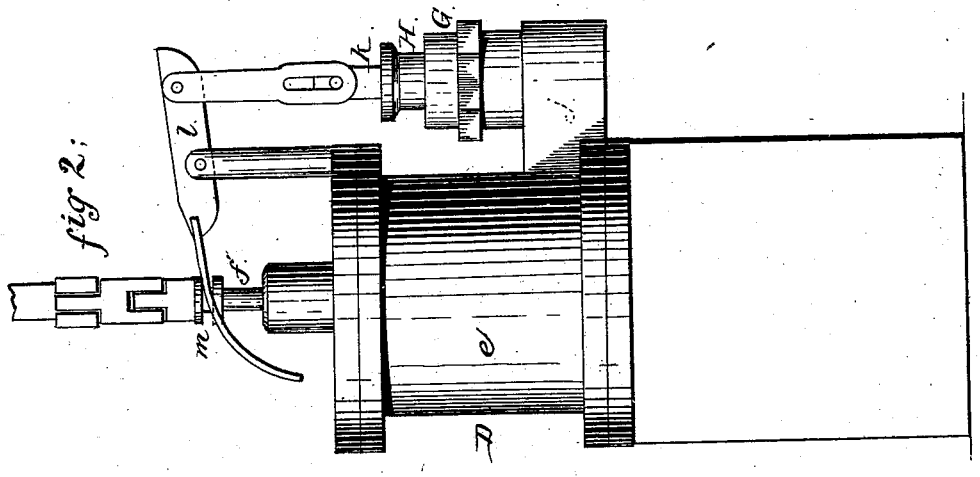


fig 2.



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2 Sheets—Sheet 2.

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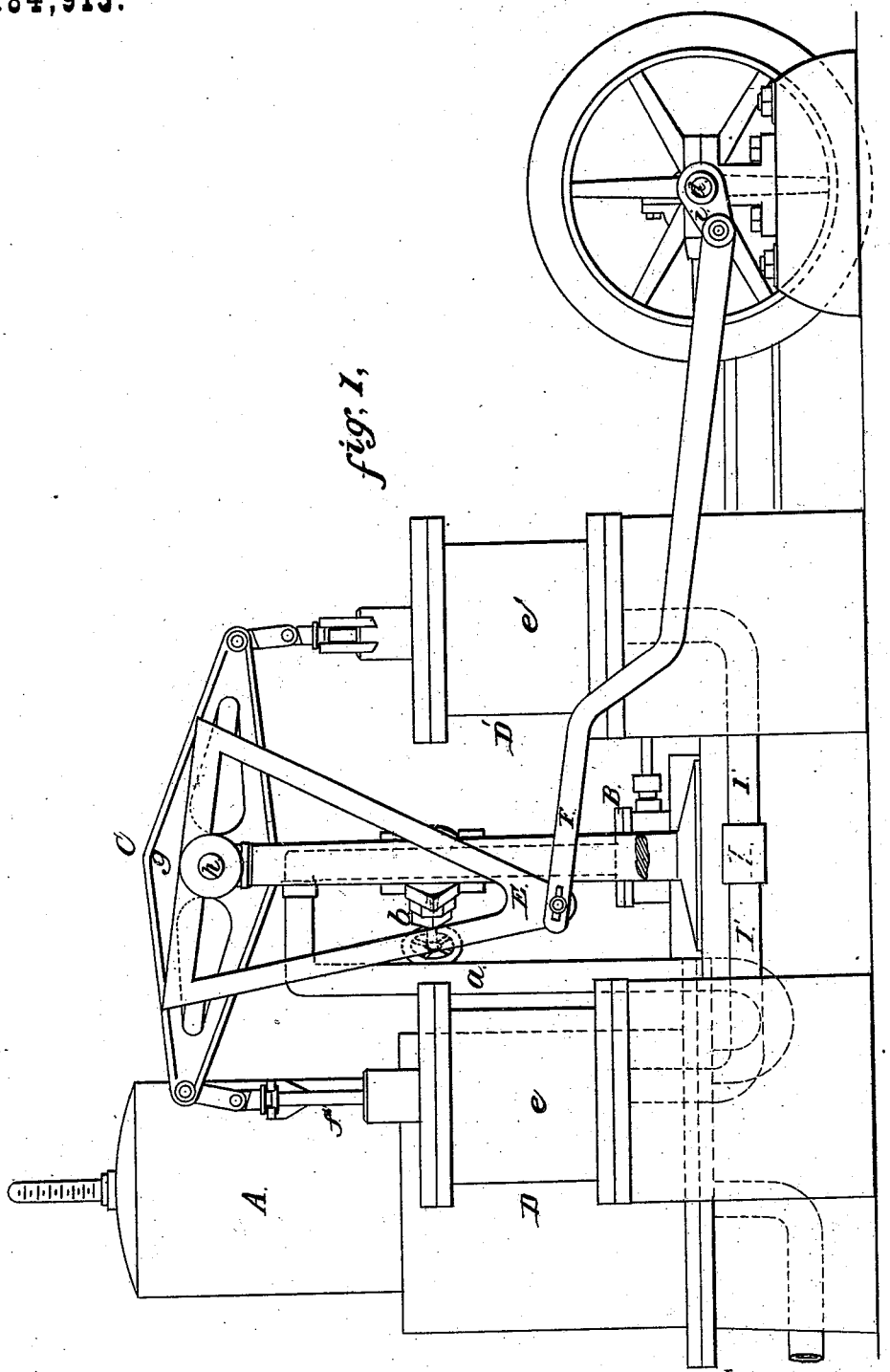

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UNITED STATES PATENT OFFICE.

FREDERICK F. SCHNAKE, OF ST. LOUIS, MISSOURI.

IMPROVEMENT IN MECHANISMS FOR UTILIZING THE EXHAUST OF AIR-ENGINES.

Specification forming part of Letters Patent No. **184,913**, dated November 28, 1876; application filed June 9, 1876.

To all whom it may concern:

Be it known that I, FREDK. F. SCHNAKE, of St. Louis, county of St. Louis and State of Missouri, have invented a Method and Apparatus for Utilizing the Exhaust of Engines, of which the following is a specification:

My invention relates to an improvement in engines operated by the expansive force of compressed air, whereby the exhaust is utilized to run an auxiliary engine of peculiar construction in connection with the point of application of the force or power of the main engine.

The mechanism designed to illustrate the mode of applying the principle of my invention consists of an ordinary reciprocating engine run by compressed air, with which is combined a couple of cylinders or engines provided with pistons, which are connected with a walking-beam. On the end of the walking-beam shaft is a triangular crank, to which is pivoted a connecting-rod, that is in turn connected with the driving-shaft to which the connecting-rod of the main engine is likewise applied.

In the drawings forming part of this specification, Figure 1 is a side elevation of the mechanism of my invention. Fig. 2 is a view of one of the cylinders, side elevation; and Fig. 3 is a vertical section of the same, on a line parallel to the connecting-rods.

Similar letters of reference indicate corresponding parts in all the figures.

Referring to the drawings, A represents the compressed-air receiver. B is the main engine, of the class known as reciprocating engines. The compressed air from the receiver is conveyed to the engine through the pipe *a*, provided with a throttle-valve, *b*. The connecting-rod of the engine is applied to the shaft *d*.

In all essential respects the construction and operation of the main engine are the same as an ordinary steam-engine, so far as applying power to the shaft *d* is concerned.

C is the auxiliary engine, of which *e e'* represent the cylinders, *f* the pistons, and *f'' f'''* the piston-rods. The latter connect with the walking-beam *g*, which is fixed to the horizontal shaft *h*, supported in suitable bearings. On the end of the walking-beam shaft is fixed the crank E, of the form of an isosceles triangle, the part corresponding to the base of the triangle being fixed to the shaft *h* in the same plane as the walking-beam, while at the apex of the triangle the connecting-rod F is pivoted. This connecting-rod is also pivoted to a crank, *i*, on the end of the shaft *d*, opposite where the connecting-rod of the engine is pivoted. On the outside of the cylinders are cast or otherwise connected the valve-sockets G G', which communicate with the interior of the cylinders by passages *j*. In these sockets are placed the valves H H', provided with rods *k k'*, which connect them with the levers *l l'*. The levers have their fulcrums in suitable standards rising above the cylinders. The power ends of the levers are bifurcated, and fit around the piston-rods *f'' f'''*, and bear at proper stages in the movement of the walking-beam against the collars *m m'* fixed to the piston-rods, so that when the piston travels downward the collars bear upon the levers, and elevate the valves; but when the pistons are raised the levers are lifted and the valves are forced down in their seats in the sockets G G'. A pipe leads from the cylinder of the main engine, and connects with a pipe, I', that leads to the cylinders, passing through the bottoms and opening into the interior of the cylinders, where their ends are closed by ordinary valve *n'*. These pipes convey the exhaust from the engine to the cylinders. Suitable valves are placed at the junction of pipes I and I' to direct the air into the proper pump-cylinder.

Having described the mechanism of my invention, I will now proceed to describe its operation. Before doing so, however, it is necessary to state that the position of the pistons *f* with relation to the engine must be such that the exhaust from the first stroke will be able to act on the bottom of one of the pistons; and for this end I have found that the proper position is for one of the pistons to be as far down in the cylinder as possible, or, in other words, the connecting-rod F and walking-beam must be thirty degrees higher than the connecting-rod of the engine when it is on a dead level. Having the different parts of the apparatus properly placed, and the receiver filled with air, the valve is

opened and the engine started. The compressed air, after acting on the engine-piston, is exhausted into the pipes I I′, and is led by them to the cylinders. The movement of the shaft *d* being communicated to the walking-beam by the connecting-rod F, one of the pistons, say *f′*, is caused to rise, and this producing a vacuum below the piston, which would cause resistance, the vacuum is destroyed by the entrance of the exhaust from the engine, and this expanding under the piston exerts an upward pressure thereon, which is given back to the driving-shaft, and added to the power of the main engine. When one of the pistons moves upward the other moves downward in its cylinder, and at the same time the valve H is lifted from the seat, and the air under the piston escapes; but when the other piston is moving upward the valve H′ is depressed in its seat, and prevents any air from the exterior entering the cylinder beneath the piston. Owing to the peculiar form of the crank E it exerts both a pulling and pushing force upon the crank on the shaft *d*.

Having thus described my invention, what I claim to be new, and desire to secure by Letters Patent, is—

1. As an improvement in compressed-air engines the combination of the reciprocating engine B, connecting-pipes, valves *n*, and cylinders *e e′*, with their pistons, substantially as and for the purpose hereinbefore described.

2. The combination of the valves H H′ with the cylinders *e e′*, piston-rods *f″ f‴*, forked levers *l l′*, and collars *m m′*, substantially as and for the purpose hereinbefore described.

3. The combination of the valves H H′, cylinders *e e′*, pistons *f*, forked levers *l l′*, collars *m m′*, and the piston-rods *f″ f‴*, substantially as and for the purpose hereinbefore described.

4. In combination with the connecting-rod F, shaft *d*, and walking-beam *g* the triangular crank E, substantially as described.

FREDERICK F. SCHNAKE.

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