No. 643,764. Patented Feb. 20, 1900.

T. A. EDISON.

METHOD OF REHEATING COMPRESSED AIR FOR INDUSTRIAL PURPOSES.

(No Model.) (Application filed Feb. 27, 1899.)

2 Sheets—Sheet 1.

Fig. 1

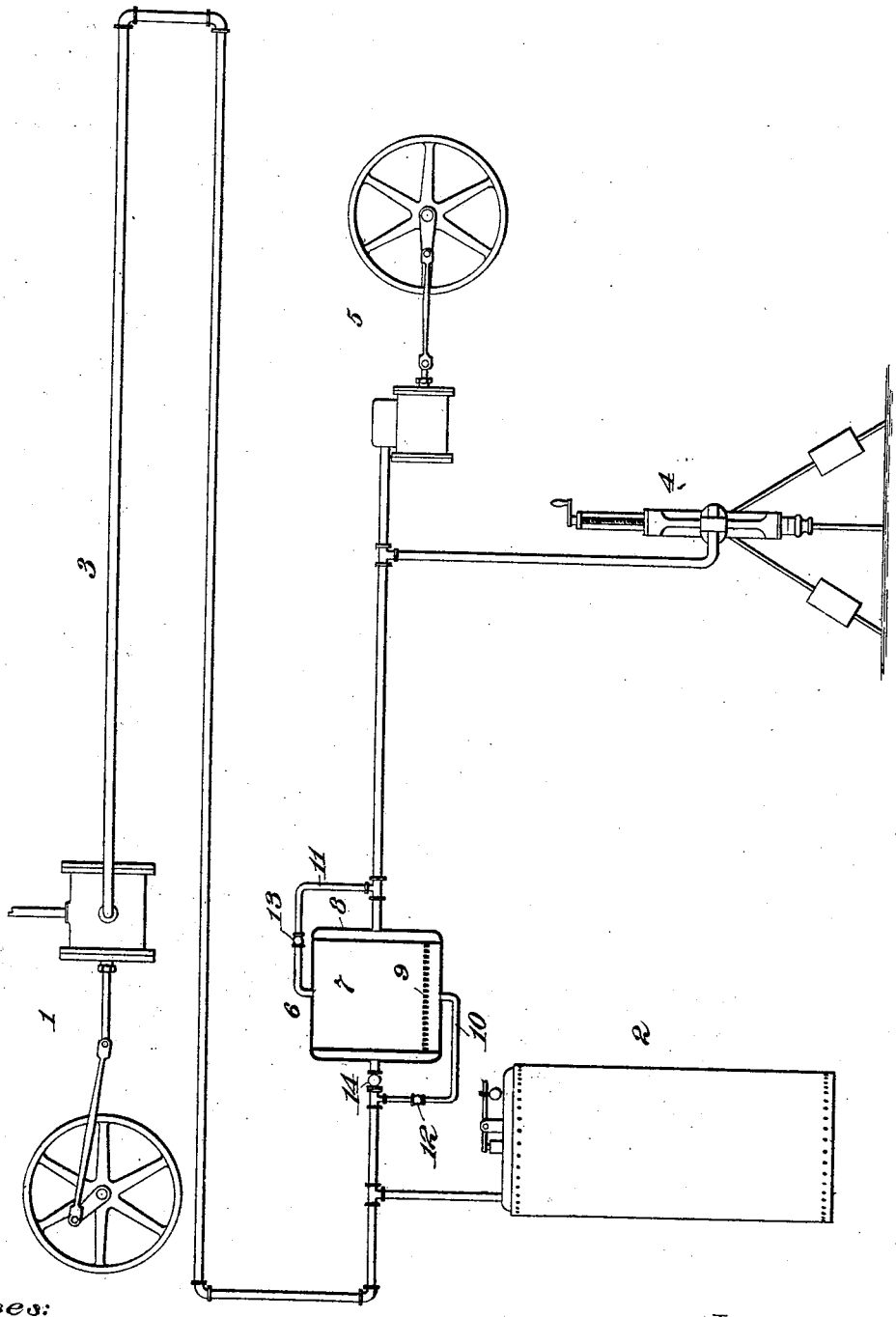

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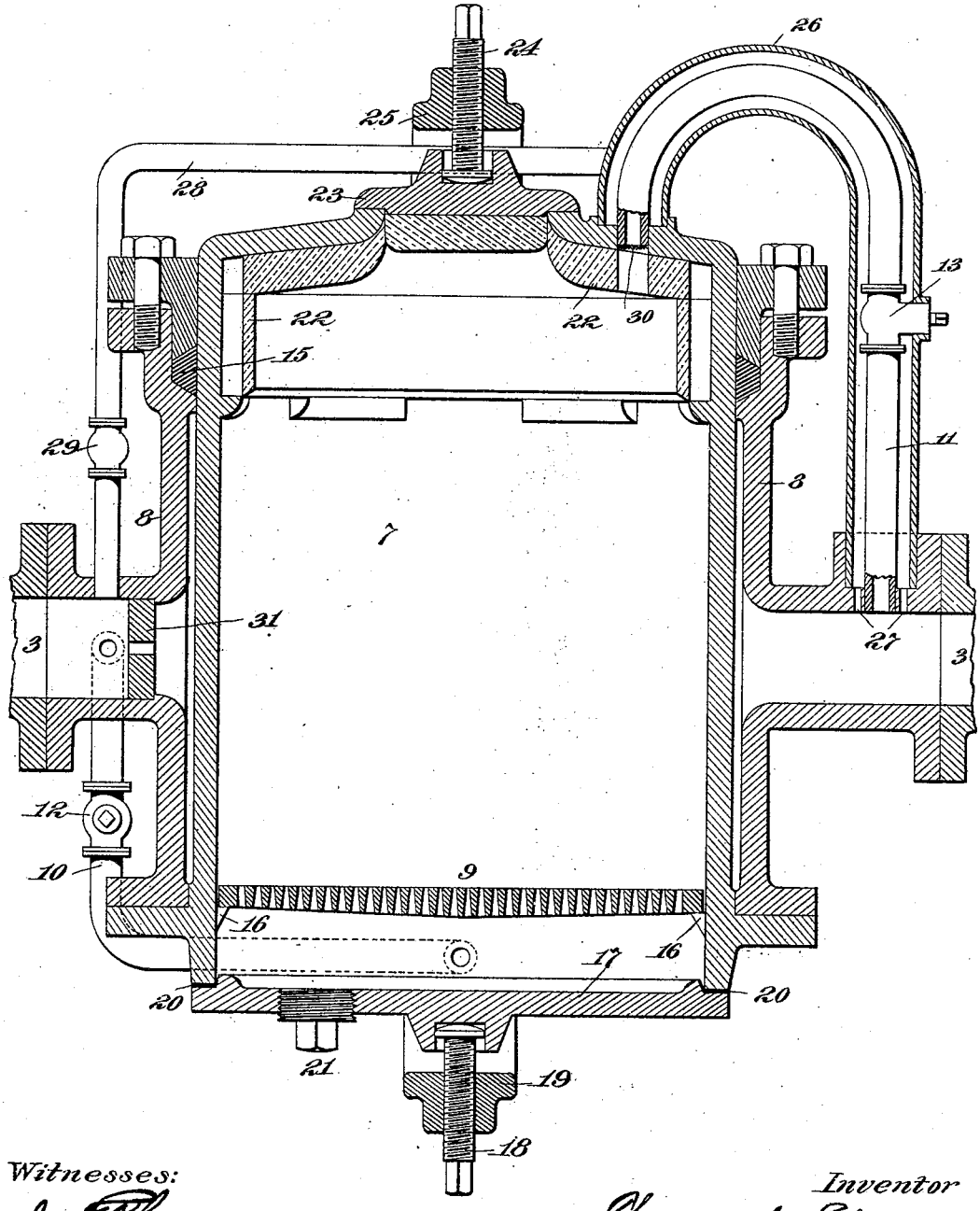
Fig. 2



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UNITED STATES PATENT OFFICE.

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METHOD OF REHEATING COMPRESSED AIR FOR INDUSTRIAL PURPOSES.

SPECIFICATION forming part of Letters Patent No. 643,764, dated February 20, 1900.

Application filed February 27, 1899. Serial No. 706,976. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Methods of Reheating Compressed Air for Industrial Purposes, of which the following is a specification.

My invention relates to an improved method or process for reheating compressed air for use for industrial purposes.

It is well known that in the operation of compressing air the conversion of the latent heat into sensible heat results in an increase of temperature of the compressed air. If the air be now allowed to expand, it will immediately resume its former temperature and pressure. If air after it has been compressed is immediately used for industrial purposes—as, for instance, for the operation of a mechanical translating device—the theoretical loss of efficiency will be relatively slight and will be due largely to loss by friction in the compressor and in the translating device in which the work is performed; but when compressed air after its temperature has been raised by the act of compression is conducted to a translating device situated at a distance from the source of supply there will be an inevitable loss of heat due to radiation, and in consequence the temperature of the compressed air will be less at the point of use than at the point of supply. A loss is occasioned, therefore, due not only to the reduction in temperature, but to a decrease in volume of the compressed air occasioned by such a reduction in temperature. Furthermore, it is known that when air under high pressure is allowed to cool sufficiently the expansion thereof in the translating device results in the actual freezing of any moisture mechanically entrained in the air or present in the vicinity of the exhaust, the ice or frost thus produced tending to block or choke the valves or pistons of translating devices employing such elements. The objections above referred to are also encountered when compressed air is accumulated in storage-tanks, and considerable time elapses between the acts of compression and use. Opportunity is thus offered for the temperature of the compressed air to be reduced by radiation, resulting not only in loss of efficiency, but in some instances in the accumulation of ice and frost in or about the exhaust-opening. In view of these objections it has been suggested that the compressed air before being used should be reheated in order that the heat lost by radiation may partly, wholly, or in excess be restored to it, and it is to the carrying out of this operation and the apparatus for accomplishing it that my invention relates.

My object is to economically and practically reheat compressed air for motive power or for other industrial purposes, so that the efficiency in use will be greatly increased.

To effect this object, the process or method consists in directing a portion of the compressed air into intimate proximity with a source of burning combustible, whereby heat will be imparted to the compressed air by radiation, in effecting a reduction of pressure of the air between the source of heat and the point of use, in causing a portion of the air to flow, by reason of such reduction of pressure, through the burning combustible, whereby combustion will be maintained and the air so introduced will be directly heated to a very high temperature, and in mixing the directly-heated portion of the air with the indirectly-heated portion of the air prior to use.

The apparatus which I have designed for carrying the process or method into effect comprises a receptacle or reheater interpolated in the air-pipe between the source of supply and a translating device, said receptacle containing, preferably, a solid or approximately-solid combustible and being of such a character as to enable a portion of the air to be reheated by radiation—as, for example, by being provided with an inclosing jacket interposed in the conductor and through which a portion of the air will pass—a by-pass being provided which extends through the reheating-chamber to permit a portion of the air to pass directly through the reheater to support combustion and be heated directly, and means being provided to permit a drop in the air-pressure between the inlet to said by-pass and the translating device to automatically cause air to flow through the

by-pass in quantity depending upon the consumption at the translating device. An apparatus of this type for the carrying out of my method or process will be made the subject of a separate divisional application for Letters Patent.

In order that my invention may be better understood, attention is directed to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a diagram of an improved apparatus for carrying out my method, showing two sources of compressed-air supply—namely, a compressor, with a line-pipe, and an air-tank—and illustrating two forms of translating devices—to wit, a rock-drill and an air-motor; and Fig. 2, an enlarged sectional view of the preferred construction of reheater for carrying out my method.

In both of the above views corresponding parts are represented by the same numerals of reference.

1 represents an air-compressor of any suitable type, and 2 represents a tank for holding the compressed air. Usually when a compressor is employed for compressing air for immediate use a line-pipe 3, connected with a translating device—for instance, a rock-drill 4—is employed. When compressed air is stored in tanks, the translating device—for instance, a motor 5—is located generally adjacent to the source of supply. The loss of energy resulting from the lowering of temperature of the compressed air, either in the line-pipe 3 or in the tank 2, it is the purpose of my invention to restore partly, wholly, or in excess, to accomplish which result I employ a reheater 6, interposed between the source of supply and the translating device. Preferably said reheater comprises an inclosed chamber 7, having a jacket 8 surrounding its side walls, said jacket being interpolated in the path of the compressed air. The chamber is provided with a grid or grate 9, supported above its bottom and carrying a supply of solid or approximately-solid combustible, preferably either charcoal, coke, or anthracite coal. This combustible is preferably in a relatively finely divided condition, although not to a sufficient extent as to become packed in the chamber to retard the flow of air through the same. The particles may in practice be about one-half-inch cube in dimensions. The pipe 10 leads from the air-pipe between the reheater and the source of supply and enters the receptacle or reheater below the grid or grate 9, as shown. The corresponding pipe 11 extends from the reheater and communicates with the air-pipe between the latter and the translating device. Preferably the pipe 10 is provided with a valve 12 therein, by which the quantity of air flowing through the combustion-chamber may be regulated. The pipe 11 may also be provided with a valve 13. It is desirable that means should be provided in the apparatus to provide for a drop in pressure in the air-pipe adjacent to the reheater in order that there may be a flow of air through the by-pass, comprising the pipe 10, the reheater, and the pipe 11. In Fig. 1 I illustrate a valve 14 for this purpose interposed in the air-pipe between the pipe 10 and the reheater.

The operation of the apparatus will be readily understood. A suitable combustible, as explained, is placed in the reheater upon the grid or grate 9. This combustible is ignited in any suitable way. Compressed air from a suitable source of supply is now allowed to pass through the jacket 8 onto the translating device or devices. A portion (preferably a very small portion) of this air passes through pipe 10 and enters the combustion-chamber of the reheater below the combustible, and thence passes evenly through the combustible to maintain combustion therein. The air which thus passes through the combustion-chamber of the reheater will be thus directly and intensely reheated and will pass out of the heater with the products of combustion and enter the air-pipe between the reheater and the translating device. The larger portion of air passing through the jacket 8 will be heated by radiation and convection from the reheater, and the temperature of this air will be further augmented by the intermixture with it of the more highly heated but smaller proportion of air entering the air-pipe from the reheater. By regulating valve 12 any suitable proportion of air may be caused to pass through the reheater, it being obvious that the greater the proportion of this air the more rapidly will the combustible be consumed, and in consequence the higher will be the temperature of combustion and of the reheated air also. It thus becomes possible to regulate the temperature of the reheated air within wide limits. By providing a device like the valve 14 to effect a very slight retardation in the flow of the compressed air a drop in pressure in the air-pipe adjacent to the reheater is secured, and the flow through the by-pass and reheater is thus assured. It will be obvious that the extent of the drop in pressure will be dependent upon the rapidity with which the reheated compressed air is consumed at the translating devices. Hence if there is no consumption of the reheated compressed air the pressure will be the same on both sides of the reheater. By reason of this fact the flow of air through the by-pass will be substantially proportional to the drop in the pressure, and as the heat developed by the reheater is dependent upon the direct air-supply to the same it follows that a greater heat will be generated in the reheater as the consumption of the reheated air is increased. Hence the device is approximately self-regulating.

In Fig. 2 I illustrate the preferred construction of the reheater for carrying out my method. The chamber 7 is made separate from the jacket 8, and a packing 15 is used to prevent leakage. The grid or grate 9 is

carried on lugs or ears 16. The bottom of the chamber comprises a door 17, adapted to be pressed tightly in place by a screw 18, working in a bridge 19, pivoted at one end and locked at the other. Asbestos packing 20 is preferably interposed between door 17 and the bottom of the chamber 7. If desired, the door 17 may be provided with a screw-plug 21 for the introduction of burning waste to start the combustion. The plug may, however, be dispensed with and the combustion be started in any other suitable way. The pipe 10 leads into the chamber 7 below the grate 9 and above the door 17, so that the opening or closing of the door does not affect the pipe connections. The supply of air to the lower part of the chamber 7 keeps it cool, but the upper portion becomes intensely heated, and unless suitably insulated there would be a considerable loss by radiation. I therefore prefer to provide the upper part of the chamber 7 with a fire-brick or asbestos lining 22, secured in place in any suitable way. The chamber is provided with a suitably lined or insulated upper door or manhole 23, adapted to be forced down into position by screw 24, working in bridge-piece 25. The pipe 11 leads from the chamber 7 at one side of the manhole 23 and connects with the air-pipe, as shown. This pipe also becomes intensely heated, and to prevent loss by radiation I prefer to inclose it with a jacket-pipe 26, having ports 27 connected with the air-pipe, whereby the heat radiated from the pipe 11 would be communicated to the compressed air. In order to maintain a circulation of air in the pipe 26 and around pipe 11, I prefer to employ a by-pass 28, having a regulating-valve 29 therein and extending from the pipe 3 to the pipe 26. In some instances the reheater will be provided at the mouth of the pipe 11 with a fine screen 30 to prevent large particles of ash from passing into the translating device. When charcoal is employed as a combustible, the ash produced is so fine that such a screen is not necessary. When only a moderate amount of air is passing through the reheater, its velocity is insufficient to carry off any ash therefrom, even when anthracite coal is employed as the combustible; but in order to meet all the exigencies of use, and particularly to prevent any ash from being carried into the translating device when the velocity of the air in the by-pass is relatively excessive, such a screen may be conveniently employed.

In place of a valve, as in Fig. 1, I show in Fig. 2 a perforated disk 31 in the air-pipe to provide for the drop in pressure on the working side of the reheater.

It is to be observed with the apparatus described that when the translating device is not in use a very slow circulation of air will be maintained through the reheater to effect slow combustion therein during prolonged periods and that when the translating device is again operated to provide for the absorption of air the circulation through the combustion-chamber will be increased to automatically produce the heating effect desired.

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

The method of reheating compressed air for industrial purposes, which consists in directing a portion of the air into intimate proximity with a source of burning combustible; in effecting a reduction in pressure of the air between the source of heat and the point of use; in causing a portion of the air to flow, by reason of such reduction of pressure, through the burning combustible to absorb heat directly therefrom and to support combustion thereof; and in mixing the directly-heated portion of air with the indirectly-heated portion of air, prior to use, substantially as set forth.

This specification signed and witnessed this 24th day of February, 1899.

THOMAS A. EDISON.

Witnesses:
JNO. R. TAYLOR,
ACHIBALD G. REESE.