(No Model.) 3 Sheets—Sheet 1.

E. SCHUTZ & J. H. HENDERSON.

HYDRAULIC AIR COMPRESSOR.

No. 517,628. Patented Apr. 3, 1894.

Fig. 1.

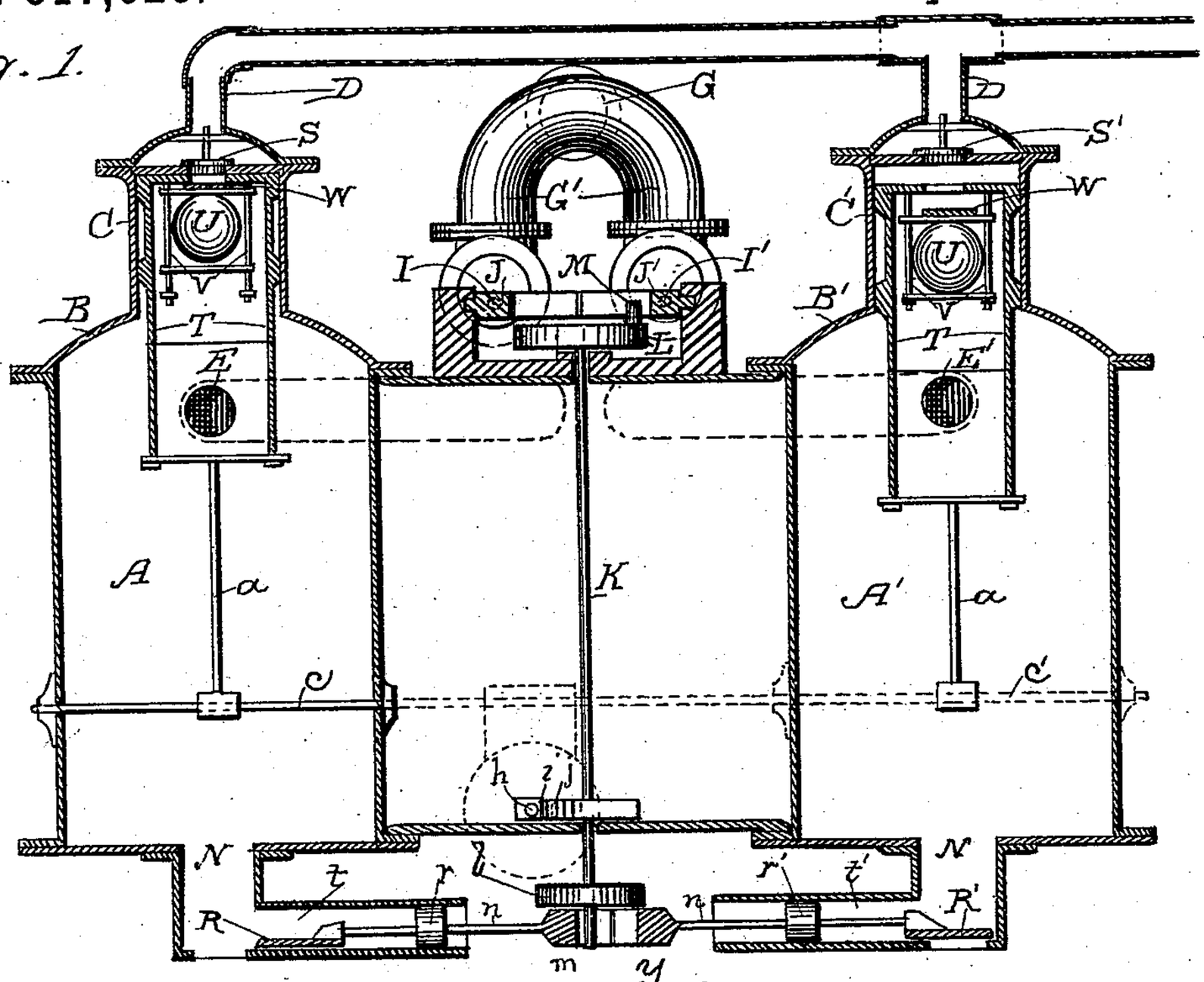

Fig. 2

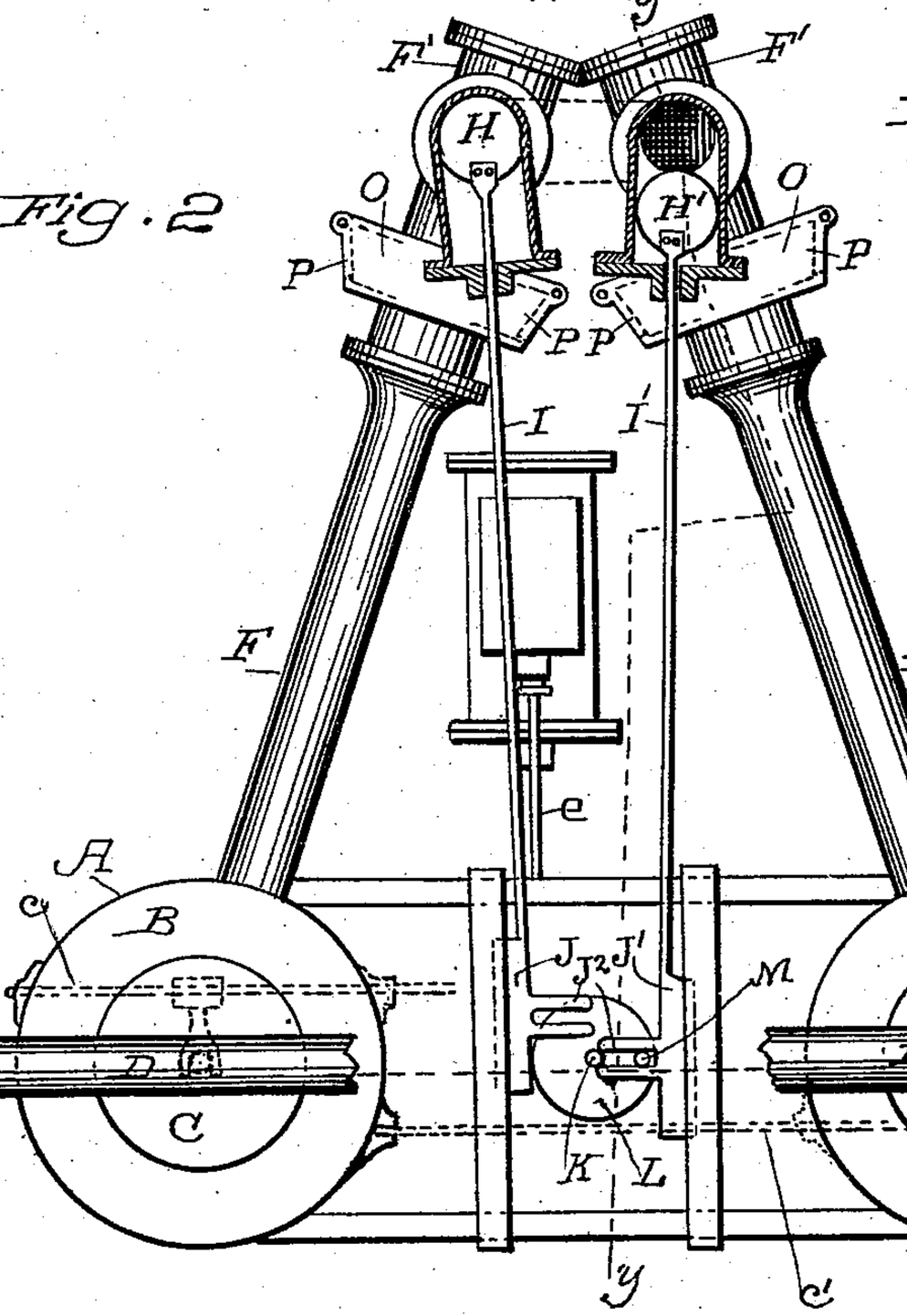

Fig. 3.

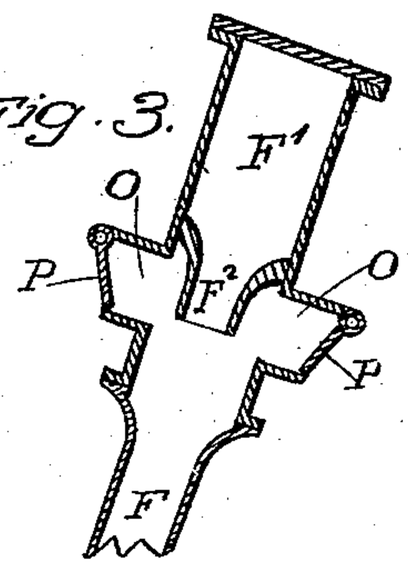

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Fig. 4.

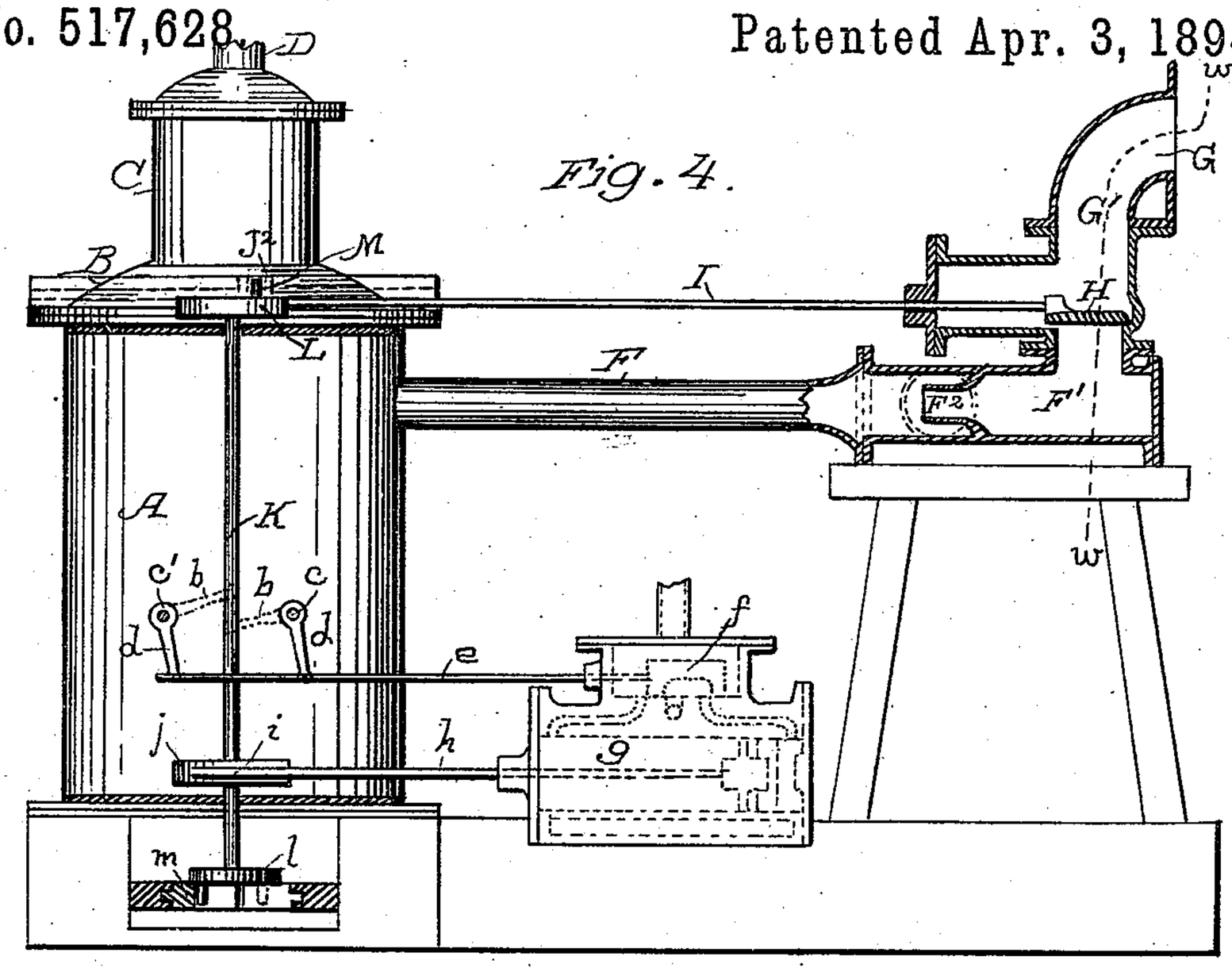

Fig. 5.

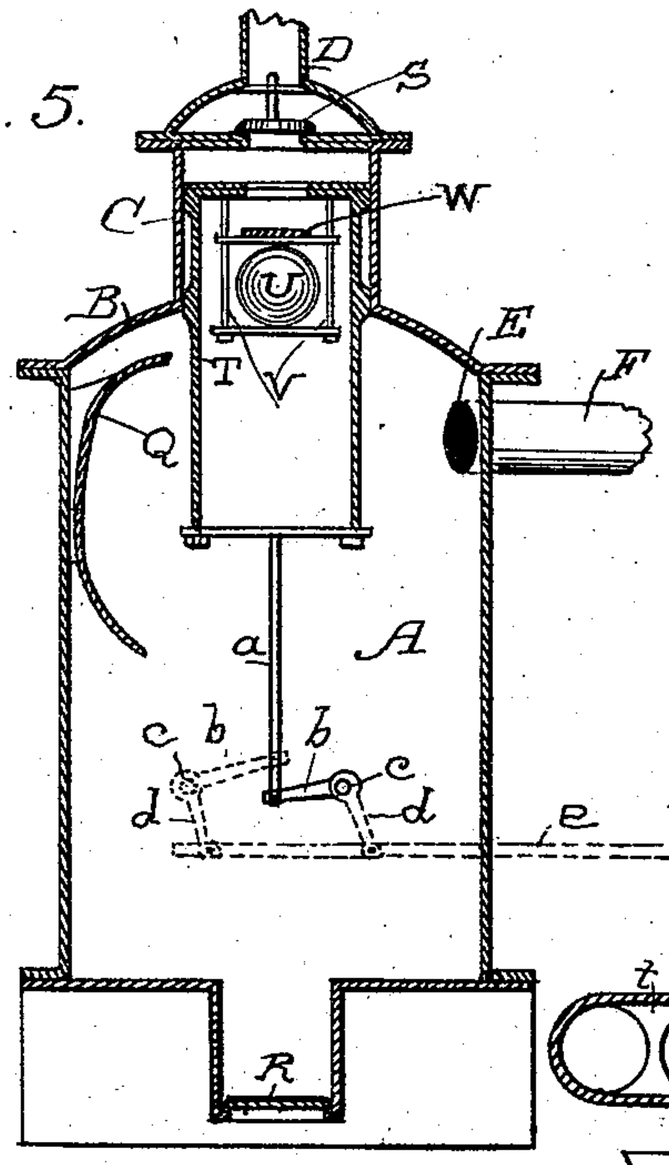

Fig. 6

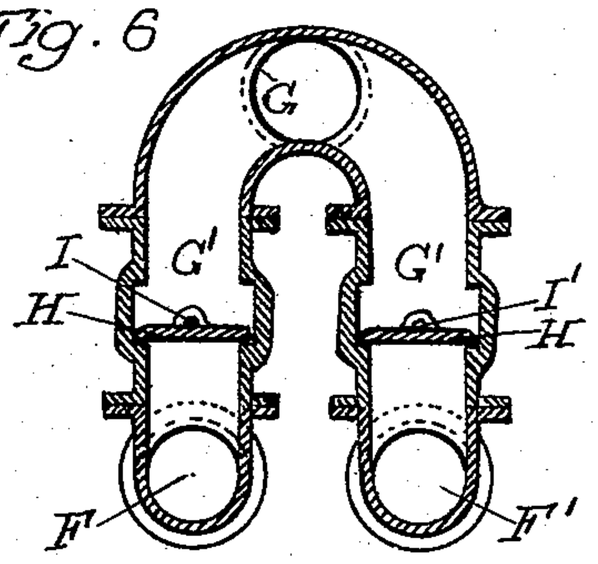

Fig. 9

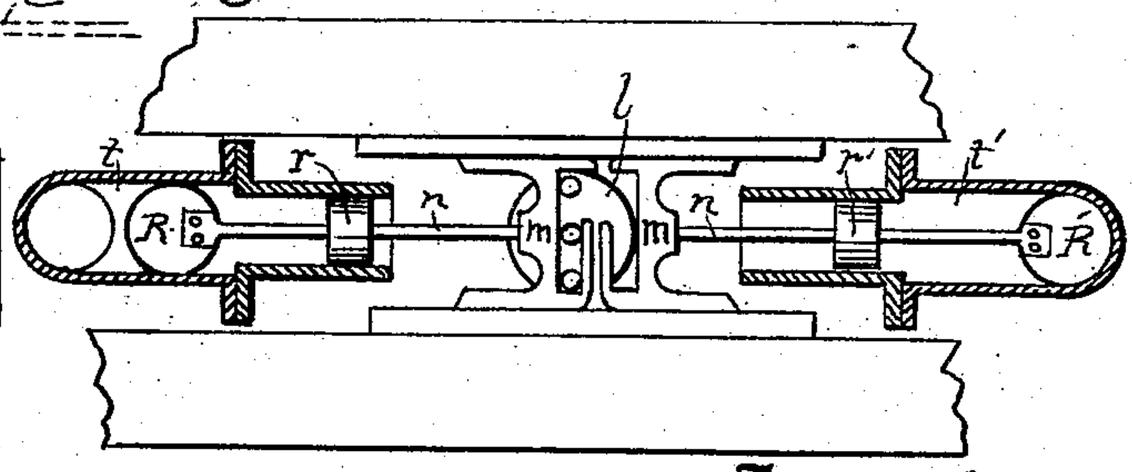

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Fig. 7

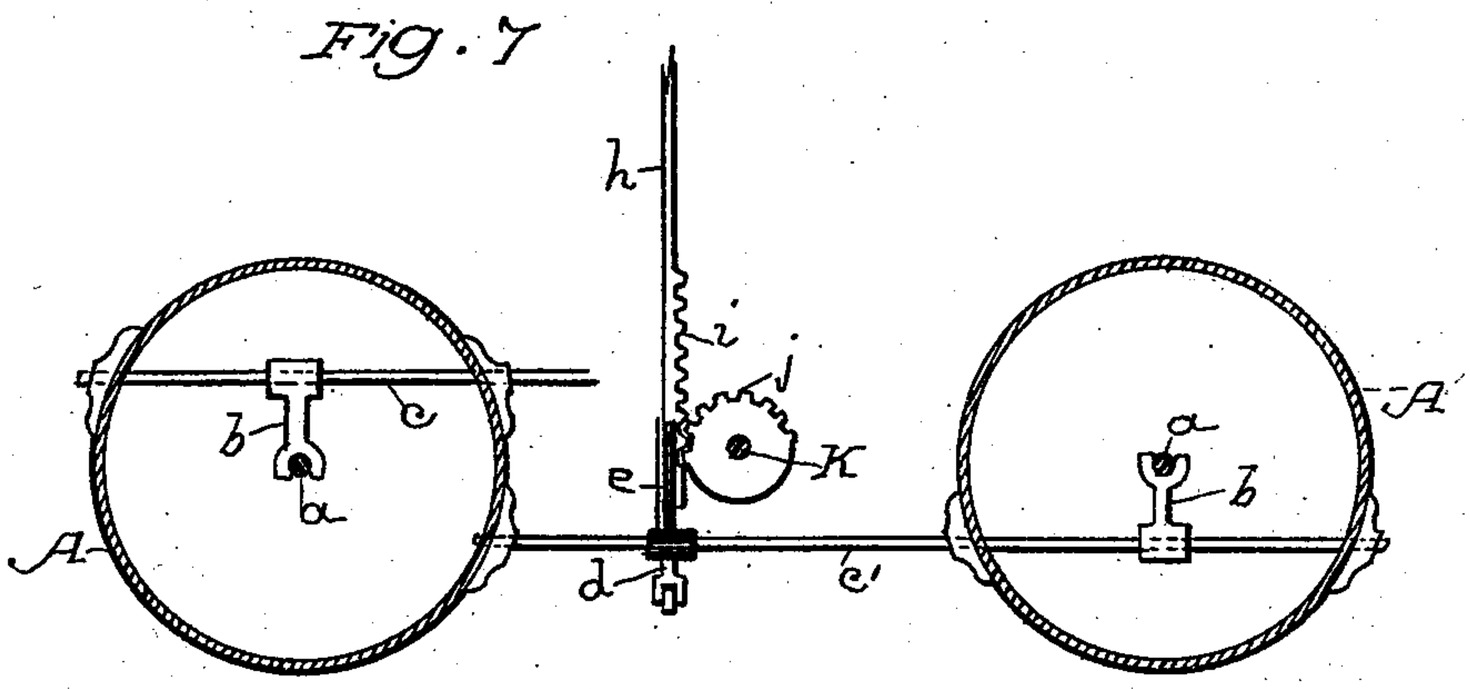
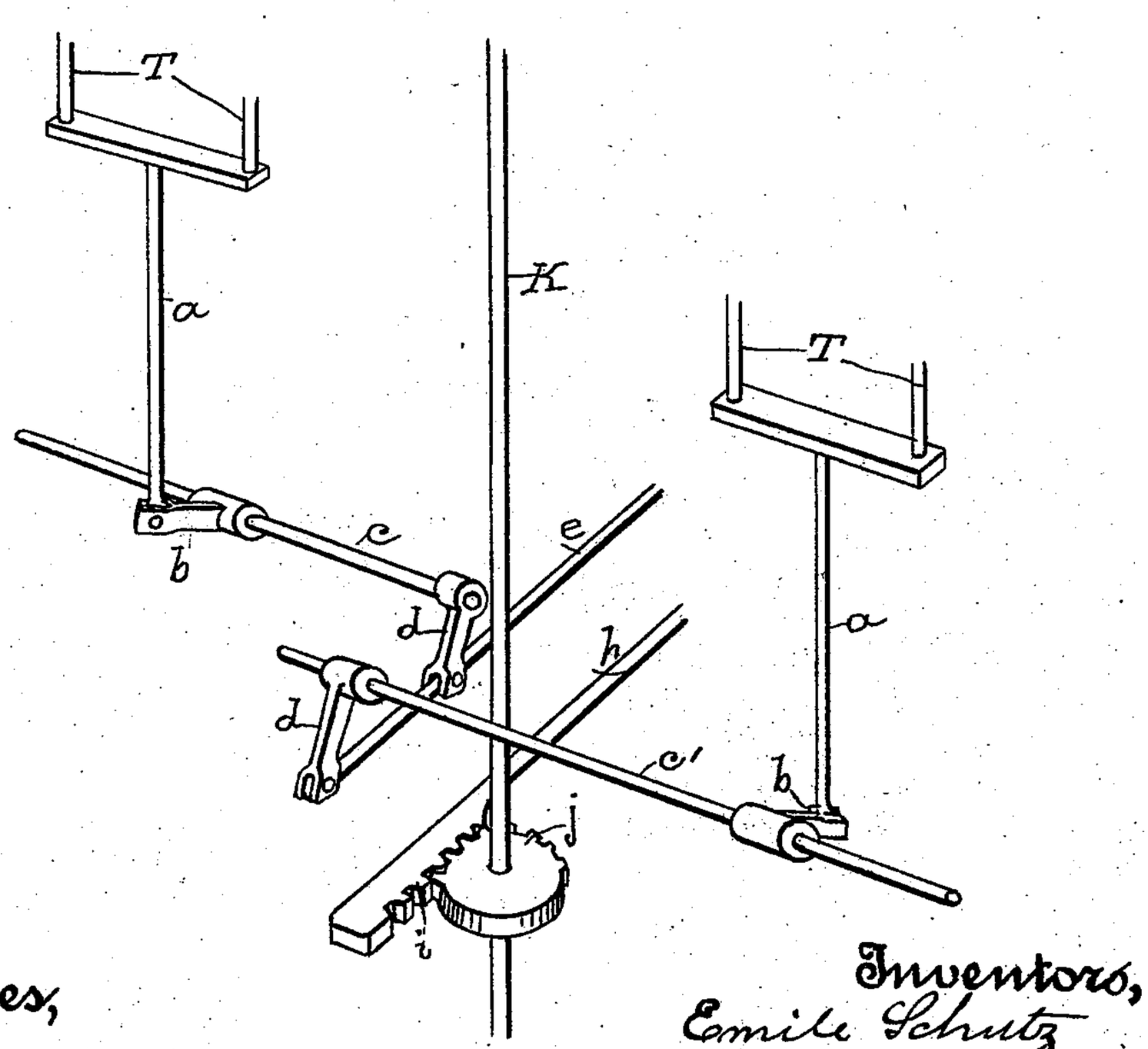


Fig. 8



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UNITED STATES PATENT OFFICE.

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

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 517,628, dated April 3, 1894.

Application filed October 13, 1893. Serial No. 488,093. (No model.)

To all whom it may concern:

Be it known that we, EMILE SCHUTZ and JOHN H. HENDERSON, citizens of the United States, residing in Sierra City, county of Sierra, State of California, have invented an Improvement in Hydraulic Air-Compressors; and we hereby declare the following to be a full, clear, and exact description of the same.

Our invention relates to an apparatus for injecting and compressing a body of air by the application of a column of water under pressure.

It consists in certain details of construction, which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a vertical section of our machine on the line *x—x* of Fig. 2. Fig. 2 is a plan view of the same, the slide valve cases being shown in section. Fig. 3 is a horizontal section of one of the chambers containing the contracted nozzles and the valves P. Fig. 4 is a vertical section on line *y—y* of Fig. 2. Fig. 5 is a vertical section on line *z—z* of Fig. 2. Fig. 6 is a vertical section through the water supply pipes on the line *w—w* of Fig. 4. Fig. 7 is a detail view of the mechanism to operate the auxiliary engine *g*. Fig. 8 is a perspective view of the same. Fig. 9 is a horizontal section of the valve chambers at the bottom of the cylinders A A′ and the disks with the pins for opening and closing the valves.

The object of our invention is to inject into the compressing cylinders by means of jets of water under pressure a body of air larger than can be supplied by simple displacement, and to cool said body of air by contact with the water, and to compress it and deliver it into transmitting pipes and receivers.

In carrying out our invention we have shown, in the present case, two vertically disposed cylinders A A′ having the upper part closed by covers B B′, and cylinders C C′ of smaller diameter extend from these covers upwardly, having the same axis as the main cylinders A A′. From the caps or covers of the cylinders C C′, pipes D serve to convey the air which is discharged from the cylinders to the proper receptacles.

The cylinders A A′ have inlet passages E E′ made in the sides near the upper part, as shown, and these passages are connected by pipes F with the water supply pipe G through which water is admitted under pressure equal to that to which it is desired to compress the air. The main admission pipe G opens into branch pipes G′ which lead respectively to the pipes F. Within the pipes G′, and above their connection with the pipes F, are fitted the slide valves H H′ connected by rods I and I′ with the sliding yokes J J′ by which they are actuated.

K is a vertical shaft journaled between the cylinders A A′ having upon the upper end a disk L, in one side of which is fixed a pin M projecting upwardly as shown.

The yokes J J′ are slotted, as shown at J^2, and the pin M travels in the slot of one of these yokes, while the disk L is making a partial revolution, and then passes directly into the slot of the other yoke while it completes the revolution. While this pin is traveling in the slot of one of the yokes, it moves the yoke so as to close the valve connected with it, and then passing from that yoke to the other it acts to open the other valve so that when the valve H has been closed as shown in the drawings, a supply of water to the cylinder connected with this valve is cut off, and the valve H′ being opened by the continued movement of the disk L and its pin M, a supply of water is admitted into the other cylinder A. By a corresponding set of valves R R′, the operation of which will be hereinafter described, the outlet passage N at the bottom of the cylinder A, of which the inlet valve was closed, will be opened, while the outlet passage of the other cylinder of which the inlet valve was open, will be closed.

Water passing down through the branch G′ and the valve H′, which is opened, enters a chamber F′ which connects with the pipe F by means of a contracted nozzle F^2 through which the water is injected into the cylinder A with great velocity and force. This nozzle F^2 discharges in line with the pipe F and it stands midway between two short pipes or passages O, each having an inwardly opening valve P. The effect of this rush of water through the nozzle F^2 will be to draw in a large quantity of air through the valves P which readily yield to exterior atmospheric pressure, and the air and water are carried

with great force and velocity into the cylinder A, the air being cooled by its mixture and contact with the body of water so that it reaches the cylinder with its temperature nearly or quite that of the water with which it mingles. The jet of water passing across the cylinder A strikes a concaved receiver Q, see Fig. 5, upon the opposite side of the cylinder, the form and construction of which is such as to prevent the water from being thrown upwardly by its momentum, and it tends to throw the water downwardly toward the lower part of the cylinder, and prevents its being splashed upward and carried into the air discharge pipes. As the passage N at the bottom of this cylinder is closed by a slide valve R, it will be manifest that the cylinder will soon be filled with water and air under a considerable pressure.

It may here be stated that the cylinder A will already contain a body of air under ordinary atmospheric pressure which enters the cylinder by displacement of the water when the previous cylinderful of water was discharged, and the additional air brought in by the jet of water through the pipe F adds to the amount so that a large quantity of air is compressed to a considerable degree within the cylinder by the action of the water jet. As the water enters the cylinder and gradually rises, it compresses the air still more, until a point of compression is reached which is so great that no further air can be drawn in through the inlet valves P, and these valves will then be closed by the outward pressure. The water continuing to flow through the pipe F into the cylinder A compresses the air, and gradually forces it upward through a check valve S in the upper part of the cylinder C through which it escapes into the conducting pipe D as soon as the compression is greater than the pressure within this pipe. Within the smaller superposed cylinders C and C′ are fitted pistons T which are adapted to reciprocate within the cylinders. These pistons are made hollow and have openings at the top for the escape of air, and within each is a float U which is movable vertically and guided by guide rods V. Above this float is a valve W which moves up and down with the float. Before the water reaches the float it and its valve will remain at the lowest point allowed by the guide rods V, as shown in the right side of Fig. 1, and the compressed air is allowed to pass to the delivery pipes. When the water rises in the cylinder A until it reaches the float, the latter is raised with it and its valve closes against the opening made in the top of the piston T and in line with the opening covered by the check valve S. As soon as the opening in the top of the piston is closed, the whole pressure of the water acts upon the piston and forces it upwardly in its cylinder until all the air which is in the space above the piston within the cylinder C has been forced out through the check valve S. At this instant the inlet valve H which supplies the cylinder A is closed, and the outlet valve R is opened in the following manner: From the pistons T, T connecting rods *a* extend downwardly and connect with crank arms *b* mounted upon shafts *c c′* which extend through proper stuffing-boxes across both the cylinders A and A′, and in the intermediate space between these cylinders. These shafts have mounted upon them lever arms *d* which are oscillated by the rotation of the shafts *c c′* caused by the rising of the pistons T T as before described. This oscillation is communicated from the arms *d* to produce a reciprocating motion of the valve stem *e* and its connected valve *f* so as to admit water into one end of the cylinder *g* where it acts upon the piston within said cylinder and moves it to the opposite end. The piston rod *h* extends outwardly from cylinder *g*, and has upon it a rack *i* which engages a pinion *j* which is keyed upon the vertical shaft K previously described, and which carries upon its upper end a disk L by which the valves H and H′ are actuated as before described. This vertical shaft K also carries upon its lower end a corresponding disk *l* which has pins upon its periphery engaging the slotted slides *m* and through their reciprocations the connecting rods *n* act to move the valves R and R′ so that one is opened when the other is closed. This action in the present case opens the valve R′ and allows the water to discharge from the cylinder A′, in which the compression of the air previously described has taken place, and at the same time, the discharge valve R is closed, and after this takes place the admission valve H is opened, so that a similar operation takes place to that previously described and corresponding compression of air takes place in the cylinder A. In this manner air is alternately compressed in each of the cylinders, and is constantly delivered through the pipes D into the receiver as long as the pressure of air in said pipes is less than the pressure of the water by which the compression takes place. As soon, however, as the pressure of air is approximately equal to the pressure of the water, the operation will cease and the apparatus will remain inactive until the air is drawn away or used when it will immediately commence to operate again without attention.

As the pressure upon the valves R R′ is very great, it is necessary to assist the engine to open the valves and to partially counterbalance the pressure. This is effected by means of pistons *r r′* fixed to the valve stems *n* and movable in cylinders *t*, the inner ends of which communicate with the cylinders A above the valves, so that the pistons are exposed to the pressure within the cylinders, and thus assist to move the valves.

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

1. In an air compressor, vertical cylinders having inlet pipes opening into the sides,

pipes connecting with the inlet pipes and through which water under pressure is admitted, reciprocating valves by which the admission of water to either cylinder is controlled, slotted slides with rods connecting with said valves and a rotary disk mounted upon a shaft and having a pin adapted to enter the slots in the slides, whereby the valves are reciprocated in opposite directions by the rotation of the disk, substantially as herein described.

2. An air compressor consisting of vertical cylinders having the inlet pipes, the reciprocating oppositely moving controlling valves near the opposite ends of the cylinders, and mechanism for operating said valves whereby water is alternately admitted under pressure into the cylinders and discharged therefrom, a jet nozzle and air inlet valves through which air is drawn, and injected with the water into the cylinders, a smaller cylinder with reciprocating piston fitted therein forming a continuation above the top of each main cylinder, an outlet pipe and valve through which the compressed air is discharged as the water fills the cylinder, a float valve movable within the piston which moves in the supplemental cylinder and closing a discharge in the top of the piston when the water reaches it, whereby the pressure of the water is transferred to the piston and the latter forced to the top of its cylinder and the air contained above it is forced into the discharge pipe, substantially as herein described.

3. In an air compressor, the vertical cylinders having the inlet pipes, reciprocating controlling valves, jet nozzles and air inlet passages, and a mechanism whereby the valves are alternately shifted to admit and cut off the supply of water to the cylinders, water discharge openings in the bottom of the cylinders with correspondingly reciprocated valves by which the openings are alternately opened and closed in opposition to the opening and closing of the admission valves, a vertical shaft journaled between the two cylinders having disks at the top and bottom with eccentric pins, slotted slides with which the valve rods are connected, and into the slots of which the pins of the disks pass when the disks are rotated so that one admission valve is opened and the other closed, and the corresponding water outlet valve is closed and the other opened, substantially as herein described.

4. An air compressor consisting of the vertical cylinders with air and water inlet pipes and reciprocating controlling valves near the upper part and oppositely moving water discharge valves at the bottom, a vertical intermediate shaft and mechanism by which the two sets of valves are operated, a supplemental cylinder extending from the top of each of the compression cylinders having a piston movable therein and an air discharge passage from the top, a float valve by which the opening in the top of the piston is closed when the cylinder becomes filled with water whereby the piston is moved upwardly, a horizontal shaft extending through the lower part of the two cylinders and having rocker arms fixed to it within each cylinder, and connecting rods by which said rocker arms are connected with the movable piston whereby the shaft is partially rotated by the movement of either piston, a water engine consisting of a cylinder with a reciprocating piston and a controlling valve, an arm connected with the rotary oscillating shaft and with the valve whereby the latter is moved to reciprocate the piston of the engine, a rack bar formed upon the piston rod of said engine, and a pinion with which it engages fixed upon the vertical shaft by which the inlet and discharge valves are actuated whereby said valves are moved automatically, substantially as herein described.

5. In an air compressor, the vertical cylinders having inlet pipes, upper reciprocating controlling valves, jet nozzles and air inlet passages, and a mechanism comprising a rotary disk and slides on the stems of the valves engaged thereby whereby the valves are shifted to alternately admit and cut off the water to the cylinders, water discharge openings in the bottom of the cylinders with correspondingly reciprocated valves and actuating mechanism by which the discharge openings are alternately closed and opened in opposition to the opening and closing of the admission valves, pistons connected with the discharge valve stems, and cylinders in which said pistons travel, connected with the main vertical cylinders, and receiving water pressure therefrom to act against the pistons and assist in moving the valves, substantially as herein described.

In witness whereof we have hereunto set our hands.

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JOHN H. HENDERSON.

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