No. 689,702. Patented Dec. 24, 1901.

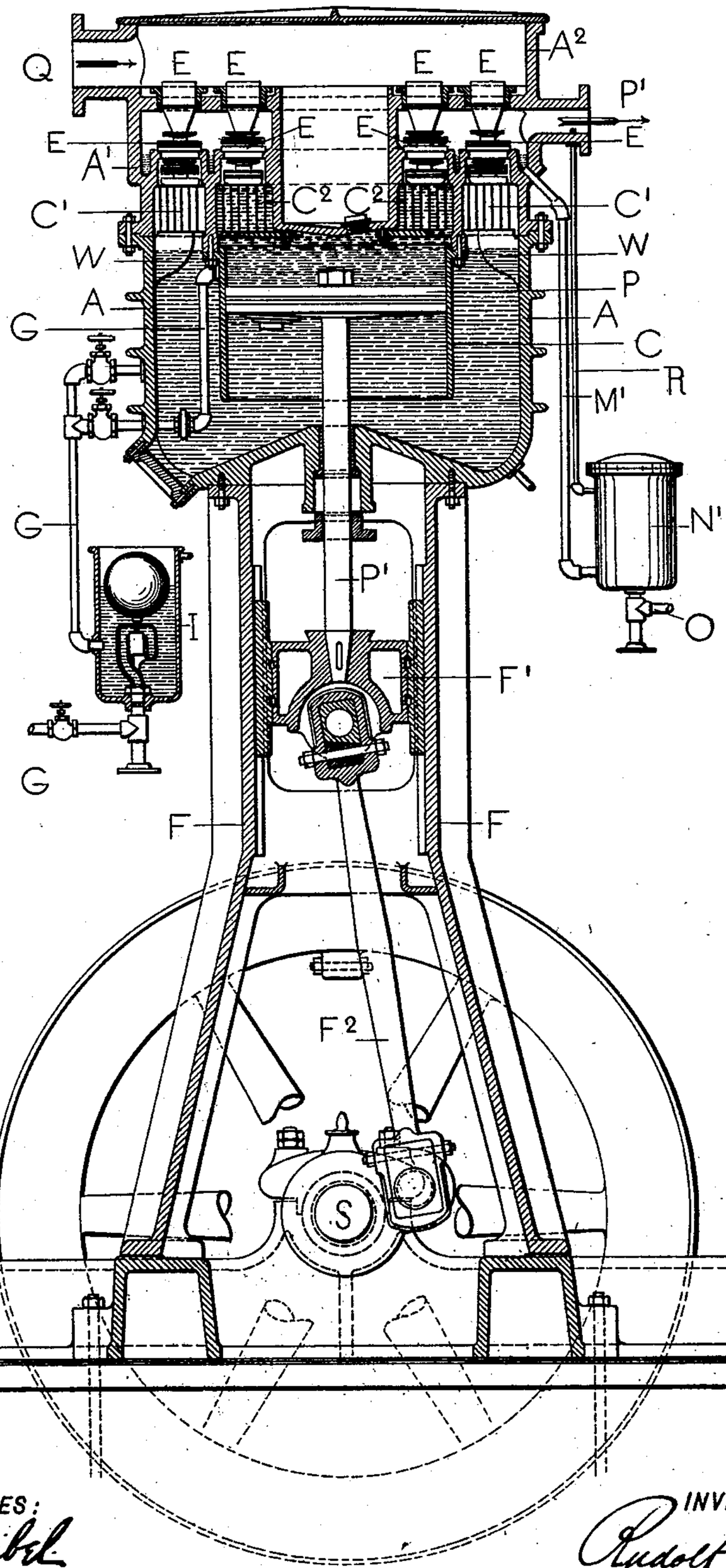
R. BERG.

AIR COMPRESSING AND COOLING APPARATUS.

(Application filed Apr. 9, 1901.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 1.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

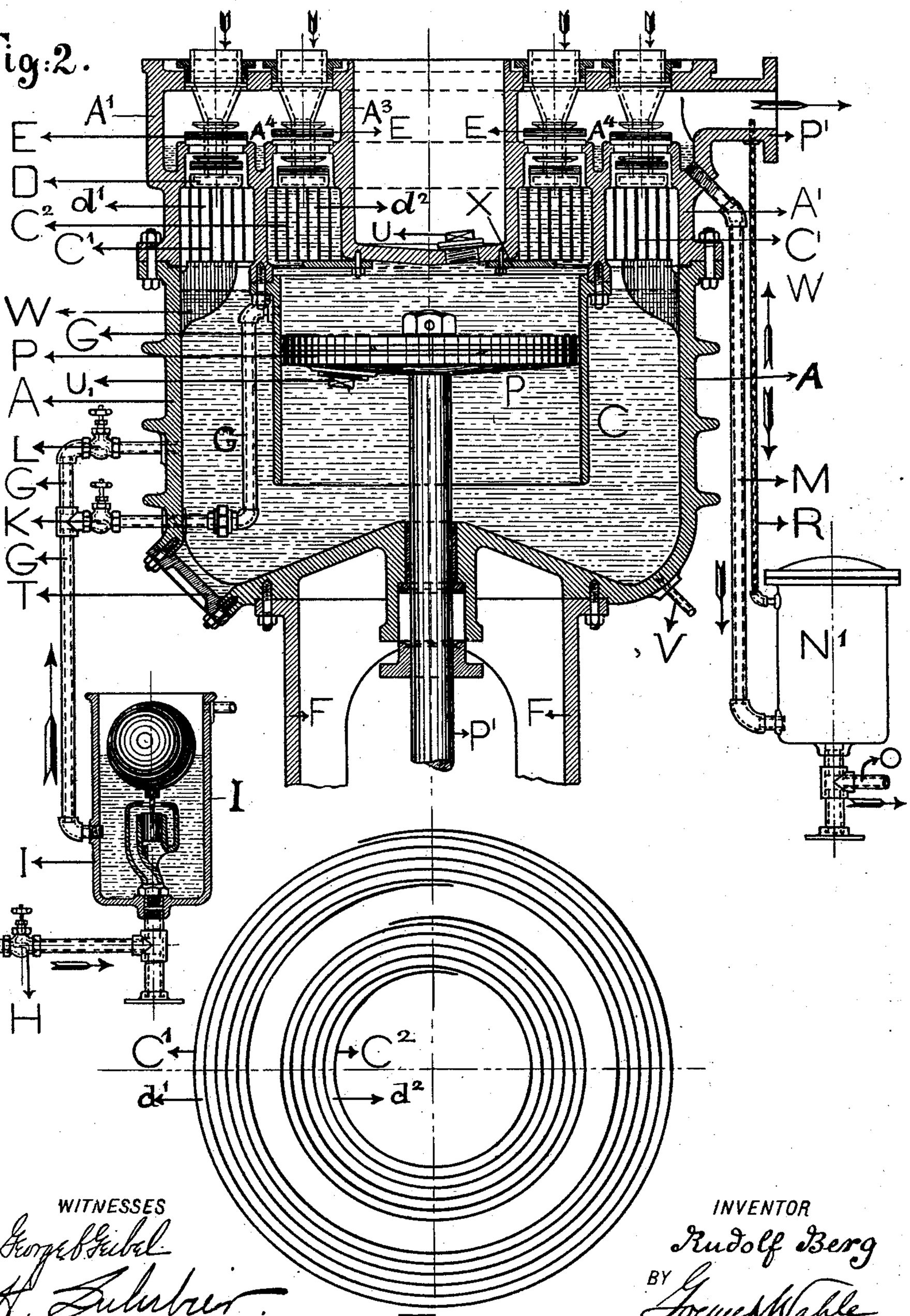

FIG. 3.

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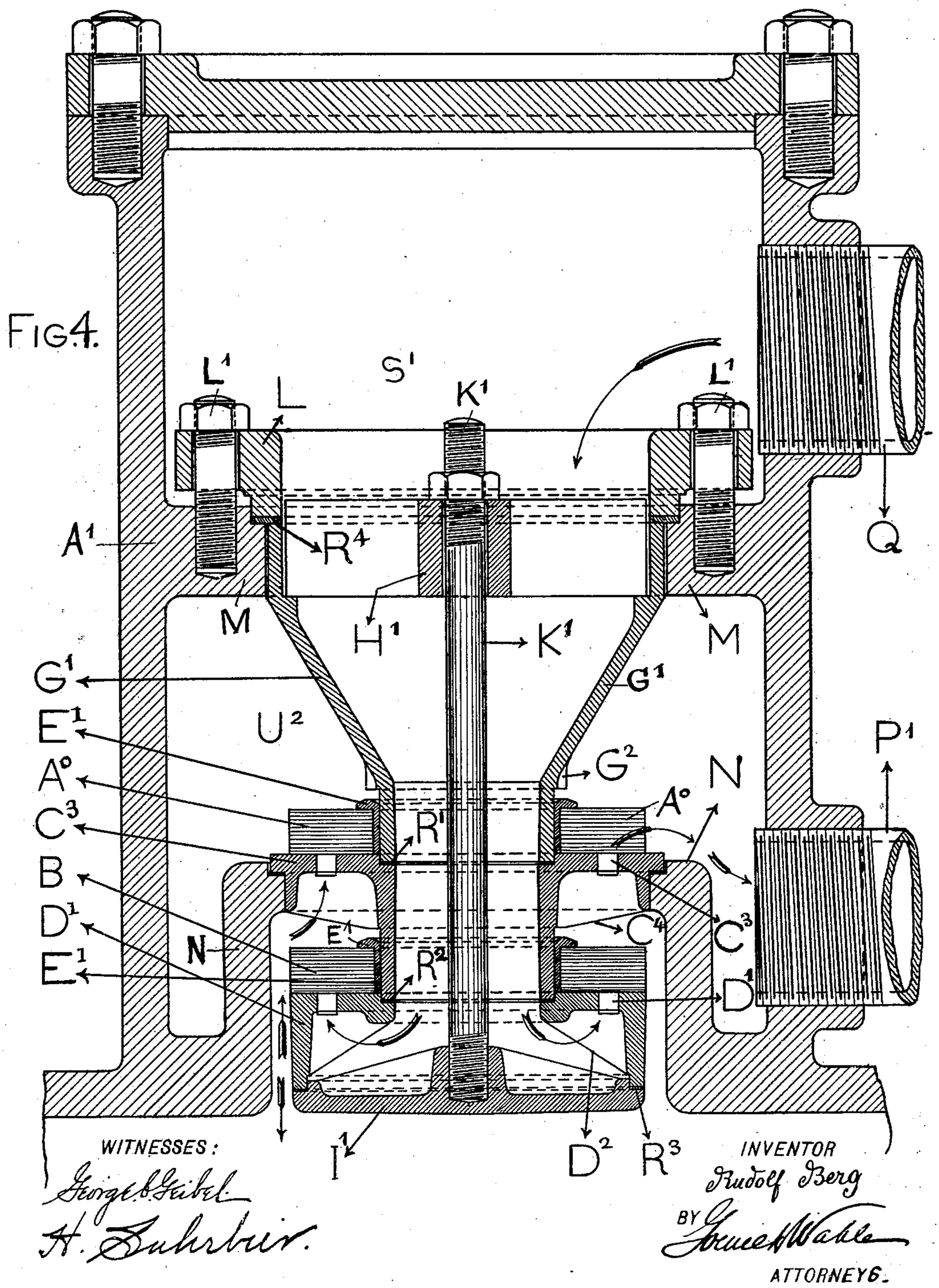
(No Model.) 3 Sheets—Sheet 3.

FIG. 4.



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AIR COMPRESSING AND COOLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 689,702, dated December 24, 1901.

Application filed April 9, 1901. Serial No. 55,046. (No model.)

To all whom it may concern:

Be it known that I, RUDOLF BERG, a citizen of the United States, residing in Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Air Compressing and Cooling Apparatus, of which the following is a specification.

This invention relates to certain improvements in the air compressing and cooling apparatus for which Letters Patent of the United States were granted to me on June 13, 1899, No. 626,883, said improvements being designed with a view of improving the heat-exchangers or heat-absorbers shown therein and of combining the suction and discharge valves in such a manner that a more effective action of the apparatus is obtained and the various defects inherent in the different constructions of air-compressors heretofore in use are obviated; and for this purpose the invention consists in the combination, in an air compressing and cooling apparatus, of an exterior casing, a piston-cylinder in the same open at one end and constantly communicating at its open end with the interior of the casing, a piston working in said cylinder, valve-chambers communicating with the piston-cylinder and the casing, suction and discharge valves in said chambers, and heat exchangers or absorbers supported one between said valves and the piston-cylinder and the other between the valves and the casing.

The invention consists, further, in certain other combination of parts, which will fully be set forth hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a vertical central section of my improved air compressing and cooling apparatus of the vertical type. Fig. 2 is a similar section through the main portion of my improved compressor drawn on a larger scale. Fig. 3 is a diagrammatic plan view of the improved heat exchangers or absorbers used in the apparatus, and Fig. 4 is an enlarged detail vertical transverse section of one of the suction and discharge valves preferably used.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, A represents the exterior cylindrical casing of my improved air compressing and cooling apparatus. The casing A is supported on an upright frame F, which is provided with legs, which are supported at their lower ends on a suitable bed-plate, while the upper parallel portions of said upright frame form ways for a sliding cross-head F′, to which reciprocating motion is imparted from the crank of the driving-shaft S by a connecting-rod F^2, as shown in Fig. 1.

At the interior of the casing A is arranged a cylinder C, which is open at the lower end. In the cylinder C is reciprocated a piston P, the piston-rod P′ of which is guided in a suitable stuffing-box in the center of the casing A and connected at its lower end with the sliding cross-head F′ in the usual manner.

The upper end of the casing A is attached to a second cylindrical casing A′, in which the suction and discharge valves E for the cylinder C and casing A are located. The casing A′ is composed of a central section A^3, an intermediate concentric partition-wall A^4, and an exterior portion, which latter is bolted to the upper end of the casing A, while the cylinder C is attached to the lower end of the partition. The exterior wall, intermediate partition, and interior portion of the casing A′ form two annular spaces, above which the suction and discharge valves E are arranged and in which the heat exchangers or absorbers C′ and C^2 are located, as shown in Figs. 1 and 2. The casing A′ is surmounted by an upper or top portion A^2, which is either made integral with the casing A′, as shown in Fig. 1, or attached thereto in a suitable manner. The top portion A^2 of the casing A′ is connected with an inlet-pipe Q for the air, while the upper portion of the casing A′ above the valves is connected with an outlet-pipe P′ for the delivery of the compressed and cooled air.

The cylinder C, as well as the exterior casing A, is filled with water or other suitable liquid, which is supplied to the cylinder and casing by a pipe G, branched at its upper end, as shown in Fig. 2. Each branch of the supply-pipe G is provided with a stop-cock, the stop-cock K being arranged in the branch pipe leading to the space in the cylinder C above the piston, while the stop-cock L is ar-

ranged in the branch pipe leading to the space below the piston, said stop-cocks acting in the nature of check-valves, respectively, for the spaces above and below the piston. The incoming end of the supply-pipe G is also provided with a stop-cock H, and between the same and the branch pipes is located a regulating-valve I, by which the supply of water is regulated while the compressor is in motion and shut off when the compressor is not in motion without requiring the shutting and closing of the stop-cock H. The regulating-valve I is composed of a cylindrical vessel provided with an overflow-pipe at its upper end and a float-valve for the supply end of the pipe G. The water or other cooling liquid fills all the spaces in the cylinder and casing, the presence of which exerts ordinarily an injurious influence on the proper running of the apparatus. As the water on one side of the piston balances the water on the other side of the same, there is but a comparatively small force required for moving the piston and forcing the water to and fro in the cylinder and casing.

The cylinder C is preferably made of brass or bronze, and the piston P is made cup-shaped, so that sand or other impurities which are carried along by the water will be collected at the center of the piston without injuring the circumference of the same. The piston P is provided at the bottom with a plug U′, while the lower part of the casing is provided with a suitable hand-hole and a hand-hole cover T, so as to permit the cleaning of the piston and casing from time to time in a quick and convenient manner. The top part of the cylinder C is provided with a screw-plug U, which when removed furnishes an opening for the introduction of a nozzle and rubber hose, so as to clean the space above the piston by the water injected in the same.

In the annular spaces below the suction and discharge valves are arranged the spiral heat exchangers and absorbers C′ C^2, which are constructed of a sheet-metal coil, the convolutions of which inclose narrow spaces d' d^2, as shown in Fig. 3. The larger coil C′, which is located in the annular space inclosed by the intermediate casing A′ and the intermediate partition A^4, is supported by inwardly-projecting lugs W, cast on the casing A, while the coil C^2, which is located in the annular space between the partition A^4 and the interior portion A^3 of the casing A′, is supported on the outwardly-projecting lugs X, that are attached to the under side of the top portion of the cylinder C, as shown in Fig. 2. The coils are placed in position in their respective spaces before the intermediate casing A′ is attached by its screw-bolts to the main casing A. The air that is drawn in through the spaces between the spiral coils C′ C^2 is compressed at a uniformly low temperature, for the reason that the heat of compression is absorbed by the metal of the coils. When the piston approaches the dead-point at its upward stroke, the interstices between the convolutions of the inner coil are filled with the water or other cooling medium, while when the piston approaches the dead-point at its downstroke the cooling medium fills the interstices between the convolutions of the outer coil, so that the temperature of the coils is lowered 4° to 6° centigrade and the heat before absorbed by them is removed. The coils are thus always in good condition for absorbing the heat produced by the compression of the air due to the strokes of the piston and for giving it off again to the cooling-water that is forced alternately through the coils.

The preferred form of suction and discharge valves is shown in detail in Fig. 4. It is composed of a suction-valve B and a discharge-valve A^0, provided, respectively, with valve-seats D′ C^3. The valves are formed of superposed rubber rings, which are retained on the inlet-tube G′ by means of bushings E′, that are provided with retaining-flanges at their upper ends, so as to prevent the too-quick wearing of the rubber valves. The valve-seats D′ C^3 are strengthened by radial ribs D^2 C^4, respectively, and are supported on a bottom disk I′, which is suspended from the upper part of the inlet-tube G′ by means of a bolt K′, that is screwed into a central screw-threaded socket in said disk I′, while its upper threaded end is passed through a center sleeve H′ of the inlet-tube G′ and supported thereon by a screw-nut K^2. The valves B A^0, the valve-seats D′ C^3, bottom disk I′, inlet-tube G′, and bolt K′ form together the suction and discharge valves E. The valve-chambers, within which the suction and discharge valves are contained, are formed at one side by the casing A′ and at the other side by the interior wall A^3. These valves are rigidly attached by a flanged top ring L and stud-bolts L′ to projecting seats M at the interior of the casing A′. The inlet-tube, top ring, and valve-seats of the suction and discharge valves are either ground at their ends, so as to fit snugly and tightly together, or they are tightly connected by means of interposed rubber gaskets R′ R^2 R^3 R^4. The motion of the discharge-valve A^0 is limited by means of projecting lugs G^2, formed on the outside of the inlet-tube G′. The air is sucked in from the space S′ above the suction and discharge valves and discharged into the spaces U^2. The interior ring-shaped seats M and N serve to support the valves and separate in connection with the same the suction-space from the discharge-space. The suction and discharge valves are also well adapted for use in hydraulic pumps and have many advantages as compared with the valves heretofore in use for the following reasons: First, the pumps can be constructed much smaller, as considerable space is saved; secondly, the valves require but comparatively small motion; thirdly, the valves form at the same time the suction and discharge chambers, so that the

air-chambers heretofore required are done away with, which is an important feature, while, lastly, the shocks and hammering are entirely avoided.

The advantages of my improved air compressing and cooling apparatus are as follows:

First. The piston-spaces of the air or gas compressors are each provided with a heat-absorbing coil of sheet metal for cooling the air or gas to a uniform low temperature.

Second. The compressor is so constructed that no bubbles are formed and that at each end of the piston-stroke the last air or gas particle is discharged.

Third. The cylinder piston and casing of the compressor are so constructed that they are not injured by sand or other impurities and that they can be readily and conveniently cleaned.

Fourth. The compressor can be arranged in horizontal as well as in vertical position.

Fifth. The water-regulating and stop devices, as well as the separator N′, with its pipes M′ R O, which are made of similar construction, furnish a uniform supply of cooling-water and remove it in the same proportion as supplied.

Sixth. The suction and discharge valves can be used for air or gas compressors and for water and other pumps, as before mentioned. A large number of valves can be arranged, and as the valve-chamber can be used as an air-chamber a separate air-chamber can be dispensed with, while the valves are subjected to very little wear, so that they have greater durability than the valves heretofore in use.

Seventh. The improved compressor has the advantage that explosions due to the mixture of hot air and vaporized lubricating-oil are entirely obviated, whereby a continuous source of danger present in air-compressors without cooling liquids is dispened with.

Eighth. The compressor supplies a perfectly pure and cool current of air that is well adapted for the ventilation of large spaces occupied by great numbers of people and for the cooling of storage-warehouses, hospitals, hotels, &c.

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

1. In an air compressing and cooling apparatus, the combination of an exterior casing, a piston-cylinder in the same, open at one end, and constantly communicating at its open end with the interior of the casing, a piston working in said cylinder, valve-chambers communicating with the piston-cylinder and the casing, suction and discharge valves in said chambers, and heat exchangers or absorbers supported one between said valves and the piston-cylinder, and the other between the valves and the casing, substantially as set forth.

2. In an air compressing and cooling apparatus, the combination of an exterior casing, a piston-cylinder in the same, open at one end, and constantly communicating at its open end with the interior of the casing, a piston in said cylinder, concentric annular spaces communicating, one with the piston-cylinder and the other with the casing, valve-chambers communicating with the said annular spaces, suction and discharge valves in said valve-chambers, and heat exchangers or absorbers arranged in said annular spaces, substantially as set forth.

3. In an air compressing and cooling apparatus, the combination of an exterior casing, a piston-cylinder in the same, open at one end, where it communicates with the interior of the casing, a piston in said cylinder, valve-chambers, suction and discharge valves in said valve-chambers, annular spaces formed between the valve-chambers and the piston-cylinder and casing, one space for the cylinder and one for the casing, and heat-exchangers or absorbing-coils supported in said annular spaces, substantially as set forth.

4. In an air compressing and cooling apparatus, the combination of an exterior casing, a piston-cylinder in the same, open at one end and communicating with the interior of the casing, a piston in said cylinder, valve-chambers, suction and discharge valves in said chambers, concentric annular spaces, one between the valve-chamber and the piston-cylinder, and the other between said chambers and the casing, and sheet-metal heat-exchangers or absorbing-coils in said annular spaces, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

RUDOLF BERG.

Witnesses:
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S. J. TOOLE.