(No Model.)

W. E. NICKERSON & A. BERRENBERG.

VACUUM PUMP.

No. 452,441. Patented May 19, 1891.

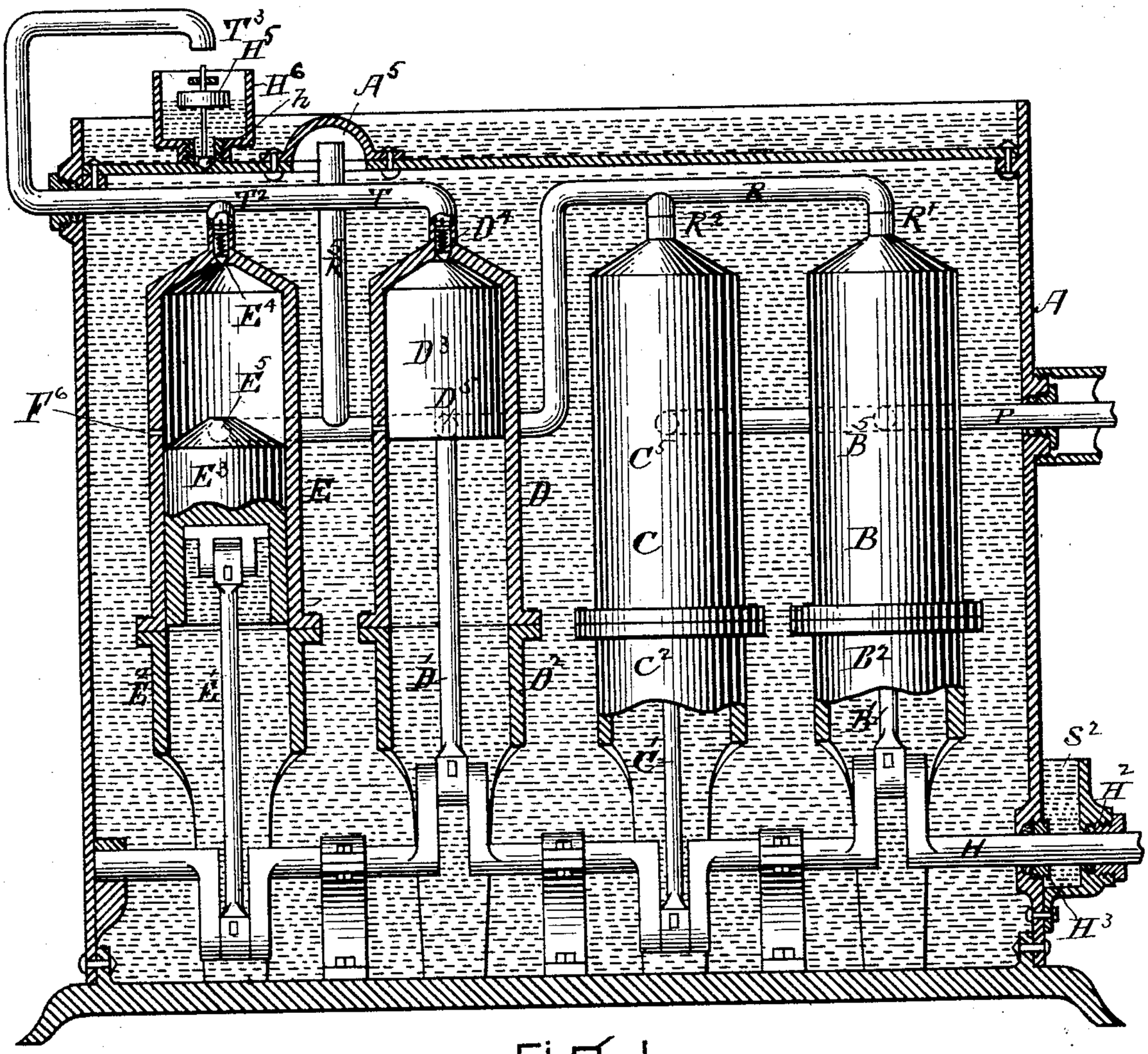

Fig. 1.

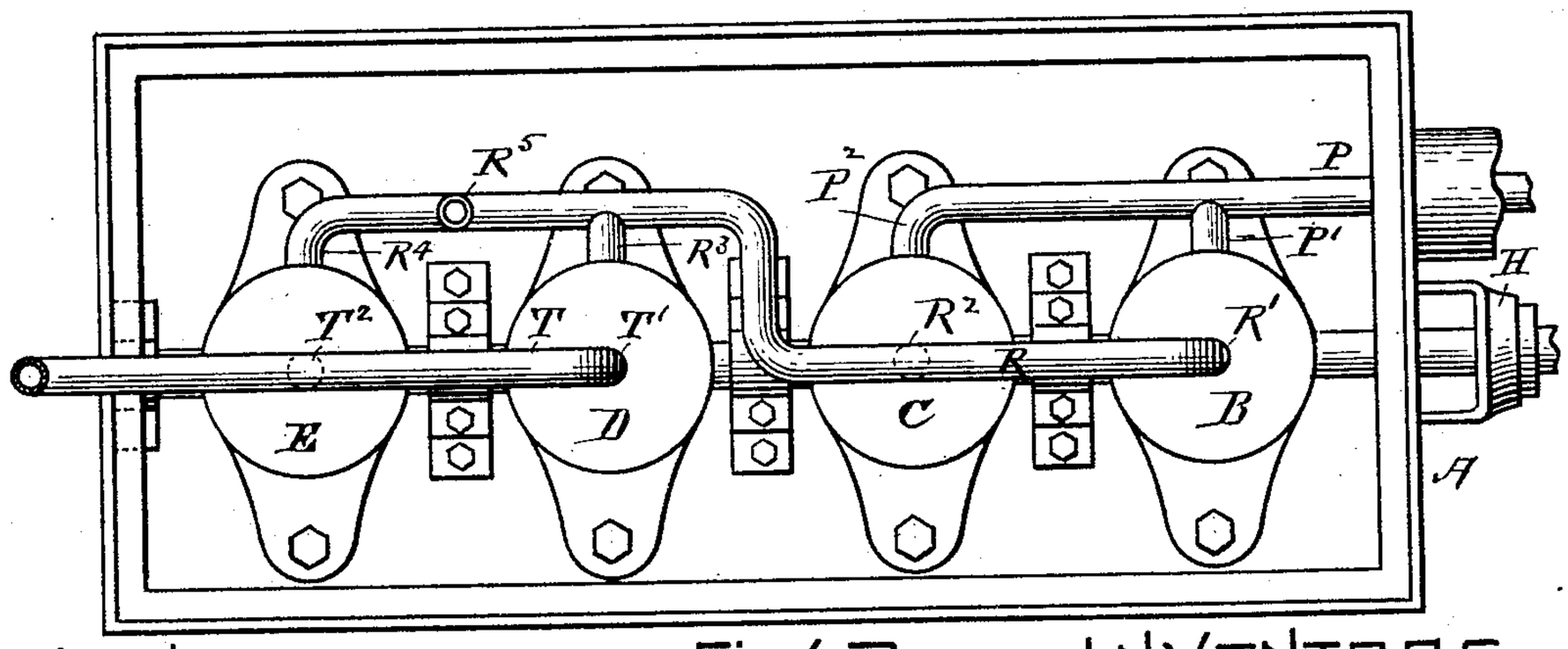

Fig. 2.

WITNESSES

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VACUUM-PUMP.

SPECIFICATION forming part of Letters Patent No. 452,441, dated May 19, 1891.

Application filed June 2, 1890. Serial No. 354,035. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM E. NICKERSON, of Cambridge, and ADOLPH BERRENBERG, of Somerville, both in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Vacuum-Pumps, of which the following, taken in connection with the accompanying drawings, is a specification.

This invention relates to the construction, arrangement, sealing, and method of coworking the cylinders of a vacuum-pump.

The object is to simplify the mechanism and to secure superior results. This object we attain by the devices shown in the accompanying drawings, in which—

Figure 1 is a view in which some of the parts are shown in vertical section and some in elevation. Fig. 2 is a plan of the device with the top removed.

In the drawings, A represents a tank made large enough to hold one or more pump-cylinders and their connections. This tank is to be filled with oil or other suitable fluid, and if it is large it must be properly braced and stayed. Near the bottom of this tank a crank-shaft H is hung on suitable housings and bearings, as shown. The shaft H passes out of the tank through the stuffing-box H^3, then through the oil S^2 in the pocket H^4 to a second stuffing-box H^2, and has driving-gears. (Not shown.)

Within the oil-tank four cylinders B C D E are shown, supported, respectively, upon base-pieces B^2 C^2 D^2 E^2. These cylinders are substantially alike and a description of one E will do for all. The cylinder proper E, coned at the top, as shown, is supported on a base E^2 and has a piston E^3, also coned, connected by a pitman E′ to its crank on the crank-shaft H. At the top of the cylinder E a downwardly-closing valve E^4 is placed. A port (indicated by dotted lines at E^6) is made in the side of the cylinder.

As has already been stated, the cylinders B, C, D, and E and their pistons, valves, and ports are alike, and therefore require no further description except to refer to the connections with the inlet and outlet pipes and to their coworking.

The system of pipes and valve connections will now be described. P is a pipe leading from the article to be exhausted. This pipe is connected to the interior of cylinder B by a branch P′, Fig. 2, which terminates in the port B^5, (see Fig. 1,) and to the interior of the cylinder C by a bend P^2, Fig. 2, which terminates in the port C^5, Fig. 1. The pipe R is connected to the valves in the tops of the cylinders B and C, (their valves being in all respects like the valve E^4, shown in section in Fig. 1,) thence the pipe R turns downward and rearward, as shown, and is connected to the ports D^5 and E^5 in the cylinders D and E. The pipe R is connected by a pipe R^5 to an air-dome A^5. (See Fig. 1.) The pipe T connects at T′ with the valve D^4 in the top of the cylinder D and at T^2 with the valve E^4 in the top of the cylinder E, thence the pipe T passes out of the tank and terminates at T^3 over a return-box H^6, which is connected to the tank, as shown, having a downwardly-closing valve *h*, attached to a float H^5. The top of the entire tank A may be covered with oil, as indicated.

The operation of this pump is as follows: The tank is nearly filled with oil or other suitable fluid, that is—a sufficient quantity is put in it to cover all of the parts, but leaving a space above, as shown. The top may be covered with oil for the purpose of sealing the joints. Now as the crank-shaft H rotates, the pistons in the cylinders B and D descend and those in C and E ascend.

The pumping action is as follows: Supposing that a half-turn of the crank-shaft is made, a vacuum is formed in the cylinder B, while air is forced out of cylinder C through the pipe R^2, R, and R^5 to the dome A^5, a vacuum is formed in cylinder D, and air is forced out of cylinder E through the pipe T to the open air. At the completion of the half-turn of the crank-shaft the ports B^5 and D^5 in the exhausted cylinders B and D will be open and air will flow to B through the pipe P from the article being exhausted, and air will flow into the cylinder D through the pipe R from the cylinder B and the articles being exhausted, and through the pipes R^5 and the lower part of the pipe R from the dome A^5 and the up-

per part of the tank—that is, from the part of the tank not occupied by the oil. In this action the pump performs another important function, namely: It by exhausting from above the oil in the tank causes the deaeration of the oil in the said tank and renders it a suitable fluid for filling the spaces around the pump-cylinders and their connections for the purpose of preventing any air or other vapor from entering the vacuum-spaces within the cylinders and their connections. Now supposing the crank-shaft to make another half-turn, the ports B^5 in cylinder B and D^5 in cylinder D will be closed, and the inclosed air will be forced out, the air from B going to the dome A^5 and from D through the pipe T to the open air. While this is going on the cylinders C and E are exhausting, C through pipe P from the article being exhausted and the cylinder E through the pipe $R^4 R^5$ from the dome A^5. This comprises the work done by a full turn of the crank-shaft, and repetition of the rotation simply repeats the pumping action of all the cylinders. As the work goes on, the vacuum in the article being exhausted and in the dome and in the space above the oil in the tank is improved until the desired minimum of air tension is attained. All of the cylinders are supplied with a small quantity of oil at each stroke of the pistons, the oil passing through small ports made in the sides of the cylinders for that purpose, one of which ports is shown at E^6, Fig. 1. These oil-ports are covered and uncovered by the piston itself the same as are the air-ports B^5, C^5, D^5, and E^5. The excess of oil is forced out together with the air at each upward stroke of the piston. The oil thus admitted serves to completely expel the air from the cylinders at each upward stroke of the piston. This oil flows from cylinders B and C through the pipe R′ R to the cylinders D and E, and thence through the pipe T to the box H^6, whence its flow back into the tank A is regulated by the float H^5 and valve *h*.

In the above description of the working of this pump it is seen that the several pistons and cylinders cowork to produce the result. Thus the piston D^3 produces a vacuum for the cylinder B to discharge into, while the piston E^3 produces a vacuum for the cylinder C to discharge into. By this coworking of the individual pumps very rapid and efficient work is accomplished.

The above-described arrangement, except as to coworking, may be modified so as to apply to a single cylinder. For instance, take the cylinder E and let the exhaust-pipe R^4 run directly to the article to be exhausted—say lamps—and have the delivery-pipe T T^3 unconnected with any other pump and pass directly to the oil-box H^6. Now this single cylinder would become for most purposes a very efficient pump.

We claim—

1. An air-tight tank containing a sufficiency of oil to wholly submerge an inclosed pump-cylinder, with a pump-cylinder the interior of which is connected to the articles to be exhausted, and also to an air-space in the tank and above the oil, whereby the action of the pump will exhaust the air from the articles to be exhausted, and also from the tank and from the oil inclosed within the tank, said cylinder having a port for admitting above the piston a small portion of oil for the purpose of expelling all the air from the cylinder at each upward stroke of the piston, a piston the length of which exceeds the length of its stroke, whereby the port for the admission of air is open only during the lower portion of the stroke of the piston, and a valved outlet-port at the top of the cylinder, substantially as and for the purpose set forth.

2. In a vacuum device, the combination of one or more vacuum-pumps and an inclosing tank, said tank being exhausted of air and containing sufficient oil to wholly submerge the said pumps, with a return-box H^6, located at the top of said tank, having a valved connection therewith and adapted to receive and return to the tank the surplus of air-expelling oil forced from the pump at each upward stroke of the piston, substantially as and for the purpose set forth.

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