No. 614,535. Patented Nov. 22, 1898.

A. N. CARVER.

PRESSURE REGULATOR FOR AIR PUMPS.

(Application filed Aug. 23, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

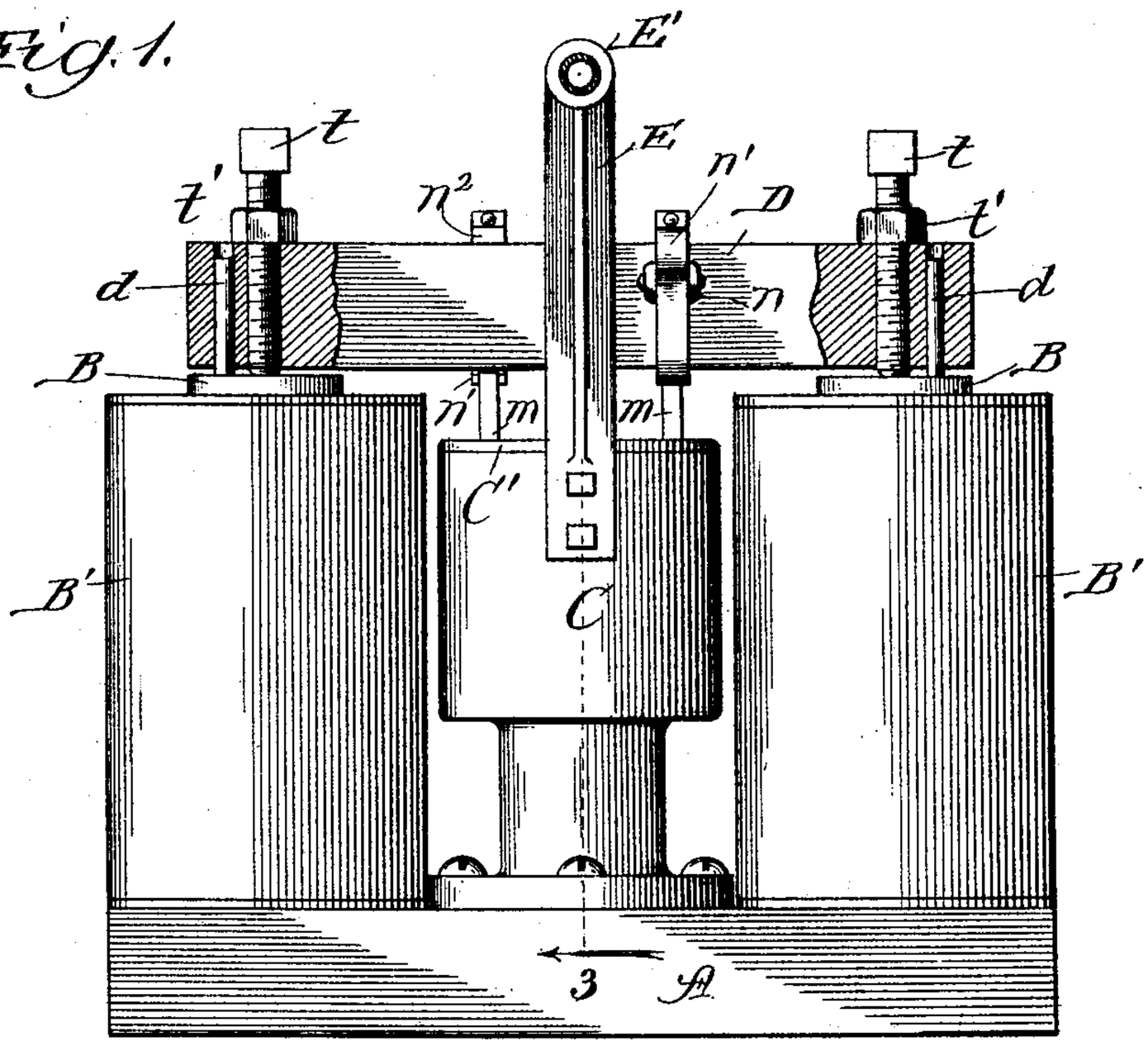
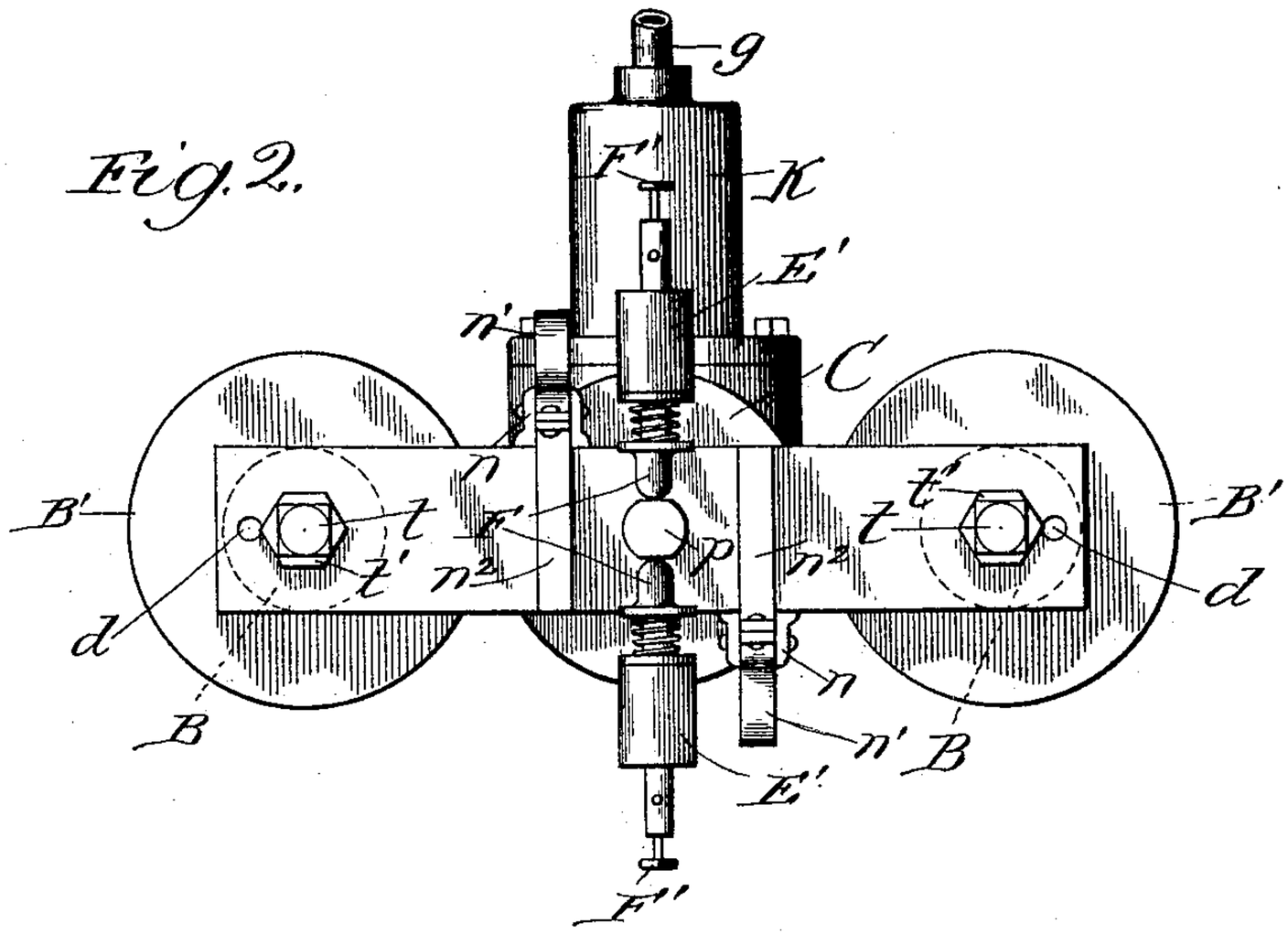


Fig. 2.



Witnesses:
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Luther S. Miller

Inventor:
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Fig. 3.

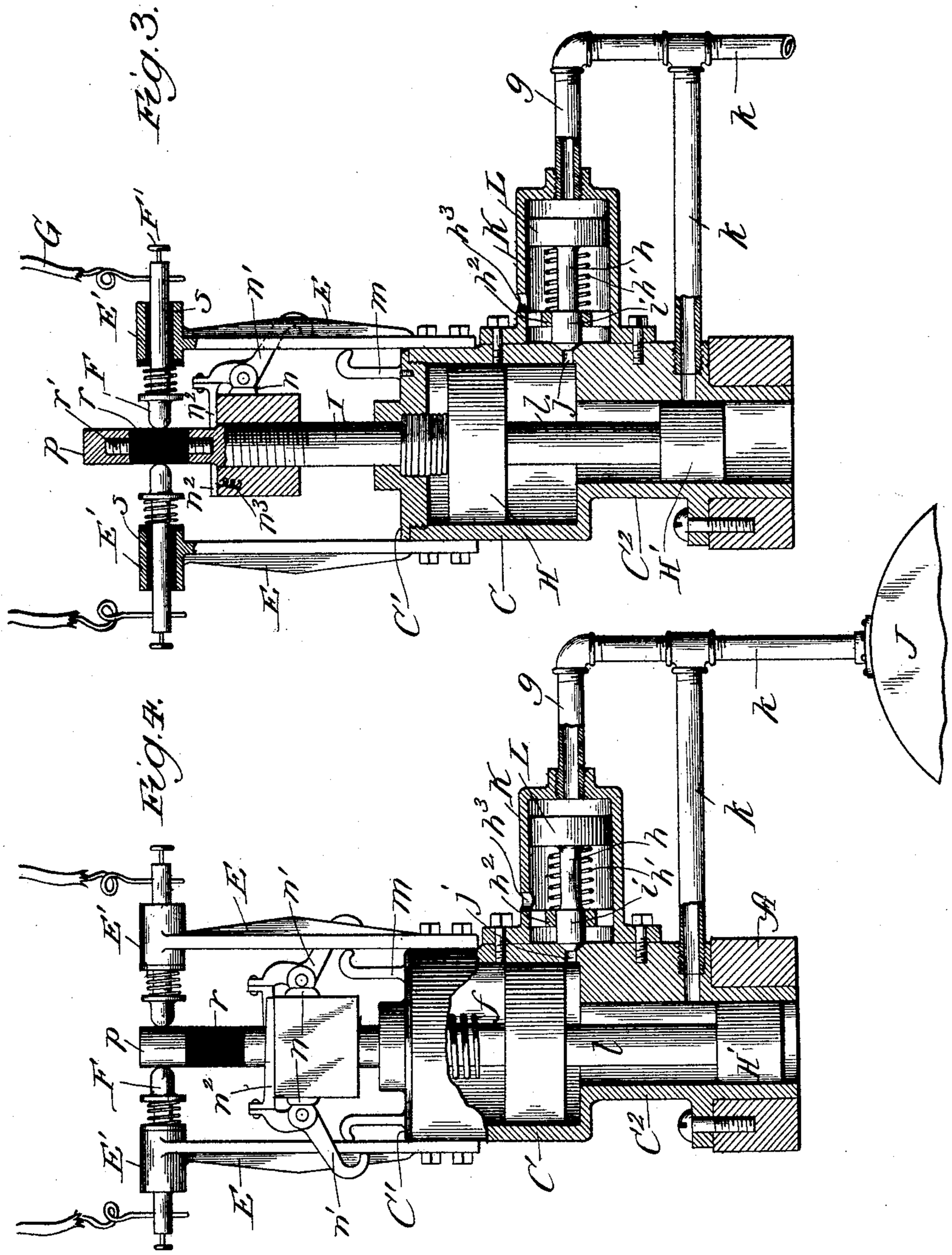

Fig. 4.

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UNITED STATES PATENT OFFICE.

ALBERT N. CARVER, OF CHICAGO, ILLINOIS.

PRESSURE-REGULATOR FOR AIR-PUMPS.

SPECIFICATION forming part of Letters Patent No. 614,535, dated November 22, 1898.

Application filed August 23, 1897. Serial No. 649,174. (No model.)

To all whom it may concern:

Be it known that I, ALBERT N. CARVER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Pressure-Regulators for Air-Pumps, of which the following is a specification.

My invention is in the nature of an improvement upon pressure-regulators for air-pumps used on motor-cars and the like, the object being to produce a regulator of simple construction which shall respond to slight changes in pressure and one which shall reduce to a minimum the danger of a failure of the air-supply in time of emergency.

My improved regulator is adapted for use in connection with any electrically-operated air-pump, and, generally stated, it involves the employment of an electromagnet the armature of which is connected with a piston movable in a cylinder communicating with the air-reservoir and means connected with the armature for making and breaking the circuit of the electric motor which actuates the pump to start or stop the latter according to the variation of the pressure in the reservoir.

In the accompanying drawings, Figure 1 is a view in side elevation of the electromagnet and pressure-cylinder of my improved air-pump regulator; Fig. 2, a plan view of the same, showing also the auxiliary venting-cylinder employed; Fig. 3, a vertical section on line 3 of Fig. 1, showing the piston in its raised position with the circuit of the motor broken; and Fig. 4, a similar section showing the piston lowered with the motor-circuit closed.

The preferred construction is as follows: Upon an iron or steel base A are supported the cores B of an electromagnet, and intermediate of said cores a pressure cylinder or chamber C. Upon the cores B are the spools B′ of the double-spool electromagnet. The magnetic circuit of the electromagnet is completed through an armature D adjustable with relation to the ends of the cores by brass set-screws t and lock-nuts t'. Secured to the sides of the cylinder C and flanking the armature D are uprights E, which terminate in guides E′, provided with insulatory linings s to receive spring-held contact-makers F, supplied with binding-posts F′ for connection with the circuit G of any electric motor (not shown) suitable to the driving of an air-pump.

The cylinder C is supplied with a piston H, provided with a rigidly-attached piston-rod I, which preferably passes loosely through the cylinder-top C′ and thence through the armature D, to which it is secured by thread connection. The rod I is provided at its upper end with a threaded socket to receive a block r of insulating material. The block r is provided with a threaded shank r' at its upper end to receive a brass knob or circuit-closer p.

The armature D is provided at its sides with lugs n, to which are pivoted dogs n', preferably of brass, and provided with shanks n^2 of the softest wrought-iron resting upon the top of the armature, to which they are magnetically attracted. Springs n^3, of sufficient resilience to overcome the residual magnetism should the current to the electromagnet fail, are confined between the shanks n^2 and the armature. The cylinder-head C′ is supplied with hooks m, which coact with the dogs n' in case of failure of the current to prevent the rise of the piston H and the escape of air from the reservoir, as hereinafter explained.

The cylinder C is provided with a downward extension C^2, forming a valve-chamber in which moves a valve H′, rigidly joined to the piston H by a stem l. With the valve-chamber C^2 communicates a pipe k, which connects with the air-reservoir J. Near the lower end of the cylinder C and at right angles to said cylinder is an auxiliary cylinder K, which serves as a venting-cylinder. The cylinders communicate through an opening j, which terminates at one end in a valve-seat for an inwardly-seating valve i, connected by a valve-stem h to a piston L in the cylinder K. About the valve-stem h is a spring-coil h', which is confined between the piston and a spider-like guide h^2, for the valve with which the cylinder is supplied. The cylinder K is provided toward its inner end with an opening h^3, leading to the atmosphere, and at its outer end with a pipe g, communicating with the air-reservoir through the medium of the pipe k.

Confined in the upper end of the cylinder C is a spring f, against which the piston H

strikes in its upward stroke, to be cushioned thereby, and which serves to give the initial downward movement to the piston after the air has been vented from below it.

The operation is as follows: By means of the binding-posts F′ the regulator is interposed in the circuit G of an electric motor which drives the air-pump, (not shown,) by means of which the air-reservoir J is charged. The coils B′ of the electromagnet are placed in a shunt from the circuit which supplies the motor-car. When the piston is in its lowermost position, as shown in Fig. 4, the circuit of the air-pump motor is completed through the brass knob *p* and the pump works to charge the reservoir J. When the pressure in the reservoir has reached a predetermined point, the air, acting through the pipe *k* upon the piston H, forces the latter up against the magnetic pull upon the armature D. As the piston nears the upper portion of its stroke it tends to move faster, because of the weakening of the magnetic field, and in order to prevent a shock at the upper end of the cylinder the cushioning-spring *f* is provided. After the piston has moved upward a sufficient distance to wholly cut the brass knob *p* out of the circuit G and replace it with the insulatory piece *r* communication between the valve-chamber C^2 and the pipe *k* is cut off by the valve H′. The circuit of the air-pump motor now remains broken till the pressure in the reservoir J, with which the pipe *g* communicates, becomes low enough to allow the piston L of the auxiliary cylinder to be forced outward under the action of the spring *h*′. This allows the air to escape by the passages *j* and h^3, and the upward pressure beneath the piston H being relieved the latter moves downward again, closing the circuit G and opening communication between the valve-chamber C^2 and the reservoir. It is evident that the device may be made to operate at different pressures by changing the relation between the armature and the magnet-cores by means of the non-magnetic set-screws *t*. The cores may be supplied with pins *d* to serve as guides for the armature in its travel.

Ordinarily the dogs *n*′ are held out of engagement with the hooks *m* by the attraction between the armature and wrought-iron shanks. If, however, the current which supplies the motor and magnet should fail, the soft-iron shanks would be quickly demagnetized and would be thrown out under the action of their springs, causing the armature to become locked to the cylinder before the air-pressure has had time to act to force the piston up. Thus is provided means for preventing the escape of the air from the reservoir in case of failure of the current.

Minor changes in details of construction may be made without departure from my invention and claims.

While the primary object of my invention is the production of a regulator for air-pumps, it will be understood that the device may be readily applied also to water-pumps for the maintaining of a certain water-pressure and in situations analogous to this. It is obvious also that it would be within the spirit of my invention to apply my improved regulator to the purpose of changing the resistance in the motor-circuit, as well as to breaking the circuit completely.

It is obvious that the cylinder and piston described for operating the armature against the attraction of its magnet may be replaced by a pressure-chamber and diaphragm or any equivalent construction. I therefore desire to be understood by the expression "means connected with said chamber and with the armature for operating said circuit maker and breaker in the opposite direction against the resistance of the armature," as used in claim 2, as intending to cover not only the piston and piston-rod, but any equivalent thereof.

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

1. In combination with a pump-motor electric circuit and a reservoir for the fluid under pressure, a circuit making and breaking device in said circuit comprising, in combination, a pressure-cylinder, a piston therein, said piston being supplied at one side with a circuit-closer and communicating at the other side with said reservoir, an electromagnet, an armature therefor controlling said piston and permitting it to be moved in one direction after the pressure in the reservoir has reached a predetermined point, and means for closing the communication between said cylinder and reservoir and permitting the air in said cylinder to be vented to allow a return of the piston under the action of said armature, substantially as and for the purpose set forth.

2. In combination with a reservoir and the electric circuit of a pump-motor, a circuit closer and breaker, an armature operating said circuit closer and breaker in one direction, a pressure-chamber communicating with said reservoir, means connected with said chamber and with the armature for operating said circuit maker and breaker in the opposite direction against the resistance of the armature, means for closing the communication between said chamber and reservoir, and a vent device between said chamber and reservoir operated to open by a reduction of pressure in said reservoir and permit the armature to be drawn to its magnet, substantially as and for the purpose set forth.

3. In an air-pump pressure-regulator, the combination with the pump-motor electric circuit and an air-reservoir, of an electromagnet, an armature therefor, a circuit maker and breaker connected with said armature, a pressure-cylinder, a piston therein said piston being rigidly connected with said armature on one side and in communication with said reservoir on the other side, and means for regu-

lating the admission of air to and its venting from said cylinder, whereby the air-pressure serves to move the piston against the magnetic attraction of the armature in one direction, and the piston is allowed to return under the influence of said attraction after the air is vented from the cylinder, substantially as and for the purpose set forth.

4. In combination with a reservoir and the electric circuit of a pump-motor, a pressure-cylinder, a piston therein, a valve-chamber and venting-chamber communicating with said cylinder and said reservoir, said venting-chamber being supplied with a vent-passage, a valve in said valve-chamber connected with said piston and controlling the communication between the valve-chamber and reservoir, and a valve controlling the communication between said vent-chamber and pressure-cylinder and operating under a reduction of pressure in the reservoir to permit the escape of air from the pressure-cylinder, an electromagnet, an armature therefor, connection between said piston and armature, and a circuit maker and breaker carried by said armature, substantially as and for the purpose set forth.

5. In an air-pump pressure-regulator, the combination with the pump-motor circuit, of a pressure-cylinder, an electromagnet having cores flanking said cylinder, an armature, standards flanking said armature, contact-makers in said circuit carried by said standards, a piston for the cylinder, a piston-rod carried by the piston attached to and extending beyond said armature, circuit closing and breaking sections carried by said rod, an air-reservoir, valve-chamber and venting-cylinder communicating with said pressure-cylinder and reservoir, said venting-cylinder being also in communication with the atmosphere, and valves guarding said communications and depending in their operation on a variation in pressure in the reservoir, substantially as described.

6. In an air-pump pressure-regulator, the combination with the pump-motor circuit, and an air-reservoir of a pressure-cylinder provided with an extension forming a valve-chamber, a vent-cylinder at the side of and communicating with said pressure-cylinder and with the atmosphere, a piston in the pressure-cylinder, a piston in the vent-cylinder provided with an inwardly-extending valve-stem and valve, a spring tending to hold said piston toward the outer end of its stroke, a pipe leading from the outer end of the vent-cylinder and communicating with the air-reservoir, a valve-stem depending from the piston in said pressure-cylinder, a valve carried thereby, a pipe leading from the valve-chamber to the air-reservoir and controlled by said valve, an electromagnet, an armature therefor, and means connected therewith and with the piston of the pressure-cylinder for making and breaking the circuit of the pump-motor, substantially as described.

7. In an air-pump pressure-regulator, the combination with the electric circuit of the pump-motor and an air-reservoir, of a double-spool electromagnet, a pressure-cylinder between said spools provided with an extension forming a valve-chamber, a laterally-extending vent-cylinder communicating with said pressure-cylinder and with the atmosphere, a piston for the pressure-cylinder, and a piston for the vent-cylinder provided with an inwardly-seated valve, a spring tending to hold said vent-cylinder piston toward the outer end of the stroke, a pipe leading from the outer end of said vent-cylinder and communicating with said air-reservoir, a valve controlling the communication between said valve-chamber and said air-reservoir, an armature connected with the piston in said pressure-cylinder and a contact maker and breaker interposed in said electric circuit and connected with said armature, substantially as and for the purpose set forth.

8. In combination with the electric circuit of a pump-motor and an air-reservoir, an electromagnet, an armature therefor, a pressure-cylinder communicating with said air-reservoir, a piston in said cylinder connected with said armature, standards extending above said armature and provided with guides, spring-held contact-makers moving in said guides, a circuit-closer carried by said armature and moving between said spring-held contact-makers, a vent device communicating with said pressure-cylinder and with said reservoir, and valves depending for their operation upon the variation of the pressure within said air-reservoir, substantially as and for the purpose set forth.

9. In combination with the electric circuit of a pump-motor and an air-reservoir, an electromagnet, an armature therefor, a pressure-cylinder communicating with said reservoir, a piston therein connected with said armature, dogs pivotally connected to said armature and provided with shanks of magnetic material resting upon said armature, means upon the pressure-cylinder to be engaged by said dogs in emergency, standards extending above said armature, contact-makers carried thereby, a circuit-closer carried by said armature, a vent device communicating with the said pressure-cylinder and said reservoir, and valves guarding the communications with said pressure-cylinder and depending in their operation upon the variation in pressure within the air-reservoir, substantially as and for the purpose set forth.

10. In combination with the electric circuit of a pump-motor and an air-reservoir, a double-spool electromagnet, an armature therefor, a pressure-cylinder between said spools supplied with an extension forming a valve-chamber, standards upon said pressure-cylinder extending above said armature, a piston

in the pressure-cylinder connected with said armature, contact-makers carried by said standards, a circuit closer and breaker carried by said armature and moving between said contact-makers, a valve-stem supplied with a valve depending from the piston in said pressure-cylinder, a pipe communicating with said valve-chamber and air-reservoir, a laterally-extending vent-cylinder communicating with said pressure-cylinder and with said air-reservoir and supplied with a vent-passage, a piston in said vent-cylinder provided with an inwardly-seating valve, a guide for said valve, and a spring confined between said guide and piston tending to hold said piston toward the outer end of its stroke, substantially as and for the purpose set forth.

11. In an air-pump pressure-regulator, the combination with the pump-motor electric circuit and an air-reservoir, of an electromagnet, an armature therefor, means for adjusting said armature with relation to the magnet-cores, a circuit maker and breaker connected with said armature, a pressure-cylinder, a piston therein said piston being rigidly connected with said armature on one side and in communication with said reservoir on the other side, and means for regulating the admission of air to and its venting from said cylinder, whereby the air-pressure serves to move the piston against the magnetic attraction of the armature in one direction, and the piston is allowed to return under the influence of said attraction after the air is vented from the cylinder, substantially as and for the purpose set forth.

ALBERT N. CARVER.

In presence of—
J. H. LEE,
R. T. SPENCER.