

PUBLISHED

MAY 11, 1943.

BY A. P. C.

O. REINER

COMBINED REVERSING METHOD AND REVERSING DEVICE

FOR THE HEATING GAS, THE AIR AND THE WASTE

GAS FOR USE IN CONNECTION WITH INDUSTRIAL

FURNACE PLANTS OPERATING WITH ALTERNATING

GAS AND AIR CURRENTS

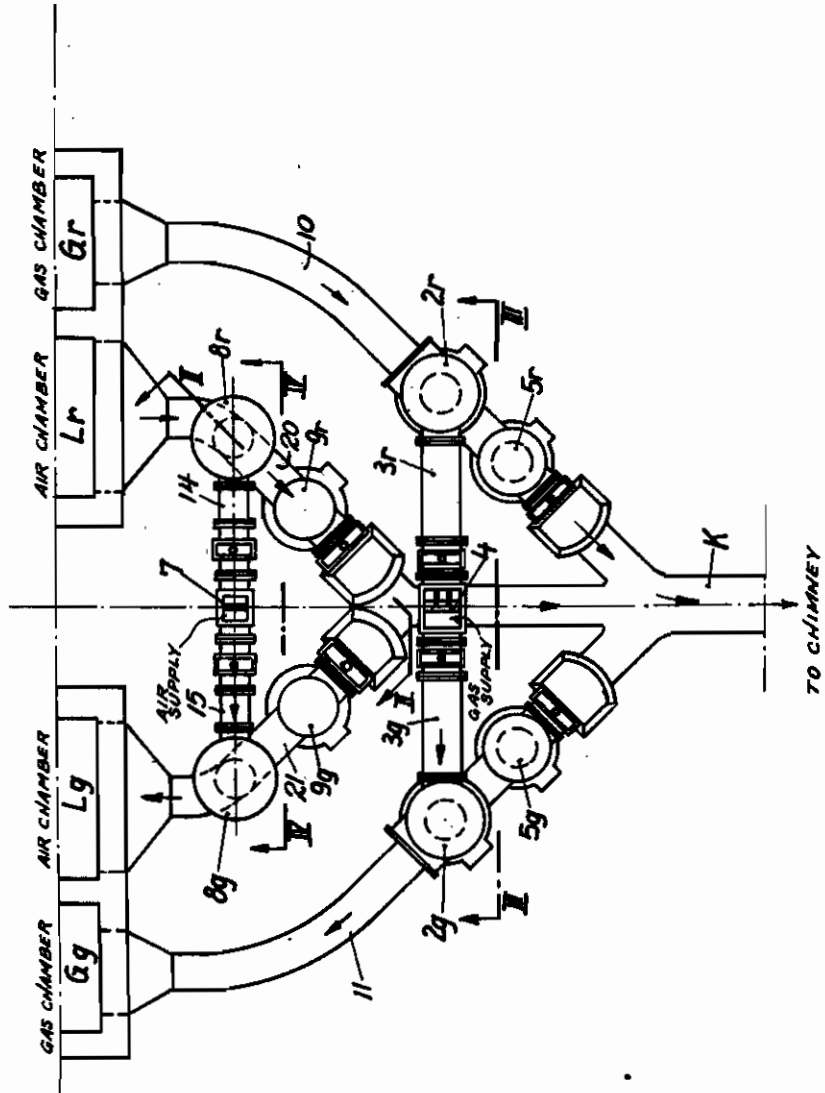
Filed March 9, 1940

Serial No.

323,160

2 Sheets-Sheet 1

Fig. 1



Inventor
OTTO REINER

By *Francis C. Bryce*

Attorney

PUBLISHED

O. REINER

Serial No.

MAY 11, 1943.

COMBINED REVERSING METHOD AND REVERSING DEVICE

323,160

BY A. P. C.

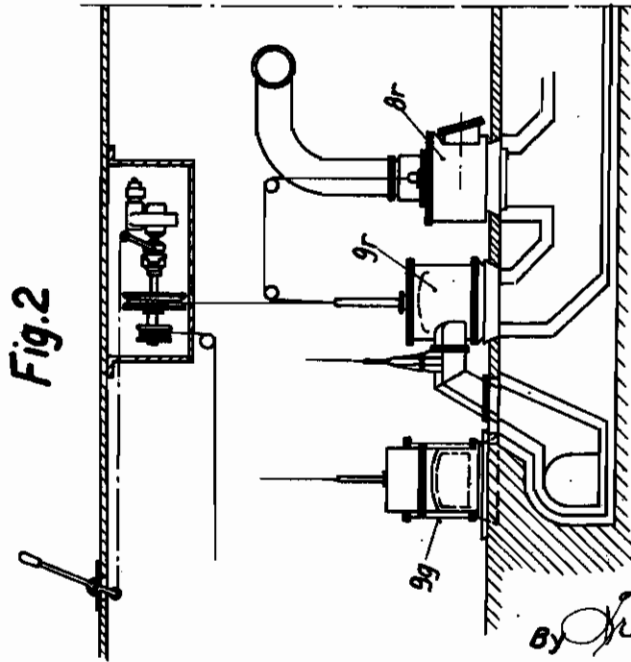
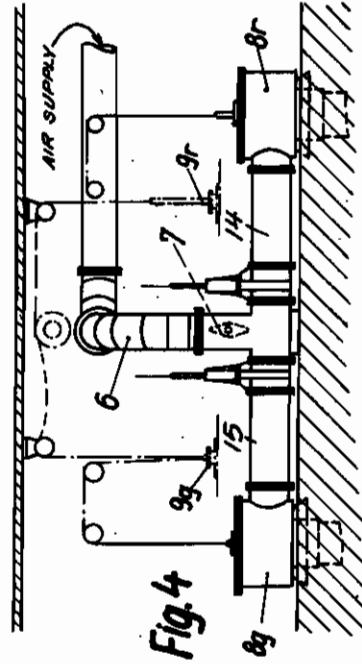
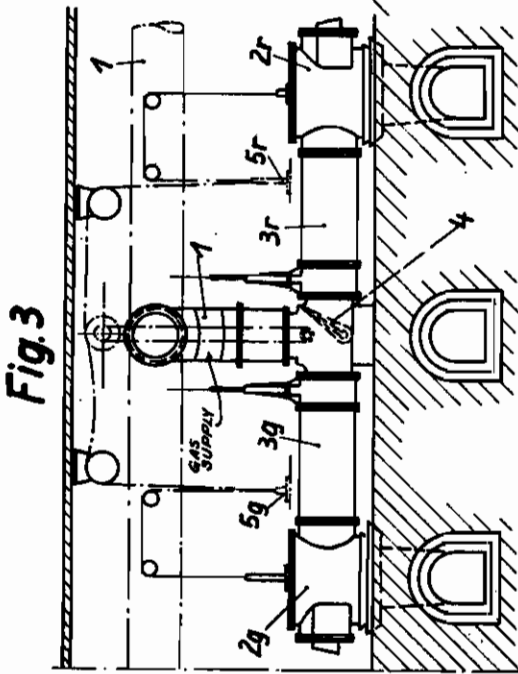
GAS FOR USE IN CONNECTION WITH INDUSTRIAL

FURNACE PLANTS OPERATING WITH ALTERNATING

GAS AND AIR CURRENTS

2 Sheets-Sheet 2

Filed March 9, 1940



Inventor
OTTO REINER

By *Francis E. Byer*

Attorney

ALIEN PROPERTY CUSTODIAN

COMBINED REVERSING METHOD AND REVERSING DEVICE FOR THE HEATING GAS, THE AIR AND THE WASTE GAS FOR USE IN CONNECTION WITH INDUSTRIAL FURNACE PLANTS OPERATING WITH ALTERNATING GAS AND AIR CURRENTS

Otto Reiner, Rheinhausen-Nrh.-Hochemmerich, Germany; vested in the Alien Property Custodian

Application filed March 9, 1940

This invention relates to an improved method, as well as to an improved device, for reversing the heating gas current, the air current and the waste-gas current, also for supplying the air, this method and device being intended for use in connection with industrial furnace plants operating with alternating gas and air currents.

It is already known to shut-off the heating gas current prior to the reversal of the furnace by means of disk-valves, throttle flaps or slide-valves in order to prevent chimney losses during the reversal. This manner of operating causes, however, an increase of the pressure in the gas conduit so that other furnaces connected up to the same gas conduit receive too large amounts of the gas, of which, therefore, a part escapes in unburnt state through the chimney because of the want of air. Besides, any combustion of gas in the upper furnace ceases when the heating gas current is shut-off, in consequence whereof no smoke gases for producing a draught in the chimney are generated, whereby the upper furnace is sucked empty during this time and cold air (false air) finds access into the upper furnace and the heating chambers. The consumption of heat units for compensating that drop of temperature is, besides, still larger than the consumption due to the loss of heating gas, in consequence whereof the losses of chimney gas cannot be wholly prevented by a prior shutting-off of the heating gas current.

It is furthermore, known to reverse, while the furnace is being reversed, first the heating gas current and thereafter the air current in order to attain separate sucking-off of the current of the return gas and the current of the return air through the chimney so that no explosions in the chimney flue can occur. This procedure suffers, however, from the drawback that the combustion of the gas in the furnace side having been heated up to then does not uniformly cease and that after the reversal of the furnace the gas and the air do not uniformly escape whereby a substantial extent of the fusing time and an increased gas consumption is entailed.

The object of the present invention is to obviate the above-mentioned disadvantages of the former reversing methods and devices by an improved method and an improved device in which the gas supplied to the furnace is continually deflected without any loss of gas by the chimney conduit and without any throttling or shutting-off. A characteristic feature of the invention is that while carrying out the reversing procedure first the abstraction of the waste-gases from the

gas chamber of that furnace side which up to then had been in connection with the discharge chimney through said chamber, as well as through the appertaining air chamber, is interrupted and thereafter the waste-gases from said furnace side are sucked away solely through the air chamber until the reversing has been finished, this sucking taking place in an increased degree relatively to the preceding sucking; thereafter, the supply of air also to the furnace side having been heated up to then is interrupted so that the air supply to both furnace sides is shut-off in the common air conduit; simultaneously therewith the reversal of the supply of the heating gas to, and the withdrawal of the waste-gas from, the two furnace sides, as well as the supply of air to the furnace side now to be heated, are effected with such a small delay relatively to the supply of the heating gas to this furnace side that the current of air and the current of waste-gas meet one another at the burning place of this furnace side which is now to be heated so that in the moment in which the reversal has been finished the correct heating of the furnace side in question takes place at once.

With this improved method the supply of gas to the furnace takes place, thus, uninterruptedly so that after the reversal of the gas current the smoke gases present in the regenerative chambers of the furnace side having been heated up to then are pressed into the upper furnace during the interruption and can be sucked away through the chimney, whereupon only then, in that moment in which the heating gases enter into the furnace, also the supply of the air into the upper furnace takes place; thus, just in the proper moment.

Another advantage which the present improved method presents is that owing to the continuous supply of the gas smoke gases effecting the sucking action in the chimney are likewise continuously available for the same so that the chimney is never able to suck in cold air (false air) into the upper furnace and into the heating chambers, whereby equally high temperatures in the upper furnace are attained.

Still another advantage presented by the improved method is that the supply of the gas and of the air to the furnace side having been heated up to then ceases proportionally and the escape of the gas and the air after the furnace reversal at the burner take place simultaneously so that neither an oxidising, nor a reducing combustion of the heating gases occurs, nor is an excess of gas or of air pressed to the upper furnace.

Finally, also the advantage exists that the return air current coming from the air generator chambers is sucked off through the chimney separately from the return gas current coming from the gas generator chambers, the gas and the air being simultaneously reversed, whereby any possibility of the occurrence of an explosion is completely prevented.

The improved method is carried out preferably by means of the improved device forming likewise a part of the present invention and being illustrated diagrammatically and by way of example on the accompanying drawings on which Figure 1 shows a plan of this device, Figure 2 a section in the plane II—II of Fig. 1; Fig. 3 a section in the plane III—III of Fig. 1, and Figure 4 a section in the plane IV—IV of Fig. 1.

In this constructional form of the device it is assumed that the shutting-off members are formed by disk valves combined with a water seal, but I wish it to be understood that instead of disk valves also valves of another design, as well as other suitable shutting-off members, may be used without affecting the method in any manner.

In said figs. is, furthermore, assumed that the right-hand side of the furnace plant with its reversing device, or reversing members respectively, which side comprises the gas chamber Gr and the air chamber Lr, is connected up to the conduit K which, in turn, is connected up to the chimney, whereas the gas chamber Gg of the left-hand furnace side is supplied with heating gas and the air chamber Lg of said side with compressed air.

I (Fig. 3) denotes the common gas supply conduit below which is arranged a change-over flap 4 located between the branch pipes 3g and 3r which terminate at the heating gas reversing valves 2g and 2r, the said flap 4 shutting-off in the position shown in Fig. 3 the communication between the conduit 1 and the pipe 3r. The valve 2r is closed, whereas the valve 2g is open. In the conduit leading from the gas chamber Gr to the chimney is arranged a disk valve 5r and in the conduit leading from the gas chamber Gg to the chimney is arranged a valve 5g. In the position of these valves as shown the valve 5r is open and the valve 5g closed. In the common air supply pipe 6 which leads to the air chambers Lr and Lg is arranged a throttle flap 7 at the place shown in Figs. 1 and 4. When this flap is turned from the position shown in Figs. 1 and 4, in which it is open, into the other position in which it is closed the supply of air to the air chambers of both sides of the furnace will be interrupted.

In the pipe leading from the common air supply pipe 6 to the air chamber Lr is arranged a valve 8r, and in the pipe leading from said pipe to the air chamber Lg is arranged a valve 8g. Furthermore, a valve 9r is arranged in the pipe connecting the air pipe Lr with the chimney, and a valve 9g is arranged in the pipe connecting the air pipe Lg with the chimney. In the position of the several members mentioned the valve 8r is closed and the valve 8b open, whereas the valve 9r is open and the valve 9g closed. There is, therefore, in these positions of these valves the left-hand side of the furnace heated, whereas the right-hand side of the same communicates with the chimney through the gas chamber Gr, as well as through the air chamber Lr.

If now the supply of gas and of air to the furnace shall be reversed, first an electromotor (not shown) is started in known manner and rotated with such a low speed that the valve 5r is slowly

lowered and at the same time the valve 2r is opened. The valves 5r and 2r are connected with one another by a rope, and as the valve 5r is heavier than the valve 2r the valve 5r will lift the valve 2r when it is lowered. Owing to the slow movement of the valve 5r the communication between the gas chamber Gr and the chimney will slowly interrupted and when the valve 5r has been completely closed the waste gases will be sucked off from the right-hand side of the furnace still through the air chamber Lr, this sucking off of the gases from the right-hand side of the furnace through the air chamber Lr taking place more strongly than the gases had been sucked off prior thereto through the air chamber Lr.

After the valves 2r and 5r have been reversed, the change-over flap 4 is suddenly turned over by means of a motor provided for it, and simultaneously therewith also the throttle flap 7 in the air pipe is suddenly turned over by an electromotor or any other known electromagnetic implement into its closing position as shown in Fig. 4 so that from this moment also the air supply to the air chamber Lg is interrupted and, thus, none of the two furnace sides receives air. From the moment of the reversal of the shutting-off devices 4 and 7 the heating gas is supplied on the right-hand side of the furnace into the gas chamber Gr but, which is essential, no air is supplied any more to the air chamber Lg of the left-hand side of the furnace whereby is obviated that unburnt air, viz. false air, enters into the upper furnace through the air chamber Lg of the left-hand side of the furnace and conducts oxygen to the molten steel, the quality of which would be deteriorated thereby.

Besides, by shutting-off the air supply by means of the shutting-off device 7 the effect is attained that no cold air is pressed into the chimney flue whereby the draught in the chimney would be reduced.

After the position of the change-over flap 4 has been reversed and the shutting-off device 7 has been closed, the electromotor pertaining to the valves 8r and 8g are started whereby the valve 8r will be opened and the valve 9r will be closed and also the valve 8g will be opened and the valve 9g closed. There are, thus, all valves engaged in the air supply reversed at the same time.

When this has been effected the shutting-off device 7 located in the blast conduit is again opened and either simultaneously therewith or a moment thereafter the position of the valves 2g and 5g is reversed wherewith the reversing procedure will be completed.

From the moment of the re-opening of the shutting-off device 7 air flows to the right-hand furnace side, viz. into the air chamber Lr, and the reversal of the air supply takes place relatively to the reversal of the gas supply by the opening of the valve 2r which such a delay (preferably a regulable one) that in that moment in which heating gas arrives at the burning place of the right-hand furnace side also the air arrives at said place so that now the heating of this side of the furnace commences without solely gas or solely air being pressed into the right-hand side of the furnace. This is rendered possible by the circumstance that the way on or through which the gas passes to the furnace is longer than the way on or through which the air passes from the reversing device to the furnace, so that, for instance, 25 seconds will elapse between the points of time at which the flap 4 is turned over and the gas arrives at the place of burning, whereas only 15 seconds will elapse from

the point of time at which the shutting-off device is again opened, so that 15 seconds are available for the reversal of the air supply.

When the above described reversing procedure has been finished, the right-hand side of the furnace is now being heated, whereas the left-hand side of the same is connected with the chimney through the air chamber *Lg* and the opened valve *9g*, as well as through the gas chamber *Gg* and the opened valve *5g*.

The provision of a separate shutting-off device *7* for the temporal interruption of the supply of air, instead of effecting this interruption by stopping the fan producing the compressed air, establishes the means for the proper design of the reversing device, as stopping and starting a fan requires by far too much time.

A reversing device suited for carrying out the present improved reversing method can be designed, it is true, also without a change-over flap, such as *4*, but a thus modified construction would operate less advantageously. With such a modified construction the driving device for the several valves must be so designed that (starting again from the position of the valves as in Fig. 1) first the valve *5r* is lowered whereupon first of all waste-gas is sucked away from the right-hand side of the furnace only through the air chamber *Lr*. Then the gas valves *2r* and *2g* are reversed which causes the reversal of the gas supplied to the furnace, and simultaneously with the movement of said valves the supply of air is interrupted by the shutting-off device *7*, whereafter the further reversing procedure takes place practically in the same manner as above described, the only exception being that, as the valve *2g* is being closed already while the valve *2r* is being opened, only the valve *5g* need be opened in the moment in which the reversal of the air is being finished.

It is, under circumstances, also possible to do without the separate shutting-off device, but the control device must then be so designated that after the gas valve *2r* has been opened, first the air valve *8g* is closed, and only then the other valves are reversed, so that, with this reversing procedure, the supply of air to the two furnace sides is likewise stopped for a certain period of time. The procedure entails the necessity that the reversal of the valve *8g* is in lead of the reversal of the valves *9r*, *9g* and *8r*.

I am describing hereinafter the complete reversing procedure with a plant lacking a change-

over flap, such as *4*, and a shutting-off device, such as *7*.

After a push-button switch (not shown) has been actuated, first the shutting-off member *5r* is closed, whereby the waste-gas current flowing from the gas chamber *Gr* to the chimney *K* is interrupted. The entire amount of the waste-gas is sucked away through the air chamber *Lr*. Now the following shutting-off members are moved simultaneously, viz. the valve *2r* is opened and the valves *2g* and *8g* are closed, whereby the gas current is continually deflected from the left-hand side of the furnace to the right-hand side thereof. As the valves *2g* and *8g* have been closed at the same time, the combustion of the gas in the left-hand side of the furnace ceases proportionally, whereby neither an oxidising combustion, nor a reducing combustion of the heating gas can arise. The supply of air to the furnace is interrupted in that the shutting-off member *8g* is closed. This interruption of the supply of air must take place in that the air chamber, counter to the gas chamber, is filled earlier by about 15 seconds. Now the shutting-off members *9r* and *9g* are likewise moved at the same time and with equal transverse sections, the member *9r* being closed and the member *9g* opened, whereby the waste-gas current is deflected from the air chamber *Lr* to the air chamber *Lg*. The entire amount of the waste-gas is sucked away by the chimney through the air chamber *Lg* and simultaneously therewith the return air of the air chamber *Lg* is sucked away together with the waste-gas flowing to the chimney, whereby is prevented that the return air comes in contact with the return gas from the gas chamber *Gg* and, therefore, no ignition in the chimney flue can occur. Thereafter the shutting-off member *8r* is opened by the intermediary of a time relay and the current of air is thereby released with a certain delay so that the burner head is fed with gas and with air at the same time. Hereafter also the shutting-off member *5g* is opened whereby the current of gas will be liberated as soon as the return air still present in the air chamber *Lg* has been completely sucked away by and through the chimney, there being simultaneously therewith also the return gas still present in the gas chamber *Gg* sucked away. All this having been accomplished, the furnace is reversed and operates with continual supply of gas and continual withdrawal of waste-gas in known manner.

OTTO REINER.