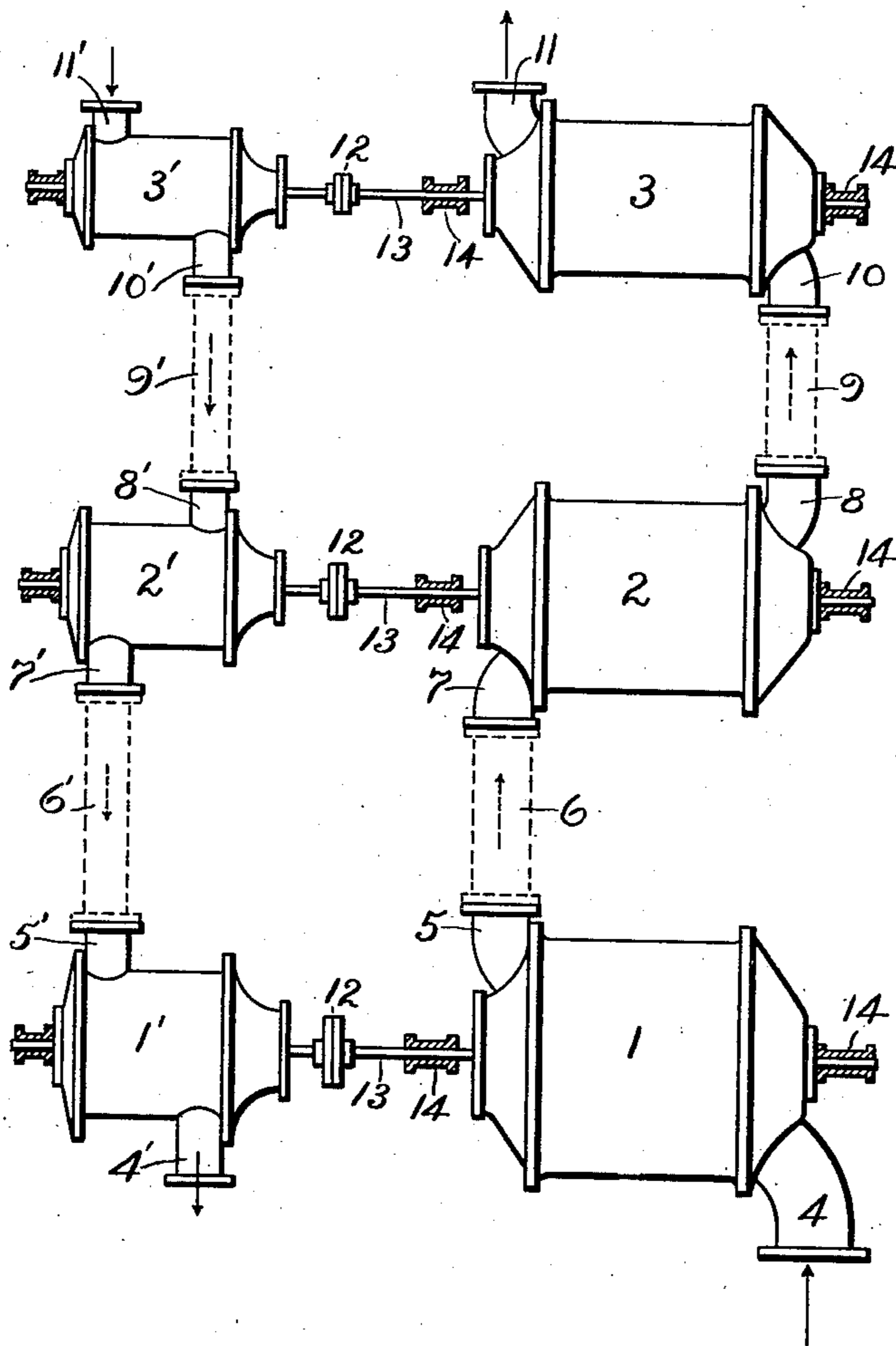


No. 883,888.

PATENTED APR. 7, 1908.

H. KELLER.
AIR OR GAS COMPRESSOR SYSTEM.
APPLICATION FILED APR. 10, 1907.



WITNESSES:

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UNITED STATES PATENT OFFICE.

HULDREICH KELLER, OF BERLIN, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY,
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AIR OR GAS COMPRESSOR SYSTEM.

No. 883,888.

Specification of Letters Patent.

Patented April 7, 1908.

Application filed April 10, 1907. Serial No. 367,339.

To all whom it may concern:

Be it known that I, HULDREICH KELLER, a citizen of Switzerland, residing at Berlin, Germany, have invented certain new and useful Improvements in Air or Gas Compressor Systems, of which the following is a specification.

My invention has reference to improvements in rotary apparatus for compressing air or other gas for industrial purposes.

In the practice of my invention I use a series of rotary compressors or of groups of compressors of any desired or improved construction, the compressors or groups of compressors being so arranged that the compression is effected in graduated stages, the air discharged from the first compressor of the series being received by the second compressor, and is there further compressed and is discharged to a third compressor, etc., until the desired degree of compression is obtained, it being understood that after each stage of compression the air or gas may be cooled.

In accordance with my invention the compressors form a series graduated in such manner that each compressor in the series is smaller in volume but is driven at a higher number of revolutions than the next preceding one, and the diameters of the compressors and their number of revolutions are so graduated that each compressor runs at the same highest practicable peripheral speed, which is limited by the maximum permissible friction and the maximum permissible strain by centrifugal force. The different speeds may be obtained each by an independent motor or engine, and in particular by a steam turbine, one for each compressor or for a group of compressors, or it may be obtained from a single motor or engine connected with all compressors or groups of compressors by suitable gearing. By preference, however, and in accordance with my invention, the motive power is obtained from a steam turbine system composed of a series of turbine wheels, the first receiving the steam at high pressure and running at high speed, and each successive wheel receiving the discharge steam from the next preceding one and running at a lower speed.

One embodiment of my invention is illustrated in the accompanying drawing, which shows a plan view of a series of turbines and

compressors connected in accordance with my invention, the connections, however, being indicated diagrammatically only and with the coolers between the successive compressors omitted.

Like reference numerals indicate like parts.

In this drawing 1, 2, 3 represent a single series of rotary compressors, each forming an element of the compressor system; but in place of any one or each of these elements there may be used a number of like elements coupled in parallel, so that the element 1 may represent either a single compressor as shown in the drawing, or it may represent a group of like compressors all driven at the same speed, receiving the air through a common channel and discharging it through a common channel. The same thing is true of the elements 2 and 3. With this understanding I shall hereinafter, for the sake of simplicity, speak of the compressor elements 1, 2 and 3, as if each were a single rotary compressor. The compressor element 1 is the largest, both in volume and in diameter. The compressor element 2 is smaller than the element 1, both in volume and in diameter, and the compressor element 3 is smaller than the element 2, both in volume and in diameter; and in this manner, if the series of compressors is extended, each successive element would be smaller both in volume and diameter than the next preceding element. The compressor 1 receives the air or gas to be compressed through the pipe 4 and discharges it through the pipe 5, from where it passes through a channel 6 and by pipe 7 to the compressor 2, from which it is discharged by the pipe 8 through channel 9, and enters the compressor 3 by a pipe 10, from where it may finally be discharged by the pipe 11, either to a storage tank or to the place where the compressed air or gas is utilized immediately. The channels 6 and 9, which are here shown in dotted lines, may either constitute by themselves each a cooler, wherein the air which has been heated in one compressor element is cooled before it is admitted to the next compressor element, or these channels may lead to specially constructed coolers to which the compressed air is carried from one compressor element and is again delivered to the next compressor element of the series.

The numerals 1', 2' and 3' represent steam turbine elements of a complete system, the element 1' being the largest, the element 2' 110

smaller than 1' and the element 3' smaller than the element 2'. These three elements are so connected with each other and with the source of steam that the steam is received
 5 in turbine 3' directly by pipe 11' from the boiler, is discharged by pipe 10' and channel 9', and admitted by the pipe 8' in turbine 2', from where it is discharged by the pipe 7' and channel 6' and admitted in turbine element
 10 1' by the pipe 5'. From this turbine element 1' the steam may be exhausted by the pipe 4', having by this time been reduced to nearly atmospheric pressure. Each turbine element is connected with the corresponding
 15 compressor element by a coupling 12 and a shaft 13, the compressor shafts having suitable bearings 14. It will be seen that in this arrangement the turbine element 3' receives the steam at its highest pressure and there-
 20 fore runs at the highest speed and that each successive turbine element, like 2' and 1', receives the steam at considerably lower pressure, so that these turbine elements run at a successively lower number of revolutions.
 25 Consequently, the compressor element 1 runs at the lowest number of revolutions per unit of time, the compressor element 2 at a higher number of revolutions and the compressor element 3 at a still higher number of revolu-
 30 tions per unit of time; but the diameters of these different compressors are so graduated that the peripheral speed of the different compressors is the same, or practically the same, and this speed is determined by the
 35 highest permissible air friction and centrifugal strain upon the compressor blades or pistons.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

40 1. A system of air or gas compression com-

prising a connected series of rotary compressors or of groups of rotary compressors, each successive element of the series being smaller in diameter than the preceding element, in combination with a series of motors or en- 45 gines, each element of the series driving faster than the preceding element and each connected with one element of the series of compressors, in such order that the compressors of larger diameter are driven at a 50 proportionally smaller number of revolutions, substantially as described.

2. A system of air or gas compression consisting of a connected series of rotary compressors or of groups of rotary compressors 55 of graduated diminishing diameter, in combination with a series of motors or engines driven at a correspondingly graduated increasing speed, and each connected to a compressor element in such order as to drive the 60 smaller ones proportionally faster than the larger ones, substantially as described.

3. A system of air or gas compression consisting of a connected series of rotary compressors or of groups of rotary compressors 65 of graduated diminishing diameter, in combination with a connected series of steam turbines each actuated by the exhaust from the preceding element of the series, the higher pressure elements driving the compressors of 70 correspondingly diminished diameters, and the lower pressure elements driving the compressors of correspondingly increasing diameters, substantially as described.

In witness whereof, I have hereunto set 75 my hand this 22nd day of March, 1907.

HULDREICH KELLER.

Witnesses:

JULIUS RUMLAND,
 KARL KRICKEBEN.