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AIR BLOWING OR COMPRESSING APPARATUS.

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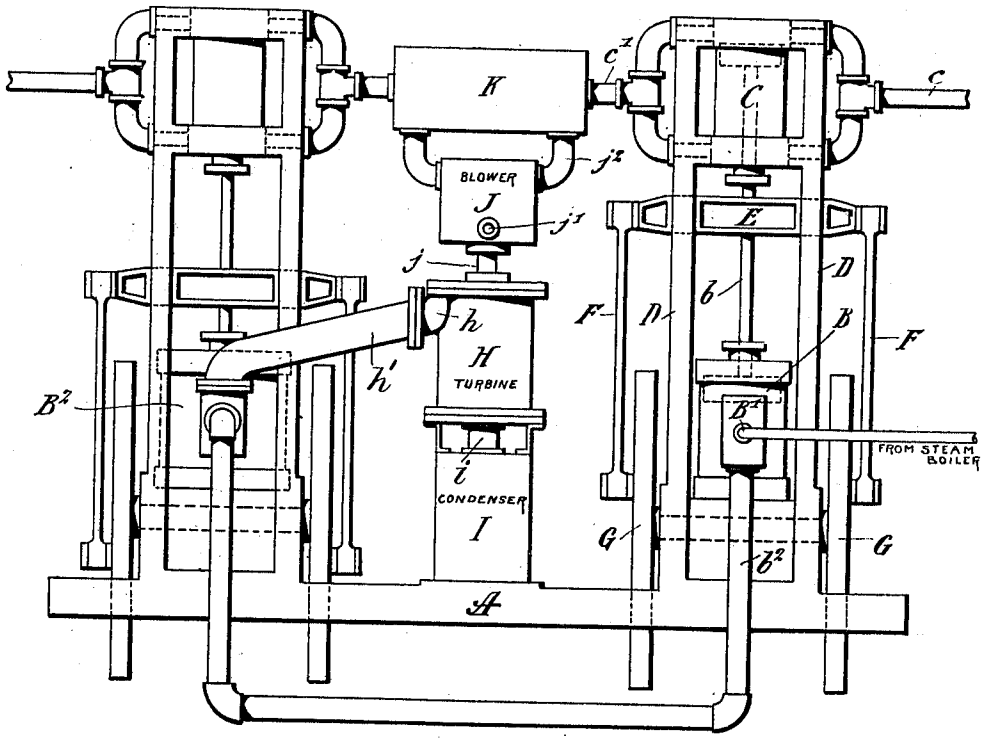
992,204.

Patented May 16, 1911.



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UNITED STATES PATENT OFFICE.

JOSEPH E. JOHNSON, JR., OF ASHLAND, WISCONSIN.

AIR BLOWING OR COMPRESSING APPARATUS.

992,204. Specification of Letters Patent. Patented May 16, 1911.

Application filed November 19, 1910. Serial No. 593,153.

To all whom it may concern:

Be it known that I, JOSEPH ESREY JOHNSON, Jr., a citizen of the United States, residing at Ashland, in the county of Ashland and State of Wisconsin, have invented certain new and useful Improvements in Air Blowing or Compressing Apparatus, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to air blowing or compressing apparatus, for example for supplying air to iron blast furnaces, Bessemer converters, or similar apparatuses.

More particularly my invention relates to a certain new combination of the different portions of the apparatus hereinafter described, the objects of which will be pointed out in this specification.

I will first describe one form in which my novel combination may be employed and will then point out the novel features in the claims.

The accompanying drawing represents a general plan of an apparatus embodying my invention, the same being of a somewhat diagrammatic nature.

As will be hereinafter seen in greater detail, the present invention contemplates the following in combination, namely a steam engine, a piston compressor actuated by the steam engine, a steam turbine driven by the engine's exhaust, a centrifugal blower actuated by said turbine, and a connection from the discharge of the blower to the intake of the compressor; or in place of any one or more of said elements the equivalent thereof. And duplication of some of the elements in proper cases is contemplated.

When a steam engine is employed to drive a piston compressor or blower, the two together are sometimes combined in the form of a "blast furnace blowing engine", and this has certain advantages which it is an object of my improvement to retain, and certain disadvantages which it is an object of my invention to overcome. The reciprocating engine requires more repairs and is more difficult to repair especially under constant heavy service, than a turbine, and this matter of repair is to a considerable extent overcome by my invention. The output of the piston compressor is limited by the size of the cylinder, since no more air can be pumped per stroke than the cylinder accommodates. At low pressures the efficiency is poor and the engine is unable to fully utilize the advantages of a high vacuum; whereas with a low pressure and velocity, and high vacuum, the conditions are extremely favorable for the economical operation of a turbine. The air or compressing end of the blowing engine must be large and heavy to withstand the stresses, and this makes it expensive in comparison with the turbine. In addition the reciprocation causes vibrations which disadvantageously affect the refrigerating or other apparatus, if there be one, which may be connected to the compressor's suction, for example for drying the air. On the other hand a steam turbine driving a centrifugal or turbo-blower has advantages which the present invention seeks to retain, and disadvantages which are sought to be overcome. When blowing is done with such an apparatus, the latter will be almost as costly as the best grade of steam engines. Moreover, it is not economical of steam at the high pressures necessary to perform the work. The delivery of air is not constant, and in fact it changes with every change of the discharge pressure even though the speed be constant. It is well known that with very excessive pressure or resistance a centrifugal blower's delivery will cease. These irregularities have sought to be overcome by governors, but without complete success. The inferiority in efficiency will be seen from the fact that a steam turbine's efficiency is but little better than that of a reciprocating engine at the same pressure and vacuum, whereas the centrifugal blower is of very much less efficiency than a piston blower; which might for example be 75% as against 90% for the latter.

An object of the present invention is to combine the good points of both of the above described types of apparatus in order not only to attain higher efficiency with lower first cost, but also many other advantages such as above indicated and as will further appear hereinafter, such for example as the retention of that valuable feature of the piston compressor which enables it to be regarded as a meter for determining the amount of air delivered.

The operation of the present invention which has been described in a general way hereinabove, consists in taking the exhaust steam from the steam cylinder of a "blast furnace blowing engine", passing it through a turbine so as to drive the latter and thence

preferably to a condenser, the turbine being allowed to drive a centrifugal blower, which latter supplies partially compressed air to the air intake of the blowing engine; the latter thus commencing its operations with air at a higher pressure than atmospheric and enabling the apparatus to give a larger delivery at the same expenditure of power.

In the accompanying drawings, A represents the bed plate of a so-called blast furnace blowing engine, of which B represents the steam cylinder of the steam engine, the same having a reciprocating piston and the usual piston rod b which extends to the piston of an air compressor cylinder C. Members D, D may serve both as a frame, and as guides for guiding a crosshead E which may slide back and forth between the steam cylinder B and air cylinder C as the apparatus operates. At each outer end of the crosshead is connected a connecting rod F, F, these rods extending to crank pins of flywheels G, G and serving to drive the flywheels, the latter in turn serving to steady and regularize the operation of the apparatus.

c represents the outlet or discharge of the air cylinder, this discharge being connected to the furnace when the apparatus is used for a blast furnace.

c' indicates the inlet or intake of the air cylinder through which air is sucked into the cylinder preparatory to being compressed.

It will be understood that when the engine B is steam driven, as it usually will be, there will be a steam inlet B′ to the cylinder from a steam boiler, and there will also be a steam outlet or exhaust at b^2. Ordinarily this would be all of the apparatus used for blast furnace blowing, but my invention contemplates the following further elements: H represents a low pressure steam turbine driven by the exhaust from the high pressure engine B, this turbine having a steam inlet h connected by a pipe h' to the outlet b^2 of the engine, and the turbine having an outlet i to a condenser I. The turbine is capable of operating with much higher efficiency than the "steam engine" at low pressures of steam, and as it is a rotary apparatus, it is devoid of the reciprocation and shaking that accompany a reciprocating engine and compressor. The centrifugal blower or turbo-blower is employed as seen at J, it being mechanically actuated by the turbine H through connection or shaft j; and this centrifugal blower has an air inlet at j' and outlet at j^2.

It is requisite to my invention not only that the turbine H shall be driven by the exhaust from the engine B, but that the air driven or blown by the centrifugal blower J shall be driven, for example through a connection c', into the inlet or intake of the reciprocating air compressor C already referred to. In this way the air compressor is furnished with air not at atmospheric pressure but in an already partially compressed state as delivered by the centrifugal blower J.

The present improvements are carried forward in the drawings by duplicating the engines and compressors, high pressure engine B exhausting to low pressure engine B^2 and the latter exhausting to the turbine, while both compressors draw air from the centrifugal blower or from an intermediate chamber K supplied by the blower; and other obvious adaptations are possible.

With my apparatus, it is quite feasible to cool the air passing through the centrifugal blower to the air cylinder of the compressor; for example, the part marked K may represent a cooler. In this way an economy will be made of 10% to 12% additional, which will be a great advantage to the operation of the apparatus.

By means of my improvements it is possible to retain the positive delivery with its regularity of action and advantageous metering effects, at the same time permitting a much smaller air cylinder than would be required with the old "blast furnace blowing engine". My improvements also permit a more efficient low pressure apparatus, namely the turbine and centrifugal blower, which will also be much smaller and less expensive than an added low pressure cylinder and piston upon the blowing engine. Besides these advantages, the intake of my apparatus is entirely free from pulsations because of the rotary character of turbine and blower, notwithstanding which and notwithstanding all the other advantages that flow from this part of the apparatus, my improvements retain the positive discharge into the blast furnace from the reciprocating compressor in virtually the same manner as heretofore, but with increased delivery.

A centrifugal blower forcing air directly into a furnace which is subject to irregularities of pressure, is very inconstant in its action, but this is entirely overcome with my improvements because the blower is working not against the blast furnace pressure but in coöperation with the suction end of a positive piston compressor. When the pressure changes, against which the engine and compressor are working, there will be some change in the speed of the flow of the steam passing from the exhaust to the turbine, and this will effect a slight change in the speed of the turbine and consequently in the delivery from the centrifugal blower. While this will to some extent affect the delivery of the engine, the effect will be very slight as the tendency is for one thing to offset the other. Thus an increased load will cause the engine to consume more steam and its exhaust will be at a higher pressure, in consequence of which the turbine and blower

will operate with greater effect, and this in turn will cause the compressor to draw more air into its suction; and in so far as there is not complete compensation, a suitable governor may be applied for exactly compensating for the change, thus securing a constant air delivery at any pressure.

It is an advantage of my improvements that the turbine and centrifugal blower combined, having small size and great capacity, may be employed singly in conjunction with a series of reciprocating engines, all exhausting into the one turbine, and the blower supplying initially compressed air to all of the reciprocating compressors.

My improvements will have a great field of usefulness in connection with blowing plants already installed, having high pressure engines, since there may be effected an increase of capacity and efficiency without throwing away present equipment. In such cases the turbine and blower may be installed and the heads of the air cylinders may be inclosed or hooded in so as to receive air under pressure and then effecting the peculiar intercombination of parts by proper piping as described herein, and adding a condenser where none exists. In this way the power previously wasted by high pressure exhaust can be saved in a most advantageous and economical manner and delivered to the compressor cylinder in the form of partly compressed air, thus increasing the capacity for a given speed in the ratio of the increase in the absolute pressure of the air delivered to it. The useful life and capacity of many existing plants may be extended in this way with relatively small expenditure.

In the claims herein, while particular terms are used to refer to the different parts, it is intended that each shall cover equivalents so long as the entire combinations claimed are retained. The novelty of the present improvements relates not to any single one of the elements because the engine is well known, as well as the compressor, the turbine and the blower, but the particular combination thereof constitutes the point of novelty and invention. The engine of the present application, it will be understood, is a positively acting engine, such for example as a reciprocating piston engine, although other forms of high pressure engines would serve in place thereof. The compressor is a positive one, such for example as a reciprocating piston compressor, as distinguished from a mere centrifugal blower. The turbine is a power producing apparatus which operates rather through the continued flow and velocity of the fluid than by pressure, and is therein distinguished from the reciprocating piston engine; the former being an effective apparatus under a rapid flow of steam at low pressure, the latter being inefficient under those conditions. The centrifugal blower is a piece of apparatus which as distinguished from the piston compressor is not positively acting and has the disadvantages among others of not being useful at high pressures; its special utilities as they are well known, being fully availed of in my present improvements.

What I claim as new and desire to secure by Letters Patent, is:

1. In combination, a steam engine actuating a positive compressor, a turbine driven by the engine's exhaust and actuating a centrifugal blower, and a connection from the blower's discharge to the compressor's intake.

2. In combination, a steam engine actuating a reciprocating-piston compressor, a turbine driven by the engine's exhaust and actuating a centrifugal blower, and a connection from the blower's discharge to the compressor's intake.

3. In combination, a steam engine actuating a reciprocating-piston compressor, a low pressure turbine driven by the engine's exhaust and actuating a centrifugal blower, and a connection from the blower's discharge to the compressor's intake; whereby the compressor is furnished with partially compressed air and further compresses it for ultimate use.

4. In combination, one or more blast furnace blowing engines each comprising a steam engine actuating a positive compressor, with a steam turbine, the same supplied with steam from each blowing engine exhaust, a centrifugal blower driven by said turbine, and a connection between the blower's discharge outlet and the suction inlets of the respective compressors.

5. In combination, a low pressure steam turbine driving a centrifugal blower, together with a reciprocating engine and compressor, for example of the type known as a blast furnace blowing engine; the combination and arrangement being such that the low pressure steam discharged by the engine drives the turbine, and the air from the turbine driven blower is supplied to the air cylinder of the compressor in partially compressed condition, thus increasing the capacity of the latter and decreasing its work.

In testimony whereof I have affixed my signature in presence of two witnesses.

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Witnesses:

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