

C. F. LEOPOLD.  
Improvement in Vacuum-Engines.

No. 125,818.

Patented April 16, 1872.

FIG. 1.

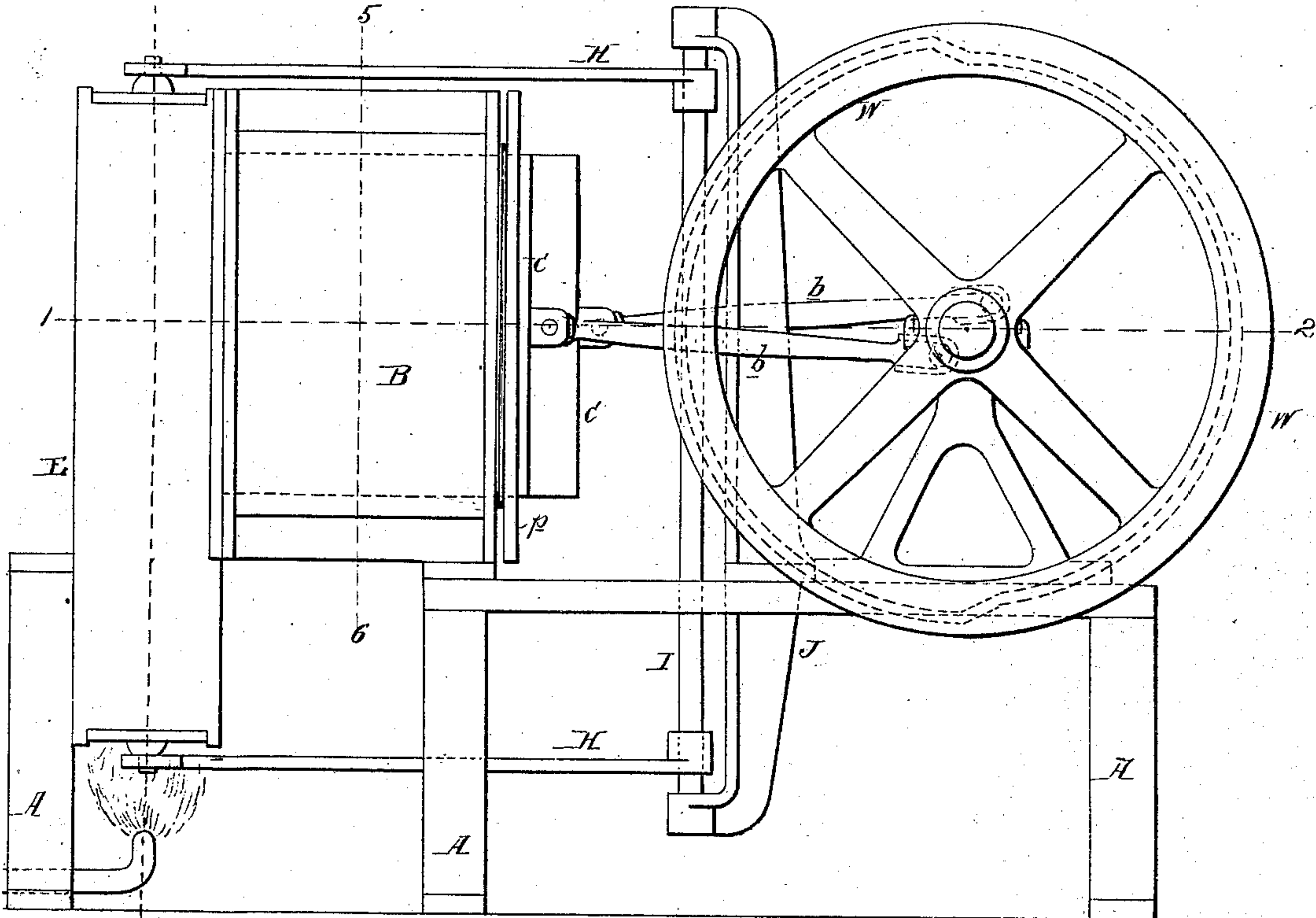


FIG. 2.

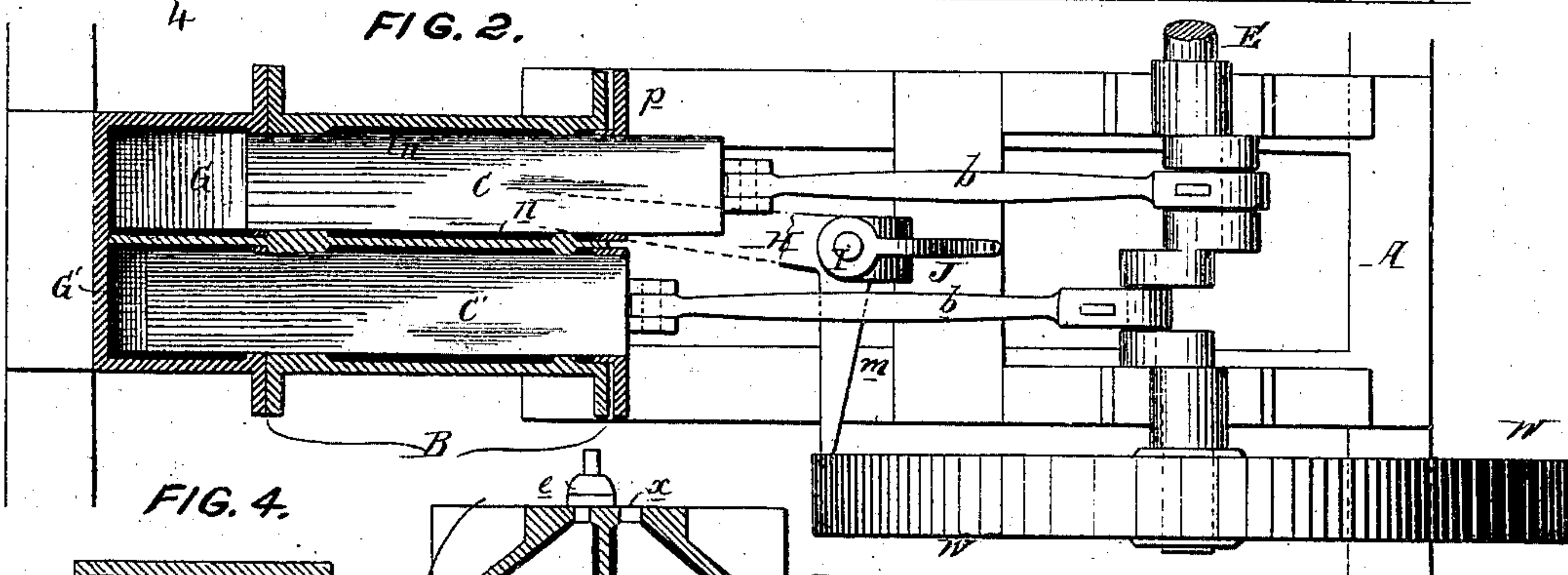


FIG. 4.

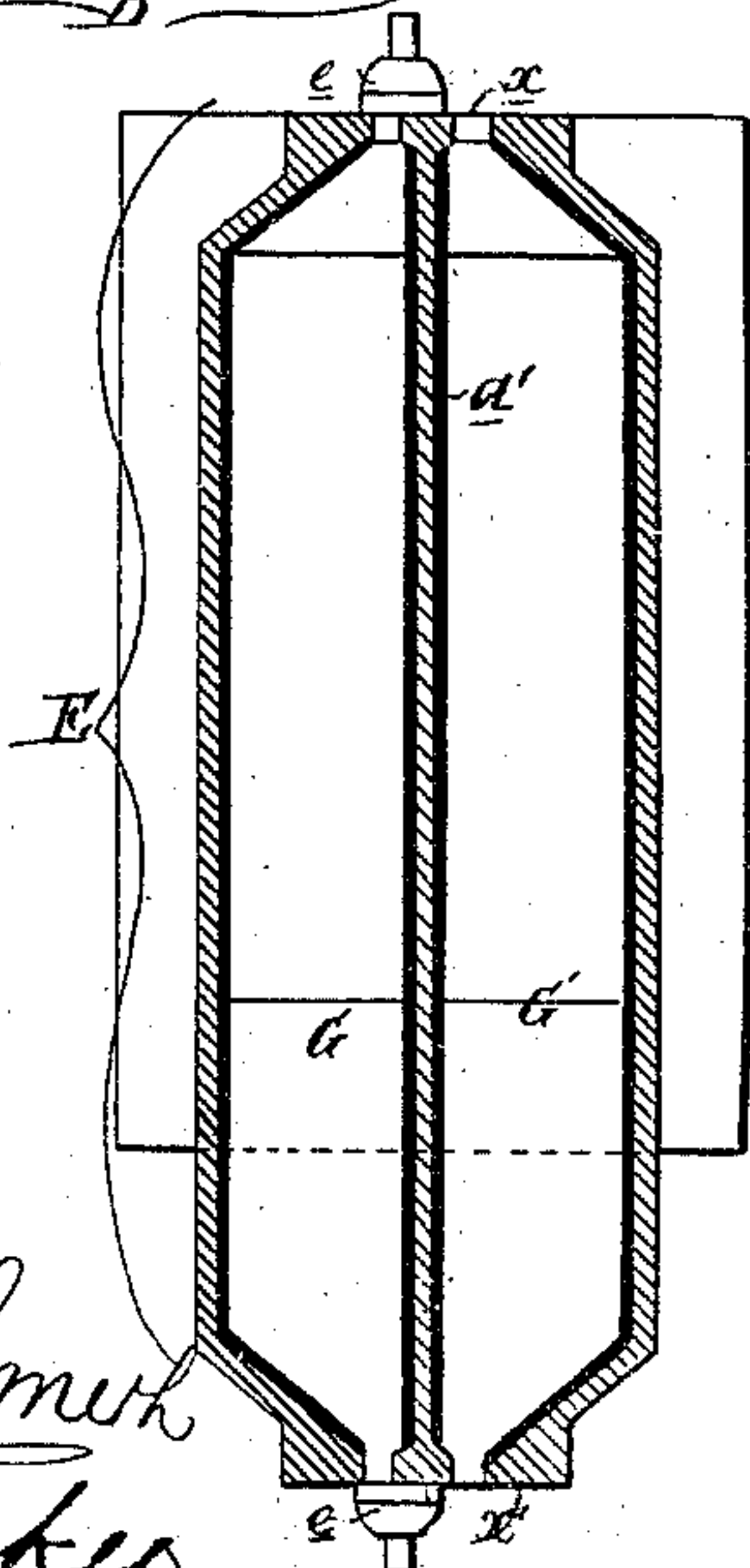
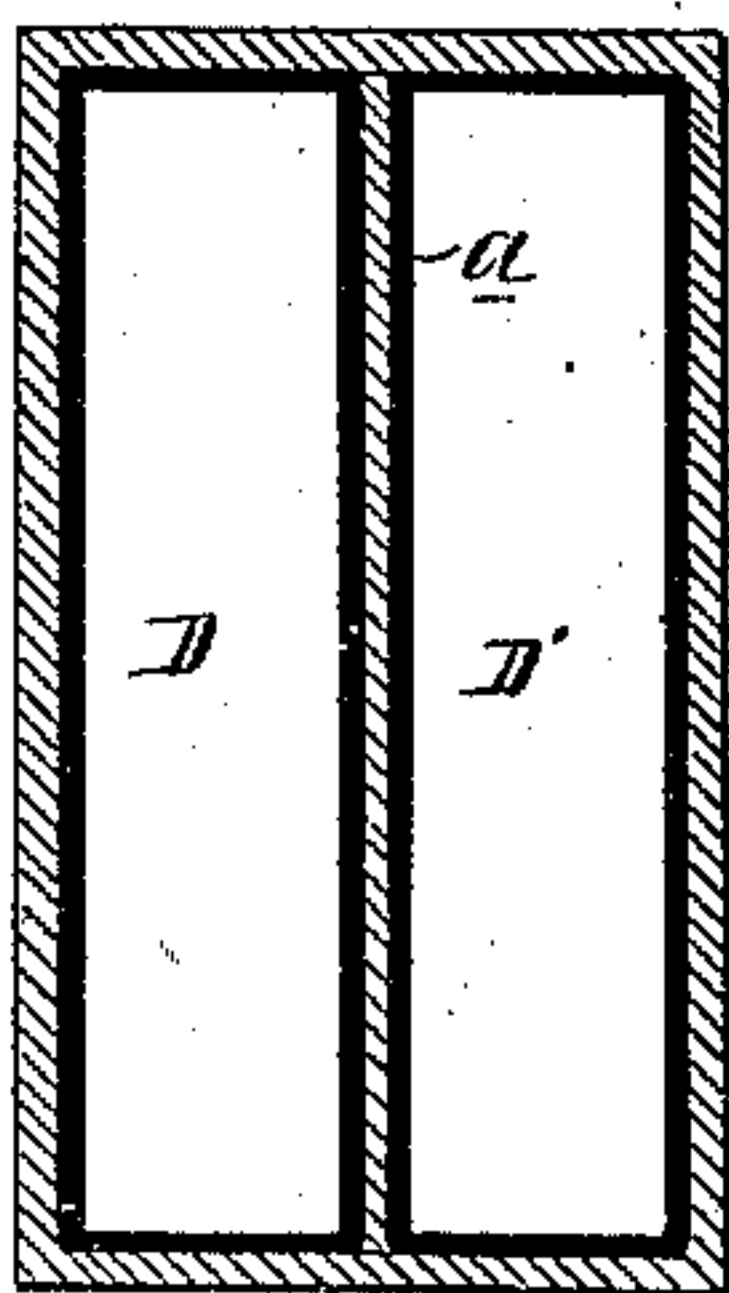


FIG. 3.

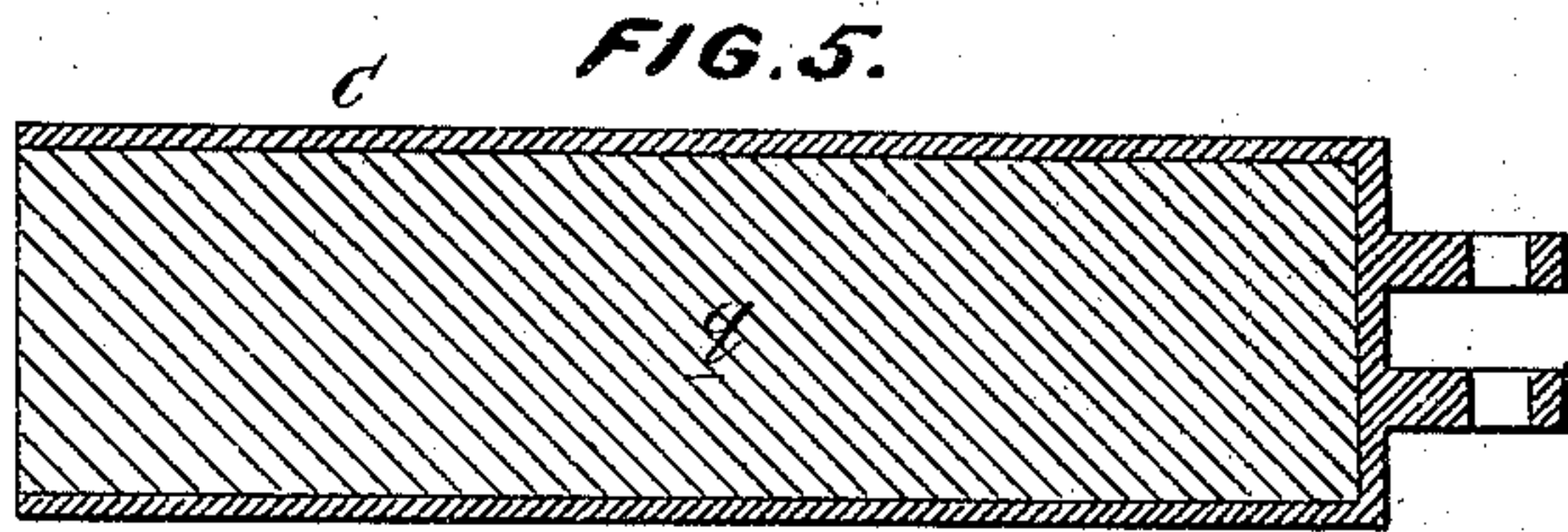


FIG. 5.

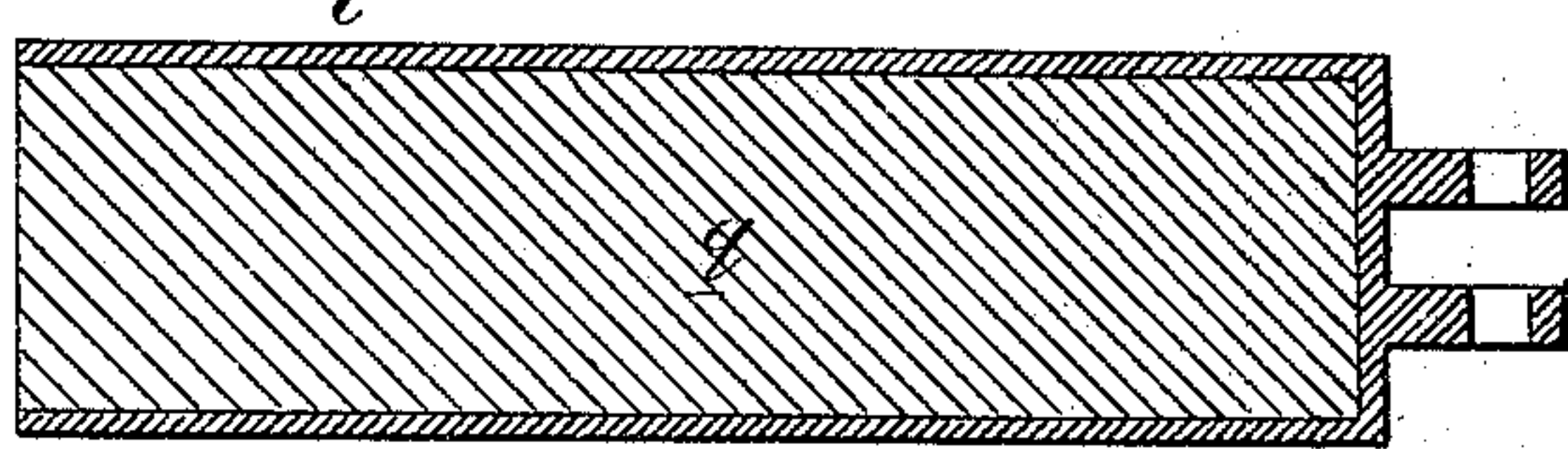
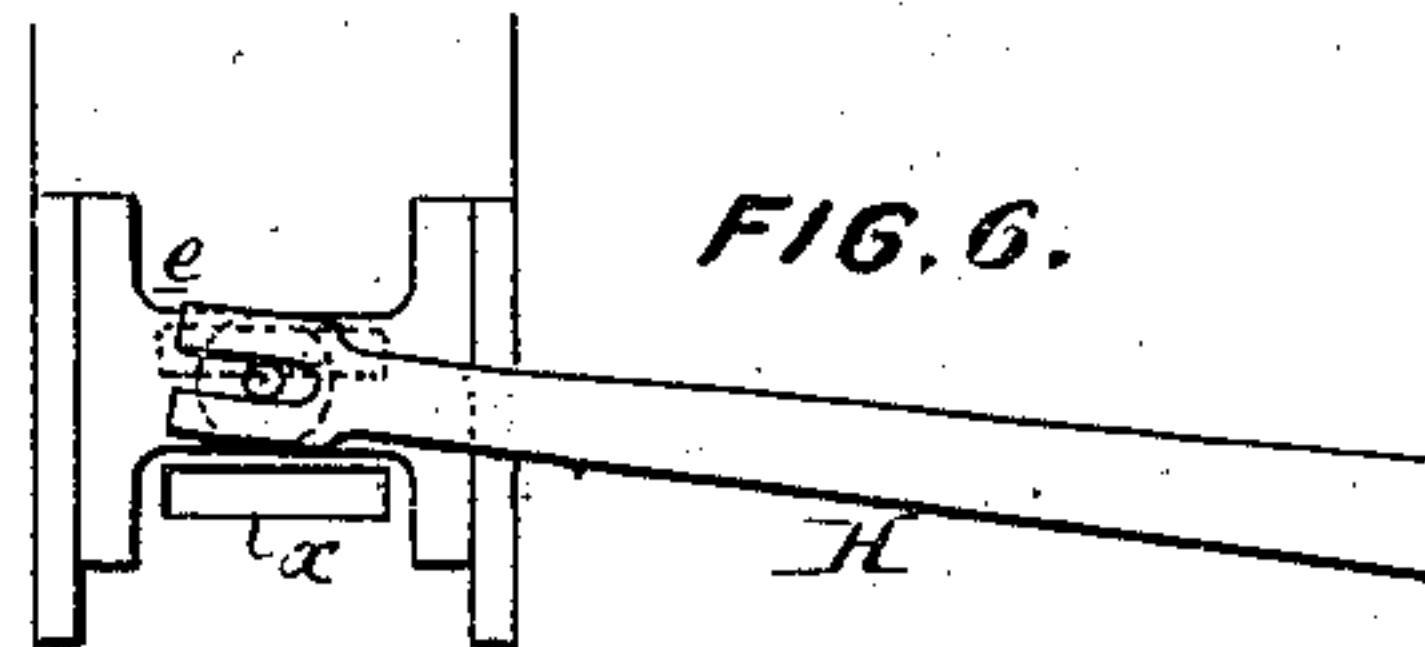


FIG. 6.



WITNESSES

Harry Smith  
John Parker

Carl F. Leopold  
by his Attor.  
Strosmann and Son



# UNITED STATES PATENT OFFICE.

CARL FRANZ LEOPOLD, OF PHILADELPHIA, PENNSYLVANIA.

## IMPROVEMENT IN VACUUM-ENGINES.

Specification forming part of Letters Patent No. 125,818, dated April 16, 1872.

Specification describing a Vacuum-Engine, invented by CARL FRANZ LEOPOLD, of Philadelphia, Pennsylvania.

My invention consists of a vacuum-engine, the detailed construction, operation, and advantages of which are too fully explained hereafter to need preliminary description.

Figure 1 is a side view of my improved vacuum-engine; Fig. 2, a sectional plan on the line 1 2, Fig. 1; Fig. 3, a vertical section on the line 3 4, Fig. 1; Fig. 4, a transverse vertical section on the line 5 6, Fig. 1; Figs. 5 and 6, detached views of part of the engine.

To a suitable frame, A, is secured a casing, B, inclosing two chambers, D and D', which, viewed transversely, as in Fig. 3, are of rectangular form in the present instance, and are separated from each other by the partition *a*. To each of these chambers is adapted a plunger, C, one plunger being connected by a rod, *b*, to one crank of the shaft E, which revolves in bearings on the frame, and the other plunger being connected by a similar rod to another crank on the same shaft. To the rear of the casing B is secured a casing, E, containing the vacuum-chambers G and G', the former of which communicates with the chamber D of the casing B, and the latter vacuum-chamber with the chamber D', the two vacuum-chambers being separated from each other by a partition, *a'*, which forms a continuation of the partition *a*. Each of the vacuum-chambers communicates with the external air through an orifice, *x*, above and an orifice, *x'*, below, as seen in Fig. 3; and the orifices of the two chambers are alternately opened and closed by valves *e*, each valve being operated by an arm, H, as shown in Fig. 6, and the two arms being secured to a vertical shaft, I, turning in bearings on a bracket, J, secured to the frame of the machine. On the said shaft I is an arm, *m*, Fig. 2, the end of which enters a cam-shaped groove in the side of the rim of a fly-wheel, W, on the crank-shaft, this groove being consequently the prime mover and controller of the valves.

Omitting for the present all description of the detailed construction of the plungers and casings, I will now proceed to explain the operation of the engine, premising that a gas-flame, or a flame derived from any other source, is constantly burning immediately below the

lower orifices *x'* of the vacuum-chamber; or, in place of the flame, hot air or products of combustion may be introduced to the vacuum-chambers in any other manner.

In Fig. 2 the plunger C is at the limit of its forward stroke and the plunger C' at the limit of its rearward stroke, and it will be observed that the movement of the rear of the plunger is restricted to the vacuum-chamber, from which it never moves so far forward as to enter the chamber of the casing A—a feature of my invention which will be particularly referred to hereafter.

When the plungers have arrived at the relative positions shown in Fig. 2 the orifices of the vacuum-chamber G are closed and the orifices of the chamber G' opened; a partial vacuum is consequently formed by the rarefied air within the chamber G, and hence the plunger C, actuated by the pressure of the atmosphere, will move rearward. The orifices of the chamber G' were opened simultaneously with the closing of the orifices of the chamber G, the partial vacuum in the said chamber G' being thus destroyed by the entrance therein of air; its plunger C' is consequently at liberty to be moved forward through the medium of the crank-shaft by, and simultaneously with, the rearward movements of the plunger C. When the latter plunger reaches the limit of its rearward movement and the plunger C' the limit of its forward movement the orifices of the vacuum-chamber G are opened and those of the chamber G' closed, when the plunger C' will move rearward and, through the medium of the crank-shaft, drag the plunger C forward.

It will now be seen without further description that the plungers will constantly reciprocate in contrary directions, and will impart a rotary motion to the crank-shaft.

It may be here remarked that the valve may be operated by many different devices, but that I prefer to have them actuated directly from the fly-wheel, in the manner described, as the rim of the wheel moves with rapidity and imparts the necessary rapid movement to the valves.

It will be seen, on referring to Figs. 2 and 4, that the interior of each plunger-chamber is recessed on all sides. Into these recesses I pack properly-prepared plumbago, which serves the twofold purpose of a lubricant and



a non-conductor of heat, the plumbago being a refractory material, which will effectually protect the metal both of the plunger and the casing from the injurious effects of the heat imparted by the gas-jets. A similar packing of plumbago is contained within the stuffing-box formed by the gland *p*, which fits into the end of each chamber *D* and *D'*. As a further means of protecting each plunger from the effects of the heat I make it hollow and of thin metal, as shown in Fig. 5, and fill the interior with baked fire-clay, *q*, or other equivalent refractory material. I also line the interior of the vacuum-chambers *G* and *G'* with refractory material, as shown in Figs. 2 and 3.

The restriction of the movement of the rear ends of the plungers to the vacuum-chambers is an important feature of my invention, for the plungers, to a considerable extent, isolate the casing *D* from the necessarily hot casing *B*, and the said casing *D* is consequently maintained in a comparatively cool state. Moreover, by this arrangement the plumbago packing *n* in the recesses of the chambers *D* and *D'* remains intact, for it is always confined within its recess by the plungers; but the most important result of thus restricting the movement of the rear of the plunger to the vacuum-chambers is that they have the full benefit of the partial vacuum created therein; for, if the end of the plungers did not traverse across, or nearly across, the vacuum-chambers, but were, on the contrary, confined in their movements to the chambers of the casing *B*, the space in which the rarefied air is confined by the valves would be more extended than it is when the plungers move in the vacuum-chambers, and consequently the vacuum would be more imperfect.

A third, or even a fourth, plunger, with guiding and vacuum chambers, might be add-

ed to the engine and coupled to the same shaft, valves being arranged and operating accordingly; and a third plunger would certainly help the crank-shaft over its dead-center; but for ordinary purposes two plungers will suffice, each plunger, in turn, moving rearward, owing to the pressure of the atmosphere, and dragging forward the other plungers, in the manner described.

Although I prefer to make the plungers of the rectangular shape described, I do not desire to restrict myself to that shape; but

I claim as my invention—

1. Two or more plungers connected at one end to the same crank-shaft, and guided in separate chambers, communicating with vacuum-chambers, within which heated air or products of combustion is alternately admitted, all substantially as described.

2. The reciprocating plungers *C* *C'*, connected to the same crank-shaft, and having the movement of their rear ends confined to vacuum-chambers *G* and *G'*, as set forth.

3. The guiding-chambers *D* and *D'*, each recessed to receive an inner lining of plumbago, which surrounds the reciprocating plunger, as specified.

4. The said vacuum-chambers *G* *G'*, communicating with the chambers in which the plungers operate, and having orifices *x* above and below, and valves for opening and closing the said orifices at the intervals and in the manner heretofore explained.

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

CARL FRANZ LEOPOLD.

Witnesses:

WM. A. STEEL,  
HARRY SMITH.