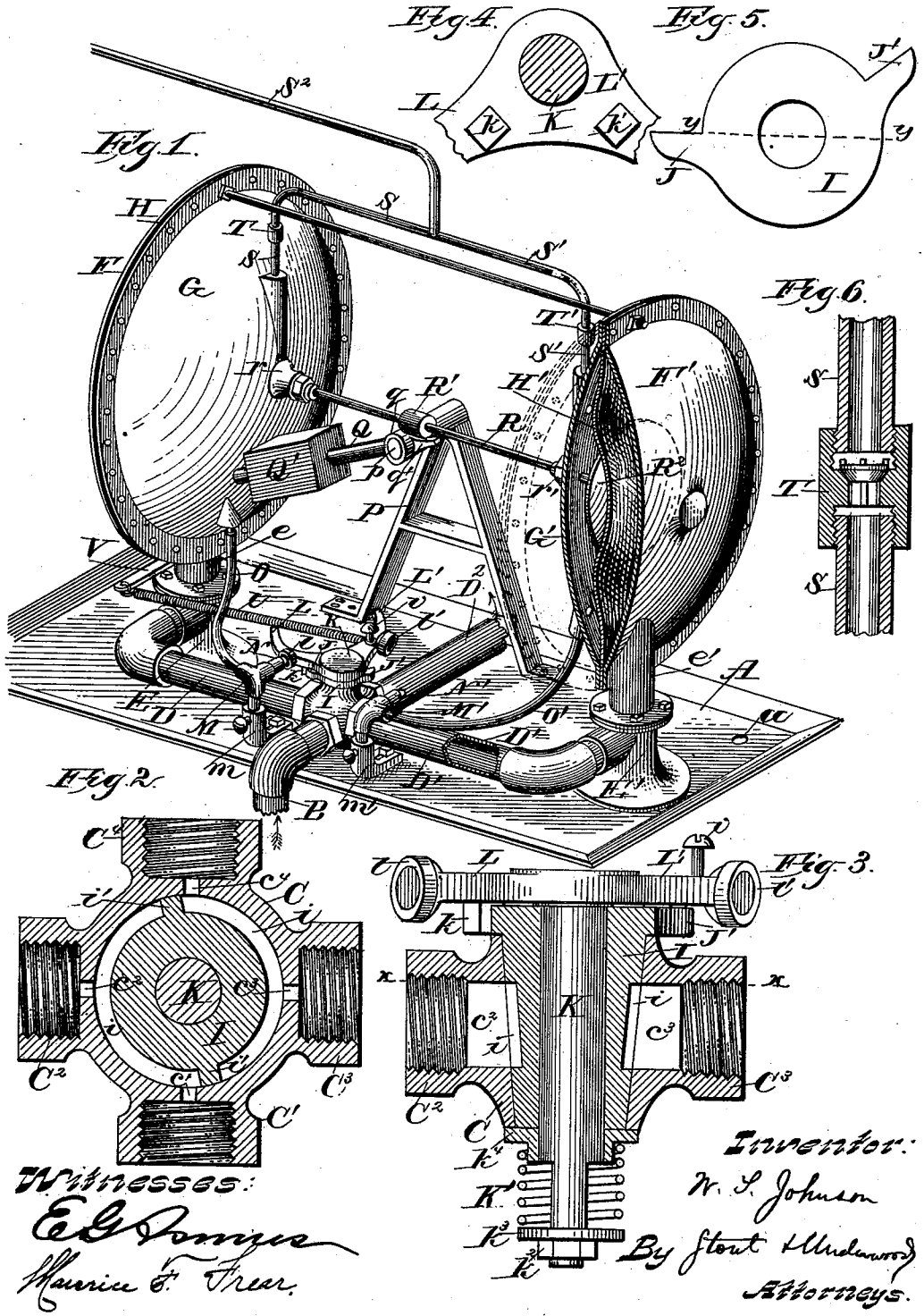
(No Model.) 2 Sheets—Sheet 1.

W. S. JOHNSON.

HYDRAULIC AIR COMPRESSOR.

No. 349,594. Patented Sept. 21, 1886.



Witnesses:
E. G. Bonnie
Maurice F. Frear.

Inventor:
W. S. Johnson
By Stout & Underwood
Attorneys.

N. PETERS, Photo-Lithographer, Washington, D. C.

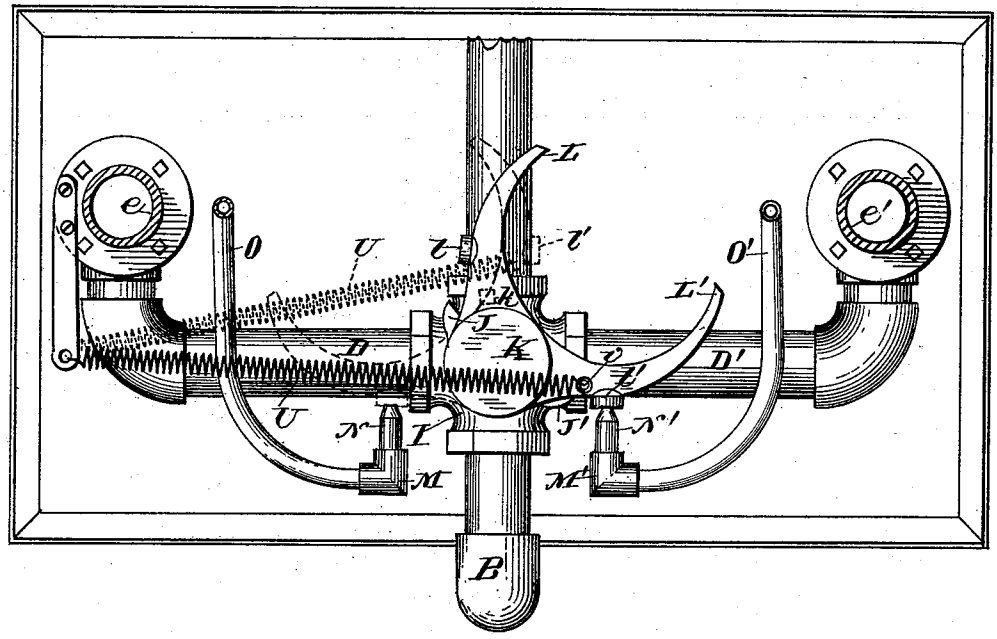
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Fig. 7.



Witnesses:
E. G. Sawyer
Maurice F. Frear

Inventor:
Warren S. Johnson
By Stout & Underwood
Attorneys.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

WARREN S. JOHNSON, OF WHITEWATER, ASSIGNOR TO THE JOHNSON ELECTRIC SERVICE COMPANY, OF MILWAUKEE, WISCONSIN.

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 349,594, dated September 21, 1886.

Application filed August 17, 1885. Serial No. 174,562. (No model.)

To all whom it may concern:

Be it known that I, WARREN S. JOHNSON, of Whitewater, in the county of Walworth, and in the State of Wisconsin, have invented certain new and useful Improvements in Hydraulic Air-Compressors; and I do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates to hydraulic air-compressing devices; and it consists in certain peculiarities of construction, as will be fully set forth hereinafter.

In the drawings, Figure 1 is a perspective view of my device partially broken away to show the construction. Fig. 2 is a horizontal section, on line *x x* of Fig. 3, of the four-way valve. Fig. 3 is a vertical section of said valve. Figs. 4, 5, and 6 are details. Fig. 7 is a plan view of the lower portion of my device, illustrating by full and dotted lines the action of the spring.

A represents the flooring, base, or platform to which my device is secured, and which base is made in the form of a pan, preferably, to catch any drip which may be emptied at the hole *a*.

B is the water supply or inlet pipe, which couples with the branch C′ of the four-way-valve casing C. From the branch C^2 of the same casing a pipe, D, leads to the hollow post or standard E, while from the branch C^3 a similar pipe, D′, leads to a similar standard, E′, at the other end of the platform, while the fourth branch, C^4, is coupled to the outlet or discharge pipe D^2. Rising from the standards E and E′, and in continuation thereof, are the pipes *e* and *e′*, cast in one piece with (or secured to) the convex disks F and F′, respectively, and to these disks other similar convex disks G and G′, which converge in the opposite direction, are secured with impervious flexible or movable diaphragms—such as thin sheets of rubber—H and H′, between the said rubber diaphragms, not being stretched tightly, but left with sufficient of the material between the rims of the disks, so as to form a loose or readily-movable diaphragm, as shown at the right in Fig. 1.

I is the valve-plug, having two central circumferential water-channels, *i i*, corresponding to the ports and intercepted by two wings, *i′ i′*, opposite to each other, and which is operated so that at all times two of the four ports c' c^2 c^3 c^4 in the valve-casing C shall be in communication but cut off from the other two ports, which are also in communication. Thus in the positions shown in Figs. 1 and 2 the ports c' c^2 are in communication, and this enables water to flow from the supply-pipe B through coupling C′ and port c' into the valve-channel and out through port c^2 and coupling C^2 into pipe D and hollow post E, and thence through pipe *e* into the space between disk F and diaphragm H while at the same time water, which is in the space between disk F′ and diaphragm H′ at the other end of the device, is flowing by gravity, assisted by pressure, as afterward described, out through pipe *e′*, post E′, and pipe D′ into the other channel *i* of the valve, through coupling C^3 and port c^3, and thence out through port c^4 and coupling C^4 into the outlet or discharge pipe D^2.

Through the vertically-perforated center of the valve-plug I there passes the stem K, formed in one piece with the curved horizontal horns L L′, each horn being provided with the stops or projections *l l′*, respectively, faced with leather, rubber, felt, or other suitable material, while from the under side of said horns, and about midway between the stops *l l′* and the stem K, there project the lugs *k k′*, as shown in the inverted plan view of said stem and horns, Fig. 4.

The top of the valve-plug I is shown in Fig. 5 as being provided with two ears, J and J′, (only one of which, J′, appears in Fig. 3, as that view represents the valve in the position shown in Fig. 5, and the section is taken on the line *y y* of that figure,) which ears are adapted to come in contact with the lugs *k k′* in the operation of the device, as hereinafter explained. The stem K projects below the valve-casing, and its lower end is screw-threaded and provided with a nut, k^2, and washer k^3, between which and the flanged collar k^4 at the base of the valve-casing C, there is interposed the spring K′ to keep the stem in place, and yet permit it to freely move, as required.

Secured to the platform A by suitable brackets, *m m′*, or otherwise, are the couplings M M′, each having two branches, one terminating in the air-inlet ports or nozzles N N′, and the other receiving one end of the pipes O O′, which

communicate, respectively, with the air-space between the disk G and its diaphragm H and that between the disk G′ and its diaphragm H′. At the opposite side of the platform from the brackets *m m′* there rises the fulcrum P, having a horizontal stationary arbor, *p*, on which turns the sleeve *q* of a pendulum-rod Q, having weight Q′ at its free end, while from the opposite side of the said sleeve, and in line with the rod Q, there projects the tooth *q′*.

R is a rod, which extends from the space on the inner side of disk G to the similar space on the inner side of disk G′, (passing through stuffing-boxes *r r′* on the outside of said disks,) and having a central stationary cylinder, R′, for operation of the tooth *q′*, as hereinafter described, while each end of said rod R terminates in a flat disk, R^2, within the air-spaces on the inner side of the disks G G′, one of said disks, R^2, only being shown. Above the stuffing-boxes *r r′* on the disks G G′ are suitable bearings for sustaining the pipes S S′, which also communicate with the air-spaces inside of said disks, and which pipes are continued, after being intercepted by the check-valves T T′, toward each other and meet above the center of my device, being there joined to a single pipe, S^2, which leads to the reservoir of compressed air, if it is desired to store the same, or to the point at which the compressed air is to be used.

U is a spring extending from a stationary arm, V, at one end of my device to a pin, *u*, upon the horn L′ of the valve-stem K.

The operation of my device will be readily understood from the foregoing description. Let us suppose that the parts are in the relative positions shown in Fig. 1. Water enters the pipe B and proceeds along the course already described in detail to the space between the disk F and diaphragm H, at the left-hand side of the device, as shown in the drawings. Now, as this water-space becomes filled the water presses against the movable diaphragm H and forces the latter toward the disk G, carrying with it the flat disk R^2 in the air-space between H and G, and consequently the rod R. As the last-named space is full of air, this air will be compressed by this action, and as in the position shown the stop *l* on the horn L closes tightly the orifice at the end of the nozzle N, the only escape for the compressed air is up out through the pipes S S^2 to the reservoir or other point of destination at the end of said pipe S^2. The rod R encounters no resistance at its other end, because the check-valve T′ prevents any of the compressed air from entering the air-space of the disks at the right-hand side of the machine through pipe S′; and, moreover, the port N′ on that side is open, and all this time whatever water may be in the water-space at the right-hand side is running out, by the course already described, from the pipe *e′* to the outlet-pipe D^2, and so the rod R moves on with its right-hand disk R^2 pressing the diaphragm H′ over against the disk F; but in this movement of the rod R the cylinder R′ on said rod is slipping over the tooth *q′*, and the instant the tooth is free from the cylinder the weight Q′ operates to swing the rod Q over in the opposite direction, with weight Q′ adjacent to the disk G′, and as the weighted rod moves over, the lower end of the said rod Q strikes the horn L′, and carries it along until the spring U, attached to said horn, is carried beyond its center of motion, when the tension of the said spring will continue the motion in the same direction and bring the stop *l′* of the horn L′ against the nozzle N′, thereby closing the air-port on the right-hand side of my device and opening the port N to the outside air, which rushes up through tube O and fills the air-space between disk G and diaphragm H at the left-hand side of my device, while at the same time the just described movement of the horn L′ serves to bring its lug *k′* in contact with the ear J′ on the valve-plug I, and turn said plug so that the course of the inflowing water will be from pipe B through coupling-branch C′ and port *c′* into the other channel *i* of the valve, and out through port c^3 and branch C^3, and pipe D′, post E′, and pipe *e′* into the water-space between disk F′ and diaphragm H′, while the water-space between diaphragm H and disk F at the other side of the device is being simultaneously emptied through the channel *e*, E, D, C^2, c^2, *i*, c^4, C^4, and D^2, and the already-described action of rods R and Q and spring U and connecting parts takes place in the opposite direction, the rod Q now striking the horn L and forcing these parts back into the position shown in Fig. 1, and so on, back and forth continuously.

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

1. In a hydraulic air-compressor, the combination, with the operating-arms of the water-valves and air-inlet ports of the air-chambers, of lugs or projections on said operating-arms, which serve to open and close the said air-inlet ports simultaneously with the movement of the water-valves, substantially as set forth.

2. In a hydraulic air-compressor, the combination, with opposing water-chambers, each water-chamber being separated from a corresponding air-compressing chamber by an impervious flexible diaphragm, of a rod having disks at its extremities within the air-chambers, said disks being independent of and free from connection with said diaphragms, water-connections having suitable valves, and connecting mechanism whereby the pressure of the diaphragms, actuated by the water against said disks, will reciprocate the rod and serve to admit and release water to and from the water-chambers, substantially as set forth.

3. In a hydraulic air-compressor, the combination, with the opposing water-chambers, each chamber being separated from a corresponding air-compressing chamber by an impervious flexible diaphragm, of a reciprocating rod having disks at its extremities within the air-

chamber, and bearing a central enlargement or projection, a weighted pendulum-rod having a tooth adapted to engage with the central projection on said rod, water-pipes connecting with the water-chambers and having a valve at their point of union with the supply and discharge pipes, air-tubes having inlet-ports and connecting with the air-chambers, a water-valve stem having horns provided with stops for closing one or the other of the air-inlet ports and simultaneously shifting the water-valve ports, and a spring for continuing the motion of the valve-stem horns when the same have been carried past the center of motion by the pendulum-rod, substantially as set forth.

4. In a hydraulic air-compressor, the combination, with the opposing water-chambers, each chamber being separated from a corresponding air-compressing chamber by an impervious flexible diaphragm, of the rod R, having disks R^2 at its extremities within the air-chambers, and central projection, R′, water-pipes connected to the water-chambers and having four-way valve at their point of union with the supply and discharge pipes, valve-stem K, with horns L L′, projections *k k′*, and stops *l l′*, valve-plug I, with cars J J′, pendulum-rod Q, with tooth *q′* and weight Q′, air-tubes O O′, connecting with the air-chambers and having air-inlet ports N N′, spring U, secured to the valve-stem, and compressed-air pipes provided with check-valves, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand, at Milwaukee, in the county of Milwaukee and State of Wisconsin, in the presence of two witnesses.

WARREN S. JOHNSON.

Witnesses:

H. G. UNDERWOOD,

MAURICE F. FREAR.