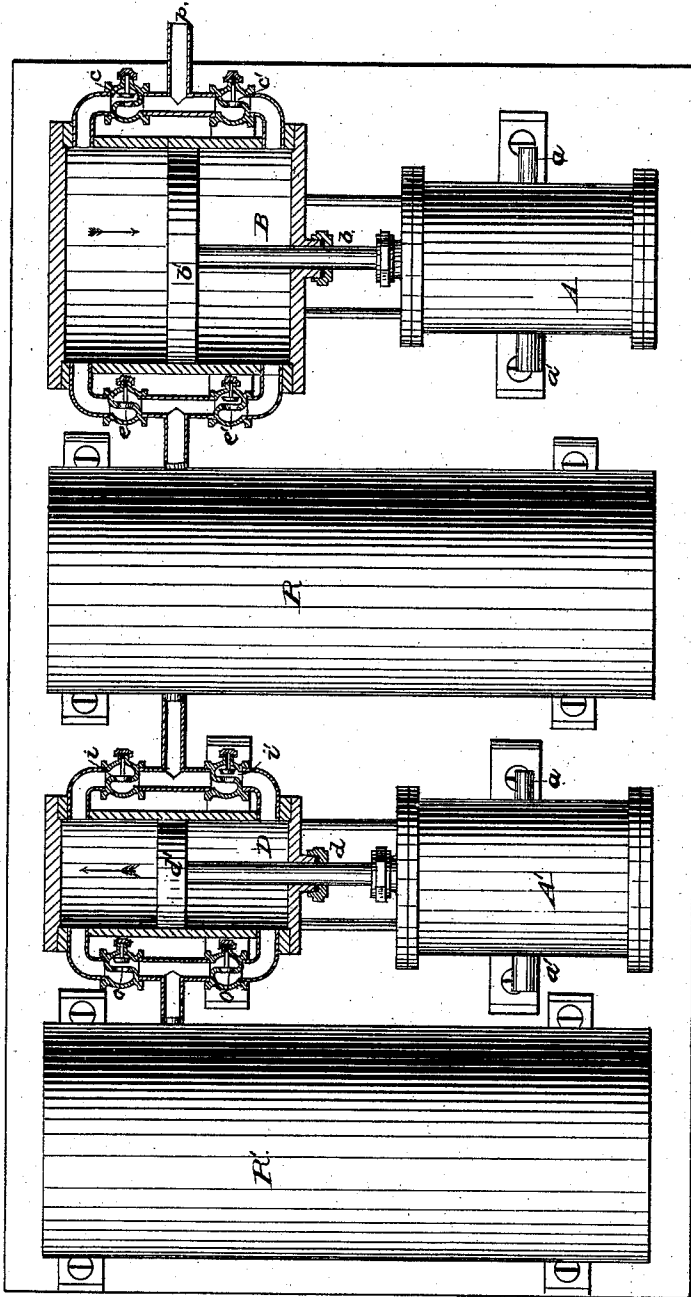


G. WESTINGHOUSE, Jr.
AIR-COMPRESSOR.

No. 173,835.

Patented Feb. 22, 1876.



Witnesses
J. E. Boggs
Claudius Parker

Inventor: George Westinghouse Jr.
By George H. Christy
his Atty.

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN AIR-COMPRESSORS.

Specification forming part of Letters Patent No. 173,835, dated February 22, 1876; application filed December 30, 1875.

To all whom it may concern :

Be it known that I, GEORGE WESTINGHOUSE, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Air-Compressors; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawing, making a part of this specification, which represents my improvement in side elevation, with the pumping cylinders and connections in section.

My improvement relates to the construction of an apparatus for the serial compression of atmospheric air, in which is combined a series of independently-operating pumps, alternating with a series of independent receivers, and a system of interposed check-valves, whereby the rapidity of the motion of all the pumps in the series will be regulated in part by the pressure or lack of desired pressure in the last of the series of receivers. By the terms series as herein employed I mean two or more.

A and A' represent two independent steam-engines of any suitable known construction. As shown, they are of cylindrical form, each with a steam-supply and exhaust port, *a a'*.

The internal construction of such engines is not shown, as it constitutes no part of the present invention.

B represents the first air-pump in the series, and D the second. The piston-stem *b* of the first engine in the series constitutes also the piston-stem of the first pump B, so as to actuate its piston *b'*. The same piston and stem-connection *d d'* is also employed with the second and each succeeding engine and pump in the series. R R' are two receivers, which alternate with the pumps in the line of the passage of air, the pump B compressing the air into R, and the pump D taking the air thus compressed from R and further compressing it into R', and so on through a succession of pumps and receivers to any desired extent. The pump B takes in air from without, by any suitable pipe or port, *p*, alternately at its opposite ends, through check-valves *e e'*, and forces or compresses the same, by a like alternate action, through check-valves *e e'*, into the receiver R, the closed check-valve in either case

preventing escape or back pressure. By a like alternate action the pump D takes air, as thus compressed, from the receiver R through check-valves *i i'*, and compresses it at a still higher or greater degree of compression or density, through check-valves *o o'*, into a receiver, R'. From this receiver the air, thus compressed, is taken by any suitable pipe-connection to the place of use, or, if further compression is desired, the operation is repeated by like apparatus, till, in the last receiver of the series, the desired working pressure is attained.

As each successive pump in the series is required to add to the degree of compression previously attained, and also as the bulk of the air to be compressed is lessened at each successive stage of the operation, I make the successive pumps B D, &c., through the series of a gradually-reduced area in cross-section from one to the next, and apportion them all in relation to each other, so that, with any given steam-pressure, such as is within the limits of ordinary steam-engine machinery, each successive pump in the series shall be capable of adding to the degree of density of compression previously attained, and also, so that the amount of work to be done by each, with reference to the final density desired, shall be properly distributed between the several pumps.

The rules governing this apportionment will come within the knowledge of the skilled mechanic, but I believe it best, having fixed the power required for the last compression and the area of the piston, which, with the power employed, will do the work, to double the piston area of each preceding pump. Thus the engine-pistons having each an area of eight square inches, the first pump-piston in the series may be made with an area of sixteen square inches, the second with eight, the third with four, and so on. But these proportions may be varied from to a considerable extent without departing from the scope of the invention.

As the rapidity of the motion of the pumps will vary somewhat with the resistance met in compression of the air, it follows that if the air be used rapidly from the last receiver of the series, the resistance to the action of the

last pump will be correspondingly lessened, and such pump will then move more rapidly to supply the loss. This will result in the lowering of the air-pressure in the previous receiver, and hence will lessen the resistance to the motion of the previous pump, and cause it to move more rapidly, and so on backwardly through the series, and as the pressure is restored the increased resistance will tend to reduce the speed of the pumps. Hence the action of the apparatus will automatically adjust itself to the requirements of the work.

Each pump-piston, instead of being connected with the engine-pistons, may be operated independently of each or all the other pistons by any suitable crank or other motion, such as is employed in converting a rotary into a reciprocating motion, the power applied to operate each pump remaining, however, the same, or nearly so.

I claim herein as my invention—

A series of two or more independent double-acting compressing air-pumps, fitted with pistons of different and gradually-reduced areas from one to the next, and intermediately-arranged receivers, communicating with each other by interposed pipes and check-valves, whereby the air is serially compressed and the speed of the pumps is regulated by the air-pressure in the various receivers, substantially as set forth.

In testimony whereof I have hereunto set my hand.

- GEO. WESTINGHOUSE, JR.

Witnesses:

JAMES M. CHRISTY,
GEORGE H. CHRISTY.