No. 836,624. PATENTED NOV. 20, 1906.

R. BERG.

AIR COMPRESSING AND COOLING APPARATUS

APPLICATION FILED APR. 22, 1905.

2 SHEETS—SHEET 1.

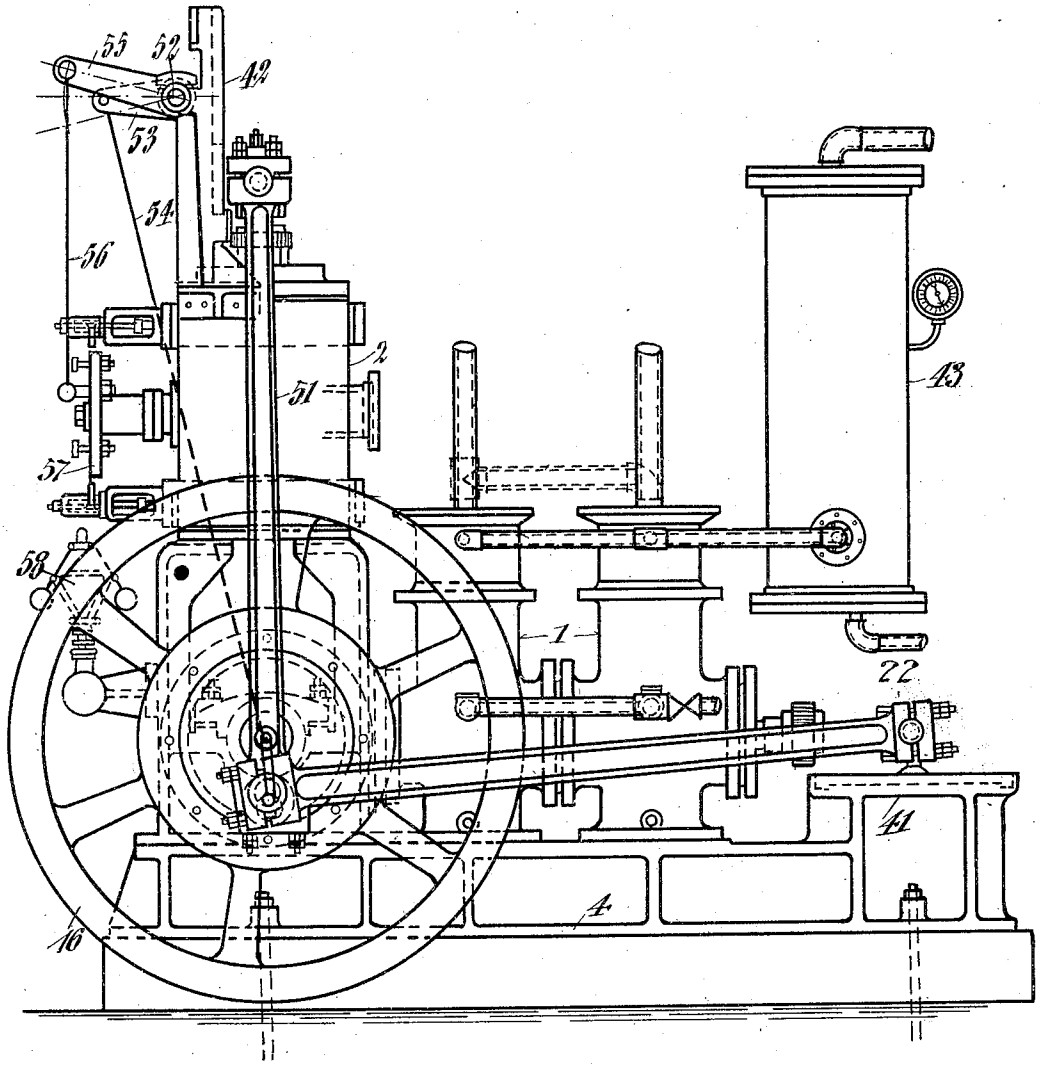

Fig. 1

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Fig. 4 Fig. 3 Fig. 5

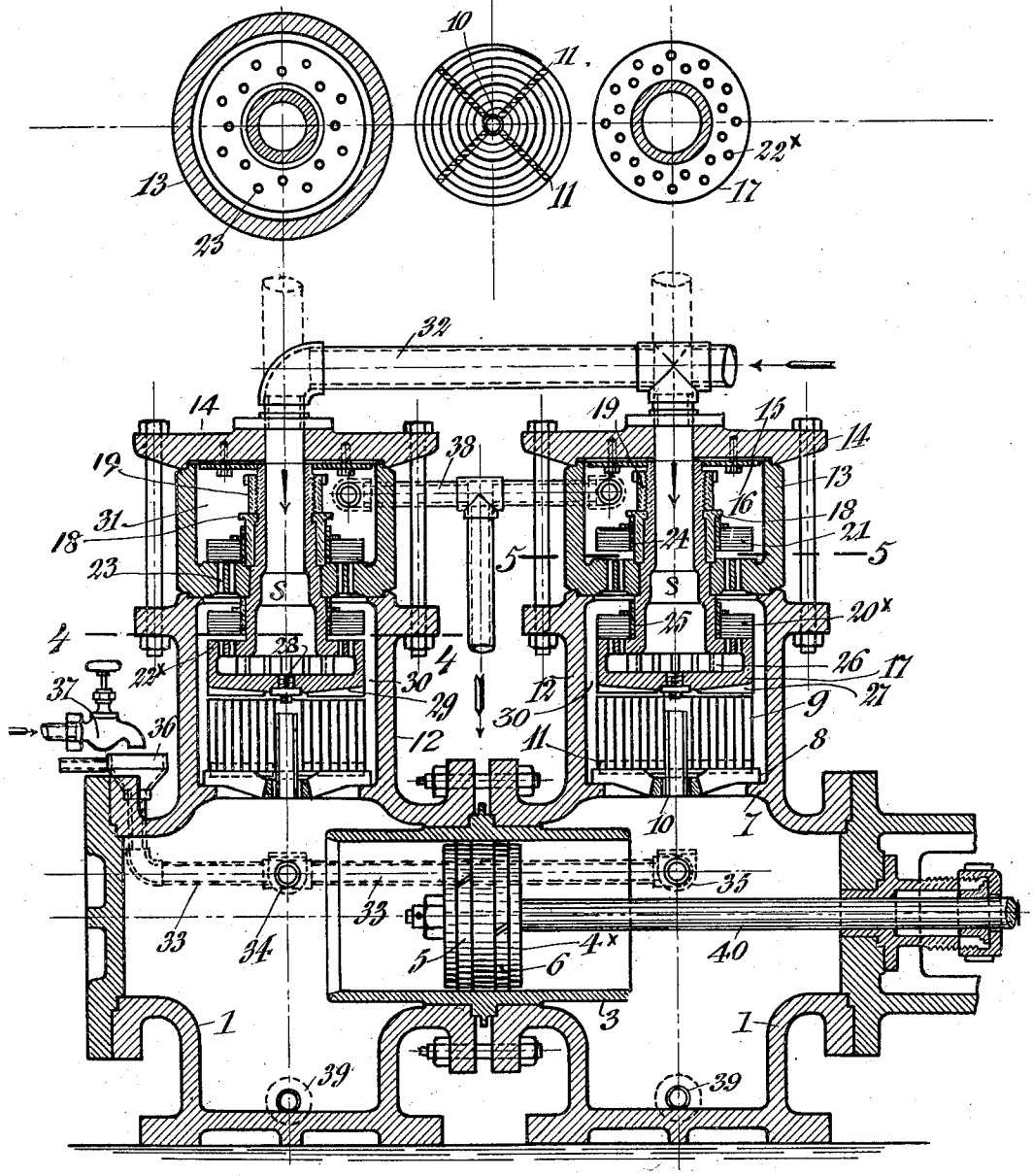

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Fig. 2

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UNITED STATES PATENT OFFICE.

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AIR COMPRESSING AND COOLING APPARATUS.

No. 836,624. Specification of Letters Patent. Patented Nov. 20, 1906.

Application filed April 22, 1905. Serial No. 256,836.

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.

In the Letters Patent which were granted to me for an air compressing and cooling apparatus on December 24, 1901, No. 689,702, the piston-cylinder was arranged vertically in the surrounding casing and the piston reciprocated vertically therein, so that the air and the cooling liquid were drawn in through suction-valves and isothermal coils and forced out through isothermal coils and discharge-valves arranged vertically above the casing and cylinder, the fresh air being drawn in and discharged with each stroke of the piston in a compressed and cooled state and then conducted to the place of use.

The object of this invention is to improve the air compressor and cooling apparatus referred to in such a manner that the piston-cylinder is arranged in horizontal position centrally between two cross-shaped casings and the piston reciprocated horizontally therein, while the isothermal coils, suction and discharge valves are located axially in line one above the other, the cylindrical extensions of the casings and discharge-valve chambers being supported thereon, so that a double-acting isothermal air-compressor is obtained; and for this purpose the invention consists in the novel features and combinations of parts, which will be fully described hereinafter and finally pointed out in the claims.

In the accompanying drawings, Figure 1 represents a side elevation of my improved air compressing and cooling apparatus, showing the connection of the air-compressor with a vertical steam-engine, arranged on the same bed-plate therewith, and with a receiver for the compressed air. Fig. 2 is a vertical longitudinal section through the air-compressor, drawn on a larger scale. Fig. 3 is a plan view of one of the isothermal coils employed in the same; and Figs. 4 and 5 are horizontal sections taken, respectively, on lines 4 4 and 5 5, Fig. 2, immediately above the suction and discharge valve seats.

Similar figures of reference indicate corresponding parts.

Referring to the drawings, 1 represents two casings which are made approximately in the shape of a cross and which are arranged symmetrically to the vertical transverse center plane of the compresssor, the lower cylindrical portions being shorter than the upper cylindrical portions or extensions and supported on a bed-plate 4, at one end of which a vertical steam-engine 2 is mounted, while at the opposite end the cross-head guide 41 for the cross-head 22 of the piston-rod 40 of the air-compressor is located. Centrally to the horizontal casings 1, and supported by a central circumferential shoulder at the meeting joint of the same, is located a horizontal cylinder 3, which is open at both ends and in which the piston $4^{\times}$ is reciprocated by its piston-rod 40, that is connected with the cross-head 22, said cross-head being actuated by connecting-rods 20, which are pivoted to offset crank-pins on the hubs of the fly-wheels 16 and at their opposite ends to the cross-head 22. The piston $4^{\times}$ of the air-compressor is provided with several packing-rings, which have sharp edges, so as to facilitate the clearing of sand or other impurities from the inner surface of the cylinder 3.

The upper cylindrical portions or extensions 12 of the casings 1 are provided at their lower ends with an inwardly-projecting rib or flange 7, on which is supported a cross-piece 8 for supporting the heat-exchanging or isothermal coils 9. The isothermal coils 9 are made of spirally-wound sheet metal, the inner ends of which are attached to a tubular core 10 by soldering or otherwise, while for properly stiffening the convolutions of the coils they are soldered to or otherwise connected at their lower ends with cross-shaped distance-pieces 11, as shown in Fig. 3, which pieces keep the individual convolutions of the coils at the proper distances from each other during the working of the compressor. Above the isothermal coils are located in the upper cylinders 12 of the casings 1 the suction-valves $20^{\times}$, so that the upper portions of the cylindrical extensions 12 serve at the same time as the chambers for the suction-valves. To the upper ends of the cylindrical extensions 12 are attached cylindrical chambers 13, in which

the discharge-valves are located, said chambers being closed by covers 14, which are connected by fastening-bolts with exterior ring-shaped flanges at the upper ends of the cylinders 12. Gaskets 15 are introduced between the upper edges of the discharge-chambers 13 and the covers 14 and retained in position on the under side of the covers by the rings 16 and suitable stub-bolts. The suction-valve $20^{\times}$ is supported on the suction-valve seat 17, while the discharge-valve 21 is supported on a seat constituted by the bottom of the chamber 13. Both the suction and discharge valve seats are provided with small openings $22^{\times}$ and 23, respectively, so that the valves can resist a high pressure and produce thereby the highest possible compression of the air in one stage.

The suction and discharge valves $20^{\times}$ and 21 are made in the usual manner of superposed rubber rings, which are placed on guide-sleeves 24 and 25 at their inner faces, said guide-sleeves having circumferential stop-flanges near their upper ends for arresting the upward motion of the valves. The guide-sleeves serve for the purpose of preventing the wear of the valves. The guide-sleeves of the discharge-valves 21 are guided on fillet-rings 18, that are fitted on suction-tubes *s*, which are located centrally in the discharge-chambers 13, said fillet-rings serving for the purpose of reducing the size of the discharge-valve rings and making them equal in size with the suction-valve rings. The upper ends of the fillet-rings are provided with circumferential stop-flanges, by which the upward motion of the guide-sleeves of the discharge-valves is limited. Above said fillet-rings 18 is arranged an interiorly-threaded nut-ring 19, by which the fillet-rings are held tightly in position against the bottom of the discharge-chambers, said nut-rings engaging exterior screw-threads on the central suction-tubes *s*, as shown clearly in Fig. 2.

The suction-valve seats are provided with ribs 26, so that they can resist the high pressure to which they are subjected. At their under sides the suction-valve seats are provided with radial ribs 27 and inclined faces 29 between said ribs, so that the air and water can freely pass from the spaces between the convolutions of the isothermal coils in outward direction along the under sides of the suction-valve seats into the annular spaces 30 between the suction-valves and the upper cylinders 12. In the bottom of each suction-valve seat is arranged a screw-plug 28, which serves for closing up the core-hole that is required in casting the suction-valve seats, so as to produce a proper casting of the same. The annular spaces 30 between the upper cylinders 12 and the suction-valves have to be made large enough so as to permit the free passage of the air and water without increasing the pressure on the piston and without impairing the isothermal compression of the air by the same. The spaces 31 in the discharge-valve chambers are connected by the discharge-pipe 38, which latter is connected with the receiver 43. The suction-tubes *s* are connected with a pipe 32 when gas is to be compressed. This is not required when air is to be compressed, in which case the air is directly admitted into the suction-tubes.

The water is supplied to the casings by a water-supply pipe 37, which is provided with a stop-cock, said stop-cock discharging into the funnel-shaped end of the supply-pipe 33, which runs along the outside of the casings 1 and 2 and is provided with check-valves 34 and 35, through which the water is sucked into the casings at opposite sides of the cylinder 3. The funnel 36 is provided with an overflow-pipe. The stop-cock of the supply-pipe regulates the supply of water to the funnel 36, and thereby the quantity of water admitted to the compressor and the proper degree of isothermal compression. The water that has taken up the heat of compression of the air or gas is conducted to the discharge-pipe 38 with the air or gas, which latter is then conducted to the receiver or to a separator 43 or directly to the place of use.

At the lower part of the casings 1 are discharge-openings 39 for permitting the cleaning of the interior of the casings. By the action of the piston $4^{\times}$ the air is first discharged and the water near the end of each stroke. As soon as the piston arrives at the end of its stroke the space near the piston is entirely filled with water which contains no air-bubbles that by their expansion and contraction would produce an injurious influence.

The operation of the compressor is the same as the operation of the compressor in my prior patent, heretofore referred to, so that but little additional description is required. By the reciprocation of the piston and the movement of the body of fluid within the compressor-casings at each stroke of the piston the sucking in of a quantity of air through one suction-valve and the simultaneous compression of the air in the other casing and its discharge through the discharge-valve of said casing are produced, so that by the alternating strokes of the piston a double-acting isothermal compression of the air is obtained, such compression taking place in the most economical manner up to a pressure of five hundred pounds in one stage.

The compressor, together with its steam-engine, takes up a comparatively small space and reduces thereby considerably the first cost of the compressor plant, while the running expenses of the same and the necessary repairs are likewise reduced, as all parts of the compressor are readily detachable from each other and easily accessible for cleaning and repairs.

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 two casings of cross shape arranged sidewise of each other, a horizontal cylinder supported at the meeting joint of said casings, said cylinder being open at both ends, a piston reciprocating in said cylinder, spiral isothermal coils supported in the lower parts of the extension-cylinders, of the casings, discharge-valve chambers supported on said extension-cylinders and axially in line therewith, suction-tubes extending through the extension-cylinders and discharge-valve chambers, fillet-rings located on said suction-tubes in the discharge-valve chambers, suction-valves located on the lower parts of the suction-tubes, discharge-valves guided on said fillet-rings, perforated valve-seats for the suction and discharge valves, the suction-valve seats being located at the lower ends of the suction-tubes and the discharge-valve seats in the bottom part of the discharge-chambers.

2. In an air compressing and cooling apparatus, the combination of two casings of cross shape arranged sidewise of each other, a horizontal cylinder supported at the meeting joint of said casings, said cylinder being open at both ends, a piston reciprocating in said cylinder, spiral isothermal coils supported in the lower parts of the extension-cylinders of the casings, discharge-valve chambers supported on said extension-cylinders and axially in line therewith, perforated discharge-valve seats formed in the bottom of said discharge-valve chambers, suction-tubes supported in the extension-cylinders and discharge-chambers, suction-valves at the lower ends of said suction-tubes provided with perforated suction-valve seats, radial ribs at the under side of the suction-valve seats and inclined portions between said radial ribs, fillet-rings on the upper parts of said suction-tubes provided with circumferential flanges at their upper ends, discharge-valves supported on said fillet-rings in the discharge-valve chambers and nut-rings on the upper ends of the suction-tubes holding the fillet-rings and suction-tubes in position on the bottom of the discharge-valve chambers.

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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P. F. TOOLE.