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METHOD OF AND APPARATUS FOR COMPRESSING GAS.

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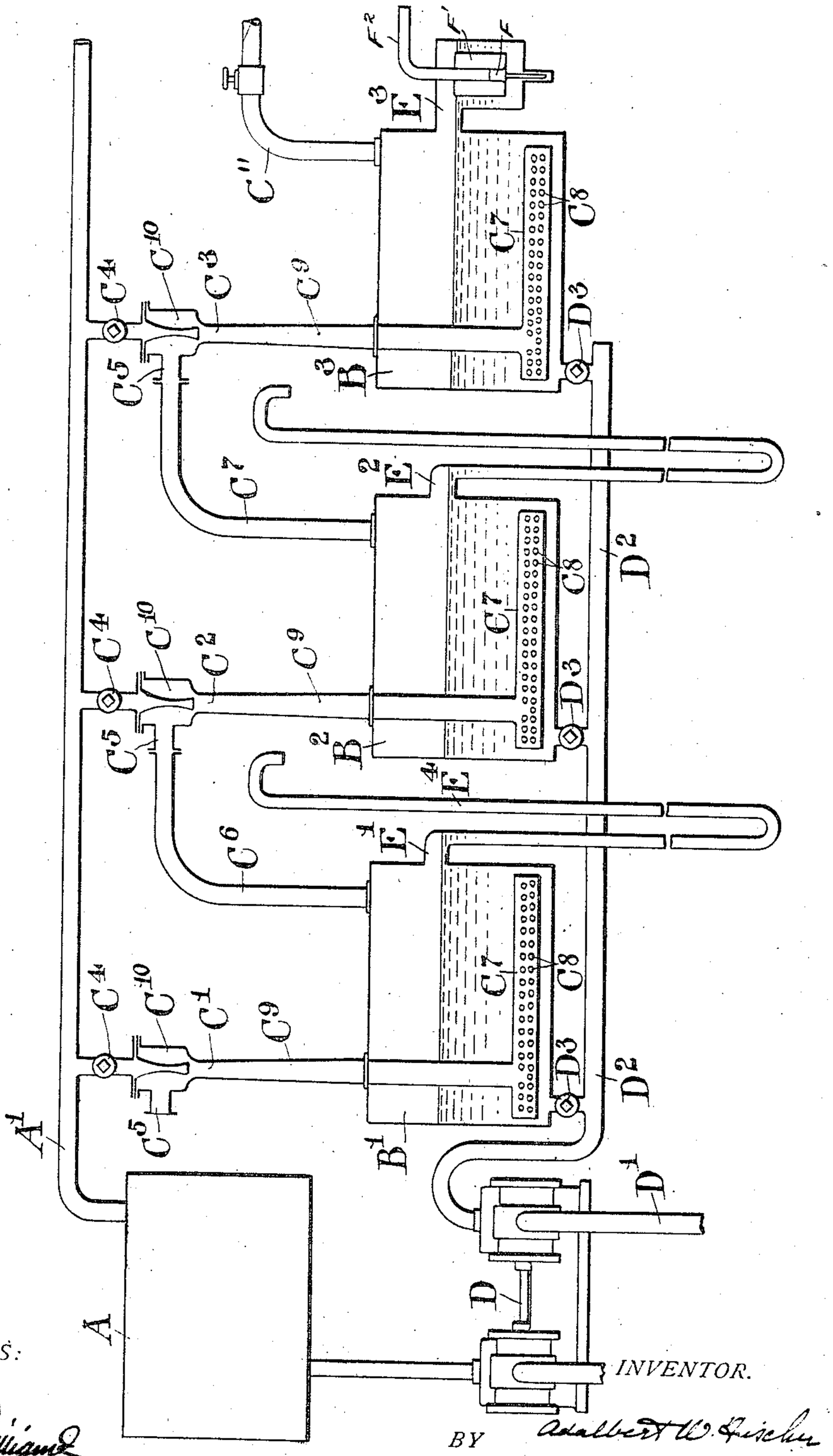
Patented Aug. 30, 1910.



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METHOD OF AND APPARATUS FOR COMPRESSING GAS.

968,926. Specification of Letters Patent. Patented Aug. 30, 1910.

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To all whom it may concern:

Be it known that I, ADALBERT W. FISCHER, a subject of the Emperor of Germany, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Improvement in Methods of and Apparatus for Compressing Gas, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My present invention relates to a method of and apparatus for compressing air or other gases by means of the jet action of steam, and has for its object to improve the method and apparatus for obtaining such compression by carrying out the compression in successive stages in each of which the gas to be compressed first has velocity imparted to it by a steam jet and then has its pressure raised by the conversion of the energy of velocity imparted to the gas by the steam into energy of pressure. The gas under the pressure given it at each stage, is acted on in the following stage by the corresponding steam jet which without lowering the pressure of the gas acted upon, first increases its velocity and then further increases its pressure. By proceeding in this manner I am enabled with a given steam supply pressure to build up the pressure of the gas compressed to a point materially higher than that to which the gas at the initial pressure can be compressed by a single steam jet drawn from a source of steam of the given supply pressure.

In carrying out the invention I greatly improve the economy of the operation by condensing the steam at each stage and separating it from the gas before subjecting the latter to the action of the steam jet in the following stage, thus avoiding any necessity for acting on the dead steam.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it, reference may be had to the accompanying drawings and descriptive matter in which I have illustrated and described in a somewhat diagrammatic manner one form of apparatus which may be employed for carrying out the invention.

In the drawings, A represents a source of steam supply such as a boiler from which runs a supply pipe A′. In the form shown the compression is carried on in three stages, and there are three receiving tanks or chambers B′, B², and B³, one for each stage. Steam jet devices C′, C², and C³ discharge one into each of the tanks B′, B², and B³. Each of these steam jet devices, which may be alike and of any well known type employed for such purposes, such for instance as is shown in United States Patent Number 571,022, granted Louis Schutte, November 10, 1896, is supplied with steam from the supply pipe A′ through a suitable valve controlled connection C⁴. The apparatus shown is for compressing air, and the air inlet C⁵ to the mixing chamber C¹⁰ of the steam jet devices C′ is open to the atmosphere. The inlets C⁵ of the steam jet devices C² and C³ are connected to the receiver tanks B′ and B² respectively by conduits C⁶ and C⁷. Preferably, to facilitate condensation, the lower end of each of the steam jet devices terminates within the corresponding receiving tank in a tubular portion C⁷ having a plurality of small ports C⁸ formed in its wall.

D represents a steam pump, which, drawing water through suitable supply pipe D′, has its delivery pipe D² connected to each of the receiver tanks by suitable valve controlled connections D³. The purpose of the water supply connections D³ is to supply condensing water to the receiving tanks to condense the steam passing into the tank from the corresponding steam jet device. Water escape pipes E′, E², E³ lead from the receiving tanks B′, B², and B³ respectively. In the form shown, pipes E′ and E² have siphon extensions E⁴ which are of regulated height so that when the water in the tanks B′ and B² rises to about the levels shown it will flow out of the receiving tank against the pressure of the atmosphere and the head due to the elevation of the extension E⁴ above the upper end of the pipe E′. This elevation is of course graduated to the pressures to be maintained in the receiving tanks B′ and B². The escape of water from

the receiver B^3 is controlled by a trap or float valve F having a cap F′ which intermittently fills with water and sinks to open the escape vent F^2 and then is emptied of water by the gas pressure forcing the water in the hollow float out through the escape vent, whereupon the valve rises and closes the vent F^2. It will, of course, be understood that in place of this trap other well known traps may be employed, and that this trap may be employed in lieu of the siphon extensions E^4 shown in conjunction with receivers B′ and B^2 whenever desirable.

In operation, steam passing from the pipe A′ to the steam jet device C′ draws in air from the atmosphere C^5 which is given a high velocity in the mixing chamber C^{10} and then has its energy of motion converted into pressure in the cone C^9 of the steam jet device, the air being delivered at this increased pressure to the receiving chamber B′. Steam passing into the receiving chamber B′ through the steam jet apparatus C′ is condensed by the water entering the chamber through the supply connection D^3. The condensing water and water of condensation pass out through the escape vent E′, and the compressed gas passes without appreciable loss of pressure to the jet device C^2, in which the velocity raising and pressure increasing operations are repeated, as they are in the third stage by the steam jet device C^3.

C″ represents the valved air outlet from the high pressure tank B^3.

By preceeding in accordance with the method disclosed, and by utilizing the apparatus disclosed, I am able to compress air or the like gas to an ultimate pressure in the final receiving tank greatly exceeding that which can be had with the same initial steam pressure in a single stage jet compression. For instance with the apparatus disclosed I can force air into the receiving tank B^3 against a pressure head which would be sufficient to prevent the device C^3 from moving any air at all if its air supply was at atmospheric pressure instead of at the pressure of chamber B^2. In practice the number of stages necessary to allow of the most economic use of steam depends on the supply pressure of the air or gas compressed, the final pressure of the air and gas and the ratio of the latter to the steam pressure.

The separation of the steam used at each stage from the air or gas compressed before the latter is delivered to the following stage, which is obtained by condensing the steam to water and tapping it off, results in material increase in the economy of the operation. The apparatus disclosed forms a highly simple and compact and inexpensive means for obtaining a relatively high compression of air or gas with a reasonable economy of steam. It will be obvious that the apparatus disclosed is only illustrative and that it may be greatly modified without departing from the spirit of my invention.

It will be understood, of course, by those skilled in the art, that the invention disclosed and claimed herein may be used as well where the ultimate purpose of its use is to produce a vacuum or low pressure in the chamber from which gas is drawn into the mixing chamber of the first steam jet device as where the purpose is to accumulate a body of compressed gas into the chamber into which the final steam jet discharges. The only difference in operation, when the invention is used for the two purposes, is in the terminal pressures. Ordinarily, where the object is to obtain a supply of compressed air, the pressure at the inlet C^5 of the steam jet device C′ is the pressure of the atmosphere, while the pressure in the final discharge tank B^3 is the pressure of the compressed air supply. In producing a vacuum or low pressure by the use of the apparatus disclosed, the pressure in tank B^3 is ordinarily that of the atmosphere, to which the tank is then preferably open, while the pressure in the inlet C^5 of the jet C′ is the pressure of the chamber being exhausted.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of compressing gas which consists in raising its pressure in successive stages by acting on the gas with a steam jet to impart velocity to the gas and then converting the energy of velocity of the gas into energy of pressure at each stage, and in condensing the steam employed at each stage, and separating the condensed steam from the gas before delivering the latter to the following stage.

2. Apparatus for compressing gas comprising in combination a plurality of steam jet devices arranged in series, a connection between the delivery end of each of the steam jet devices but the last one with the mixing chamber of the following steam jet device, a connection for supplying gas to be compressed to the mixing chamber of the first of said devices, and means for condensing the steam supplied by each jet device and before delivering the air to the next jet device.

3. Means for compressing gas comprising in combination a steam source, a series of steam jet devices supplied with steam from said source of steam, a receiving tank for each steam jet device into which the latter discharges, means for supplying gas to be compressed to the mixing chamber of the initial one of said series of steam jet devices, and means for conveying gas from each of the receiving chambers but the final one to the mixing chamber of the steam jet device next in the series.

4. Means for compressing gas comprising in combination a steam source, a series of steam jet devices supplied with steam from said source of steam, a receiving tank for each steam jet device into which the latter discharges, means for supplying gas to be compressed to the mixing chamber of the initial one of said series of steam jet devices, means for conveying gas from each of the receiving chambers but the final one to the mixing chamber of the steam jet device next in the series, and means for condensing the steam passed into each receiving tank.

5. Means for compressing gas comprising in combination a source of steam, a series of steam jet devices supplied with steam from said source of steam, a receiving tank for each steam jet device into which the latter discharges, means for supplying gas to be compressed to the mixing chamber of the initial one of said series of steam jet devices, means for conveying gas from the upper end of each of the receiving chambers but the final one to the mixing chamber of the steam jet device next in the series, means for supplying condensing water to the steam passing from the steam jet, and means for carrying off the condensing water and the water of condensation from the steam jet devices, arranged to maintain a substantially constant water level in said tanks.

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Witnesses:
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