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J. H. HENDERSON & E. SCHUTZ.

HYDRAULIC AIR COMPRESSOR.

No. 475,111. Patented May 17, 1892.

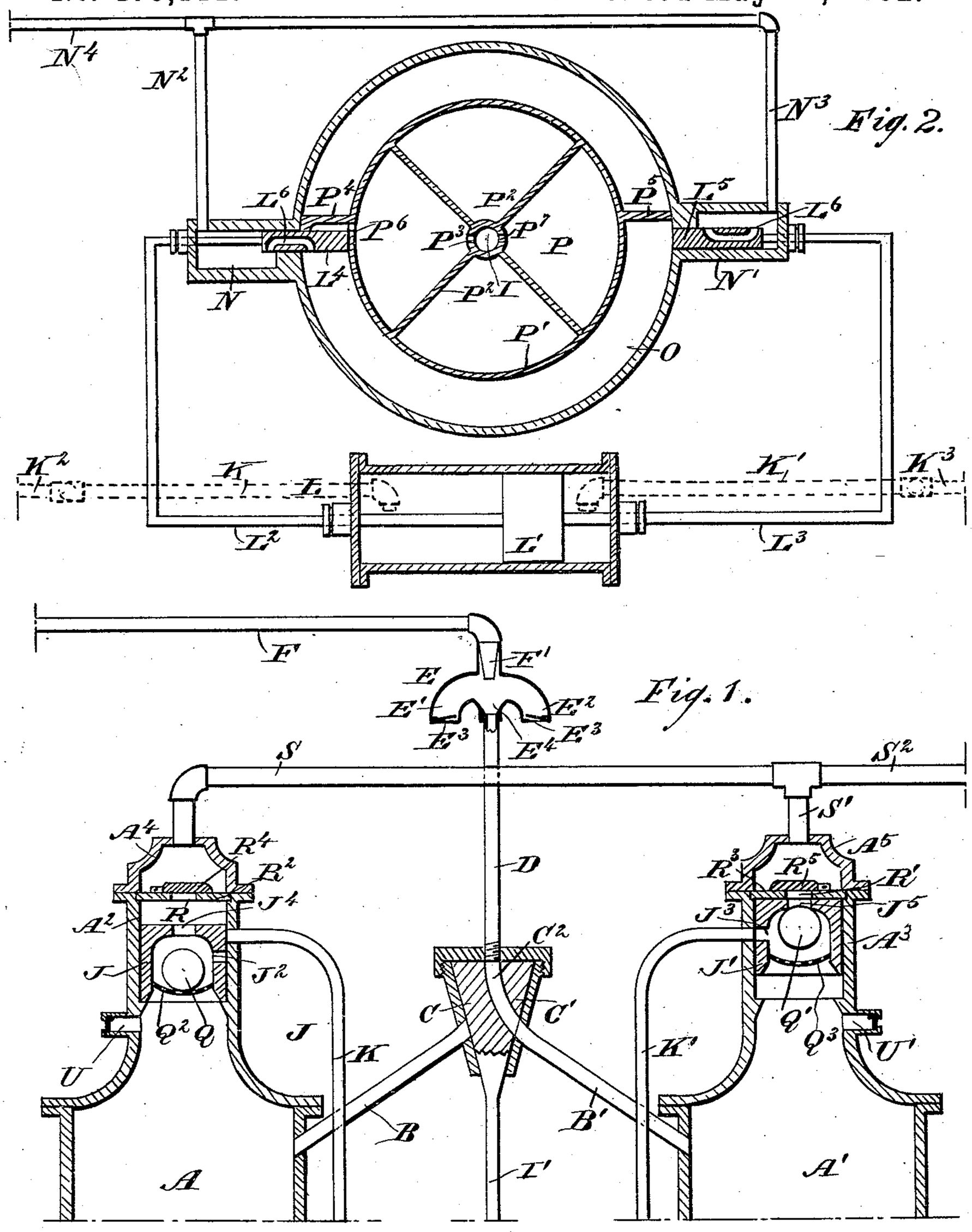

Fig. 2.

Fig. 1.

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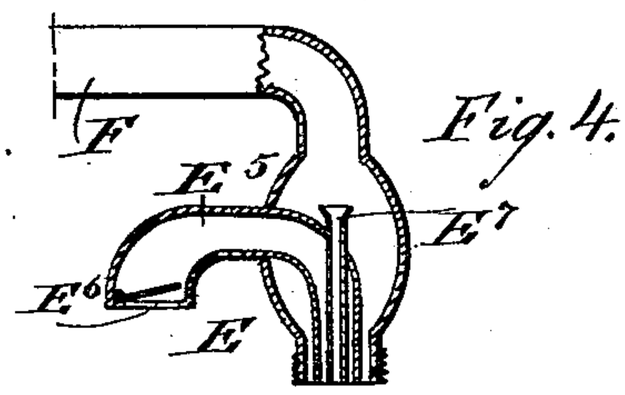

Fig. 4.

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Fig. 3.

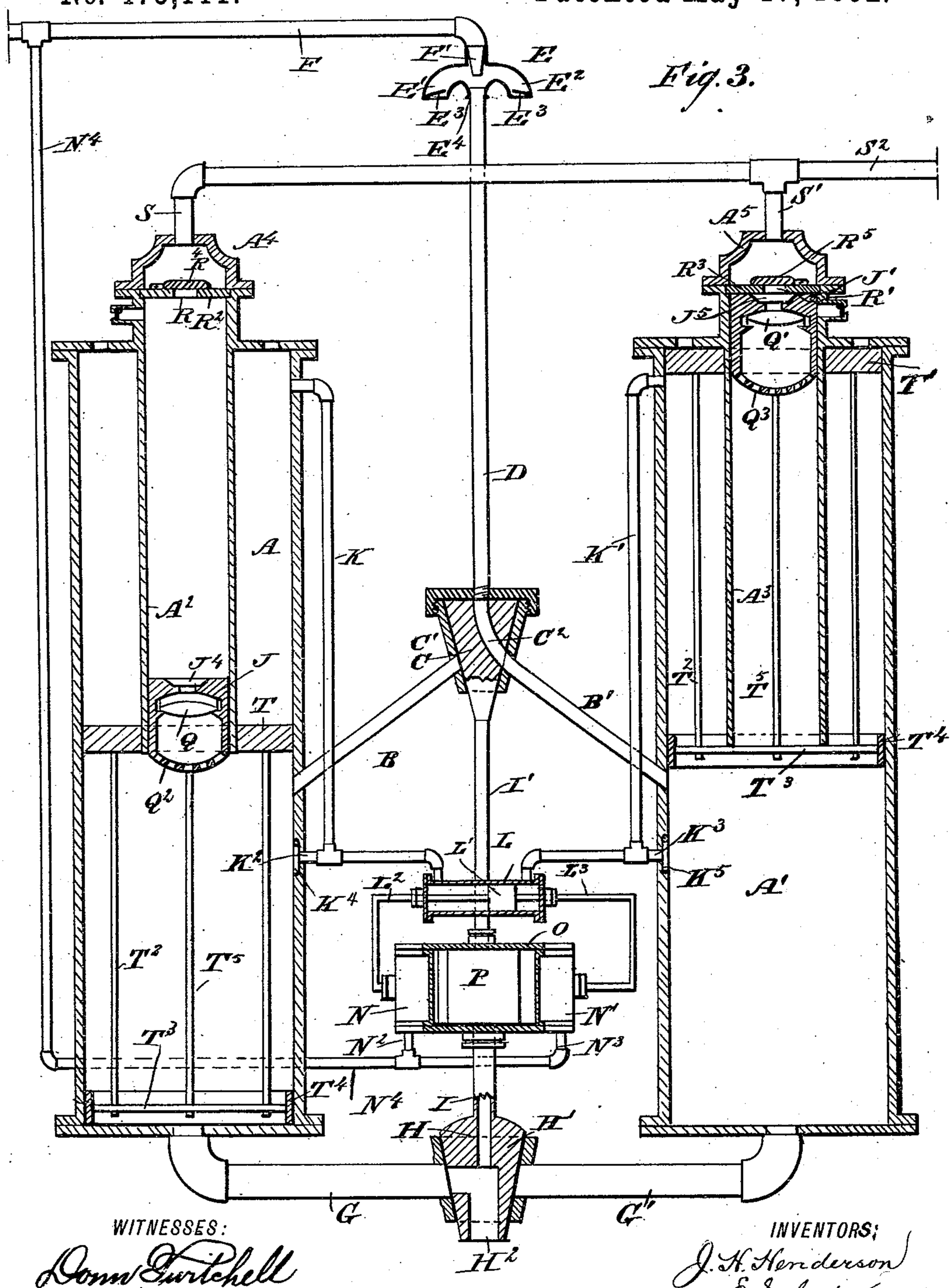

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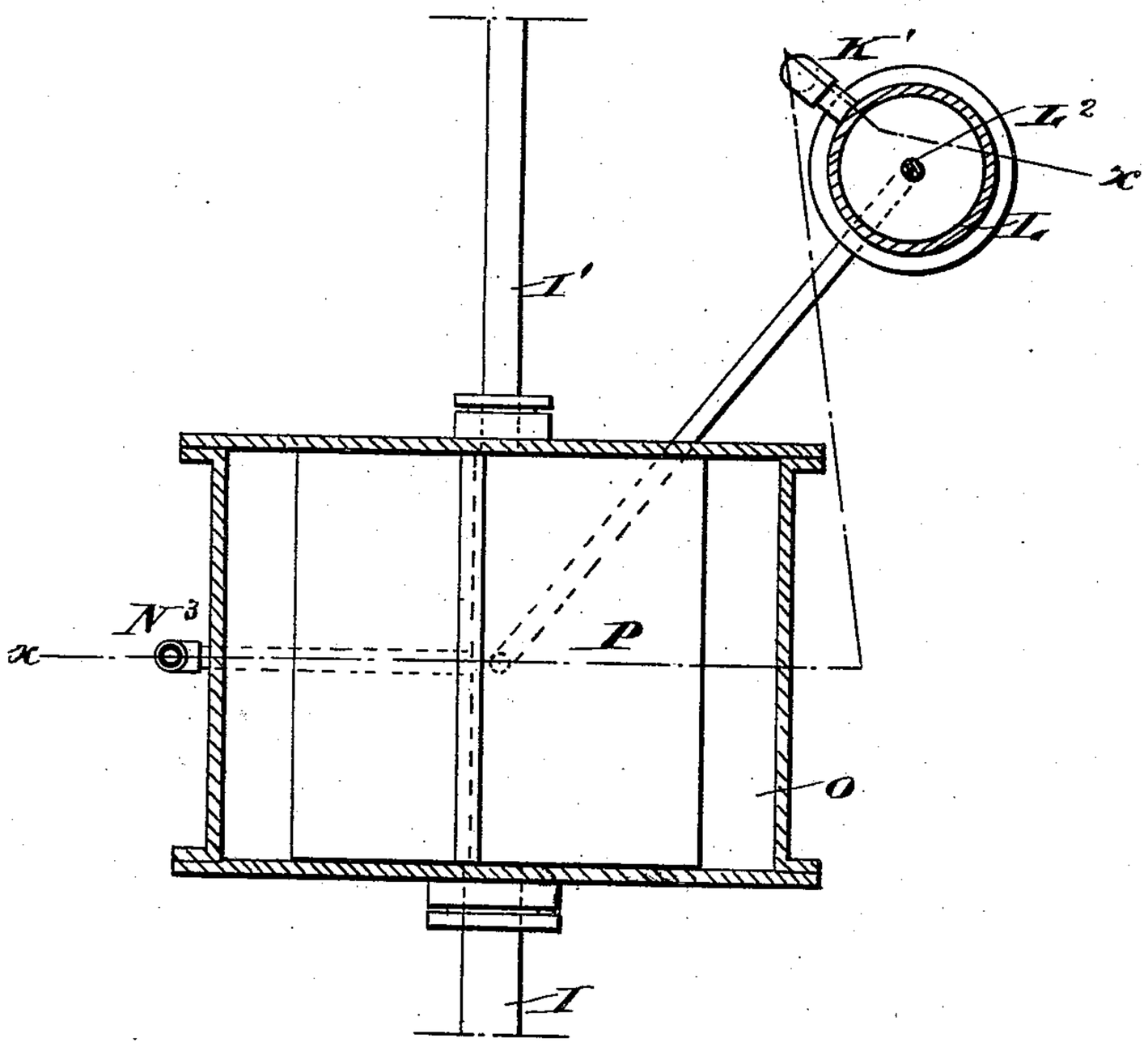
Fig. 5



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JOHN H. HENDERSON AND EMILE SCHUTZ, OF SIERRA CITY, CALIFORNIA.

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 475,111, dated May 17, 1892.

Application filed July 22, 1891. Serial No. 400,307. (No model.)

To all whom it may concern:

Be it known that we, JOHN H. HENDERSON and EMILE SCHUTZ, both of Sierra City, in the county of Sierra and State of California, have invented a new and Improved Hydraulic Air-Compressor, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved hydraulic air-compressor which is simple and durable in construction, very effective and automatic in operation, and arranged to utilize the force of water with the greatest advantage and directly on the air to be compressed.

The invention consists of two cylinders adapted to be alternately connected with the water-supply and a water-discharge, and valves automatically controlled from the water in the cylinders and alternately controlling the inlet and outlet of the water to and from the said cylinders.

The invention also consists of certain parts and details and combinations of the same, as will be hereinafter described, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the views.

Figure 1 is a sectional side elevation of the improvement. Fig. 2 is an enlarged sectional plan view of the motor for actuating the inlet and outlet valves of the air-compressor cylinders on the lines *x x* of Fig. 5. Fig. 3 is a sectional side elevation of a modified form of the improvement. Fig. 4 is an enlarged sectional side elevation of a modified form of air-nozzle, and Fig. 5 is a transverse section of the motor and air-compressor.

The improved hydraulic air-compressor is provided with two vertically-arranged cylinders A and A′, connected at or near their upper ends with pipes B B′, respectively, leading to a valve C, the valve-plug C′ of which contains an opening C^2, adapted to alternately connect with the ends of the pipes B B′. The upper end of the opening C^2 in the valve-plug C′ is arranged centrally and connects at all times with a pipe D, leading into a nozzle E, arranged to draw in air and water for charging the cylinders A and A′ alternately with air and water. The nozzle E is preferably of the construction as shown in Figs. 1 and 3, but may be of the construction as illustrated in Fig. 4.

As shown in Figs. 1 and 3, the nozzle is provided with two downwardly-bent arms E′ and E^2, each containing an inwardly-opening valve E^3 to permit the air to pass from the outside into the nozzle. The under side of the nozzle is formed at the center with a funnel E^4, held on the upper end of the pipe D, and into which discharge the branch arms E′ and E^2. Into the top of the nozzle opposite the funnel E^4 discharges the conical spout F′ of a water-supply pipe F, connected with a suitable water-supply. When water passes through the pipe F and discharges through the spout F′ into the funnel E^4, then the force of the water sucks in air through the valves E^3 in the arms E′ and E^2, so that both air and water pass down the pipe D into the valve C, and from the latter, according to the position of the valve-plug C′, into either of the pipes B or B′, and from the latter into the respective cylinder A or A′. The lower ends of the cylinders A and A′ are provided with water-discharge pipes G and G′, leading to a valve H, the valve-plug H′ of which is provided with an L-shaped opening H^2, adapted to alternately connect at one end with the ends of the pipes G and G′. The valve-plug H′ is secured on a hollow valve-stem I, provided with a solid extension I′, carrying the valve-plug C′ of the valve C, so that both valves C and H are operated simultaneously and in such a manner that when the valve C connects with the pipe B then the valve H connects with the pipe G′, and when the position of the valves is changed then the pipe B′ connects with the valve C and the pipe G connects with the valve H. Thus when one cylinder is filling with water and air, as above described, the other is emptying or discharging its water through its respective pipe and the valve H.

Each of the cylinders A and A′ is formed at its upper end with auxiliary cylinders A^2 and A^3, respectively, containing the pistons J and J′, respectively, fitted to slide, and provided in their walls with ports J^2 and J^3, respectively, adapted to alternately connect or

disconnect with the pipes K and K′, respectively, extending downward and opening at opposite ends into the cylinder L, located, preferably, between the two cylinders A and A′ and arranged horizontally.

In the cylinder L is fitted to slide a piston L′, held upon piston-rods L^2 and L^3, extending in opposite directions, preferably of U shape, as plainly shown in the drawings. The ends of the piston-rods L^2 and L^3 carry slide-valves L^4 and L^5, respectively, each provided with a U-shaped port L^6, as is plainly shown in Fig. 2. The slide-valves L^4 and L^5 are fitted to slide in the water-chests N and N′, connected by branch pipes N^2 and N^3, respectively, with a pipe N^4, leading to the water-supply pipe F, previously described.

The ports L^6 in the slide-valves L^4 and L^5 are adapted to connect alternately the chests N and N′ with a cylinder O, arranged centrally on the valve-stem I, controlling the valves C and H, as above mentioned. In this cylinder O is mounted to revolve a water-wheel P, provided with a rim P′, arranged concentric with the cylinder and connected by spokes P^2 with a hub P^3, secured on the hollow valve-stem I, above described. On the rim P′ of the wheel P are secured on opposite sides the wings P^4 and P^5, extending close to the inner surface of the cylinder O, as plainly shown in Fig. 2. On the rim P′ next to the wing P^4 is arranged a port P^6, leading to the interior of the wheel P, so that the water can discharge from the cylinder O through the said port P^6 into the wheel P and from the latter through a port P^7 in its hub P^3 to the opening in the hollow stem I. The opening in the stem I leads to the opening H^2 in the valve H, so that water can readily be discharged from the cylinder O, wheel P, and stem I. Water from the cylinder L can be discharged through branch pipes K^2 and K^3, respectively, extending from the pipes K and K′, respectively, and opening into the cylinders A and A′, respectively, near their lower ends, the inlet being controlled by valves K^4 and K^5, respectively, as shown in the drawings.

In the pistons J and J′ are arranged the floating ball-valves Q and Q′, respectively, adapted to rest, when not engaged by water, on the perforated bottoms Q^2 and Q^3, respectively, held in the pistons J and J′. The valves Q and Q′ are adapted to be seated on openings J^4 and J^5, respectively, arranged in the top of the said pistons J and J′, the said openings being adapted to register with openings R and R′, respectively, formed in covers R^2 and R^3, respectively, held in the top of the auxiliary cylinders A^2 and A^3, respectively. The openings R and R′ are controlled by hinged valves R^4 and R^5, respectively, held on top of the covers R^2 and R^3, respectively, in the caps A^4 and A^5, respectively, secured on top of the cylinders A^2 and A^3, respectively. The caps A^4 and A^5 are connected by pipes S and S′ with a pipe S^2, leading to an air-reservoir to store the compressed air, as hereinafter more fully described.

The operation is as follows: When the several parts are in the position as illustrated in Fig. 1, the valve C connects the pipe D with the pipe B′, while the valve H connects the pipe G with the outside. Now when water is forced through the supply-pipe F it draws or sucks in air in the nozzle E, so that both air and water flow into the pipe D through the valve C into the pipe B′ and into the cylinder A′ to accumulate in the latter. Water in the cylinder A can flow out through the pipe G as the valve H is opened to the pipe G. Air passing into the cylinder A′ rises to the top of the same and passes through the openings J^5 and R′, past the valve R^5 into the cap A^5, and from the latter through the branch pipe S′ into the pipe S^2, leading to the air-reservoir. When the water has almost filled the cylinder A′, it reaches the float-valve Q′, so that the latter closes the opening J^5 and prevents further escape of air or water into the cap A^5. At the same time the rising water acts on the piston J′, lifts the same so that its opening J^3 finally registers with the pipe K′, and water can now flow from the cylinder A′ into the said pipe K′ and into one end of the cylinder L to act on the piston L′ therein, so that the said piston is shifted to the left, thus causing the slide-valve L^5 to establish by its port L^6 communication between the water-chest N′ and the cylinder O. The water from the supply-pipe F, passing along the pipe N^4, can now pass into the cylinder O at one side of the wing P^5, so that the pressure of the water against the said wing causes the wheel P to revolve, whereby the valve-stems I and I′ are likewise turned and the position of the valves H and C is changed, the valve C connecting with the pipe G and the valve H connecting with the pipe G′. The wheel P makes about one-half revolution—that is, until the wing P^4 strikes the under side of the slide-valve L^5, which latter prevents further rotation of the wheel. The water in the cylinder A′ now discharges through the pipe G′ and valve H, while water and air accumulate in the cylinder A. The other wing P^5 now faces the port side of the slide-valve L^4, so that when the latter moves inward on the next change or return stroke of piston L′ the water passes into cylinder O through port L^6 to press onto the wing P^5 to further revolve wheel P in the same direction. During this second movement of the wheel P the water in front of wing P^4 is discharged through ports P^6 and P^7, and when the wheel comes to rest it again assumes the position shown in Fig. 2. On the next or third half-revolution the water between valve L^4 and wing P^5 discharges through port P^6 as soon as the valve L^4 begins to move outward. The above-described operation is then repeated—that is, the float-valve Q finally closes the opening J^4 and the piston J is moved upward to register by its opening J^2 with the pipe K, so that wa-

ter flows from the cylinder A to the left-hand end of the cylinder L to shift the piston L′ back to its former position. This movement of the piston L′ causes the valves L^4 and L^5 to change positions, so that the water from the pipe N^4 flows into the water-chest N and into the cylinder O, thereby causing the wheel P to rotate in an opposite direction to bring the valves C and H back to their former positions, as shown in the drawings. Thus it will be seen that the cylinders A and A′ are alternately charged with water and air, the water in each cylinder compressing its air directly and forcing the same into the reservoir without intervening mechanism.

It is understood that the water in the cylinder O always readily discharges through the ports P^6 and P^7 and hollow valve-stem I whenever a return movement of the wheel takes place. The ends of the cylinder L likewise discharge their water through part of the pipes K and K′, respectively, and the branch pipes K^2 and K^3, respectively, lead to the cylinders A and A′.

The air-compressor thus far described is principally intended to be used when the pressure per square inch in the supply-pipe F is equal to or greater than the required pressure of air per square inch in the air-reservoir. In case the water has not the sufficient fall and pressure to counterbalance the required pressure of air per square inch in the air-reservoir the device is arranged as illustrated in Fig. 3. In this case the auxiliary cylinders A^2 and A^3 are extended about half-way down the cylinders A and A′, as illustrated in the said figure.

In the cylinders A and A′ are fitted to slide the pistons T and T′, respectively, having a central opening fitting onto the auxiliary cylinders A^2 and A^3, respectively, as plainly shown. From the under side of each of the pistons T and T′ extend downwardly rods T^2, connecting with the spider T^3, fastened to a ring T^4, fitted into the cylinders A and A′, respectively. When the piston T or T′ is in a lowermost position—that is, at the lower end of the auxiliary cylinder A^2 or A^3—then the ring T^4 rests on the bottom of the respective cylinder, as shown to the left in Fig. 3, and when the piston T′ or T is in an uppermost position, as shown to the right in Fig. 3, the spider T^3 rests against the lower end of the auxiliary cylinder A^3 or A^2. The pistons J and J′ are fitted to slide in the auxiliary cylinders and are connected by a rod T^5 with the spider T^3, so that the said pistons J and J′ move simultaneously with the pistons T and T′, respectively. The pipes K and K′ are now controlled by the pistons T and T′, respectively, instead of by the pistons J and J′, as was the case above described in reference to Fig. 1.

The upper ends of the cylinders A or A′ are provided with air-inlets, so as to prevent vacuum forming in the cylinders. As illustrated in Fig. 1, the air-inlets U and U′ for the said cylinders A and A′ are provided with valves, as plainly shown in Fig. 1, the said valves closing when the compressing is taking place.

In case a large quantity of water is available on either high or low pressure, the nozzle E (shown in Fig. 4) is preferably employed to mingle the air and water together, so that the two will have a greater surface bearing against each other, so as to take in more air, according to the quantity of water used. This nozzle contains an air-pipe E^5, provided at its outer end with a valve E^6 and extending to the center of the nozzle-casing into the pipe D. A small pipe E^7 leads from the nozzle-casing into the downwardly-extending part of the air-pipe E^5, so as to form a water-way through the center of the air-pipe, the water entering the said pipe E^7 at its upper end, which extends into the water-supply pipe F. The valve E^6 opens to admit the air and closes with the pressure of the water.

It will be seen that an air-compressor constructed in this manner is very simple and durable, not liable to get out of order, entirely automatic in operation, and has its force of water acting directly on the air, so as to compress the same.

It will be understood that in case the air in the air receptacle or receiver has a pressure per square inch equal to the pressure of water at the nozzle E, then the compressed air counterbalances the water, and consequently all flow of water into the cylinders A and A′ will cease, thus saving the water until a sufficient quantity of air has been withdrawn from the air-reservoir to reduce the pressure therein. The device then again will commence its operation automatically in the manner above described.

Having thus fully described our invention, we claim as new and desire to secure by Letters Patent—

1. An air-compressor comprising two upright cylinders, an inlet-valve for automatically controlling the alternate filling of the said cylinders with a mixture of water and air, and a supply-pipe connected with the said valve and provided with an air-nozzle and a water-supply pipe, substantially as shown and described.

2. An air-compressor comprising two upright cylinders, an inlet-valve for automatically controlling the alternate filling of the said cylinders with a mixture of water and air, a supply-pipe connected with the said valve and provided with an air-nozzle and a water-supply pipe, and a discharge-valve for controlling the discharge of water from the said cylinders, substantially as shown and described.

3. An air-compressor comprising two upright cylinders, an inlet-valve for automatically controlling the alternate filling of the said cylinders with a mixture of water and air, a supply-pipe connected with the said valve and provided with an air-nozzle and a water-supply pipe, a discharge-valve for con-

trolling the discharge of water from the said cylinders, and air-pipes for carrying off the air from the said cylinders, substantially as shown and described.

4. An air-compressor comprising two upright cylinders, an inlet-valve for automatically controlling the alternate filling of the said cylinders with a mixture of water and air, a supply-pipe connected with the said valve and provided with an air-nozzle and a water-supply pipe, and a motor actuated from the accumulating water in the said cylinders and controlling the said inlet-valve, substantially as shown and described.

5. An air-compressor comprising two upright cylinders, an inlet-valve for automatically controlling the alternate filling of the said cylinders with a mixture of water and air, a supply-pipe connected with the said valve and provided with an air-nozzle and a water-supply pipe, a discharge-valve for controlling the discharge of water from the said cylinders, and a motor actuated from the accumulating water in the said cylinders and actuating simultaneously both the said inlet and discharge valves, substantially as shown and described.

6. An air-compressor comprising two upright cylinders having air-discharge pipes, a motor connected with and alternately actuated from the accumulating water on the said cylinders, inlet and outlet valves for the said cylinders and actuated simultaneously from the said motor, and a piston fitted to slide in the upper end of each of the said cylinders and arranged to control the water passing from the respective cylinder to the said motor, substantially as shown and described.

7. A hydraulic air-compressor provided with a motor for actuating the inlet and outlet valves and comprising a cylinder, water-chests connected with a water-supply, slide-valves arranged in the said chests to alternately connect the latter with the cylinder, and a wheel secured on the valve-stem and within the said cylinder and provided with wings, substantially as shown and described.

8. A hydraulic air-compressor provided with a motor for actuating the inlet and outlet valves and comprising a cylinder, water-chests connected with a water-supply, slide-valves arranged in the said chests to alternately connect the latter with the cylinder, a wheel secured on the valve-stem and within the said cylinder and provided with wings, a cylinder containing a piston controlled by the water of the compressor-cylinders, and piston-rods connecting the said piston with the said slide-valves, substantially as shown and described.

9. An air-compressor provided with a nozzle comprising a casing having a central funnel, side arms leading to the said funnel and each provided with a valve, and a water-spout opening into the said casing on top opposite the said central funnel, substantially as shown and described.

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