The invention relates to blower valves of blast furnaces. As is well understood, the ordinary blast furnace has one or more uptakes connected to the interior of the furnace below the charging bell, and extending upwardly above the top of the furnace. These uptakes serve as take-off means for the furnace gases. They are interconnected usually by a manifolding have a downcomer for conducting the furnace gases to a solids separator and thence to a gas washer.

The tops of the uptakes are provided with blower valves which are either manually or automatically operated for the purpose of relieving sudden pressure excesses. The gases issuing from a blast furnace are at high temperature and have large quantities of abrasive solids entrained in them, and are referred to herein by the term "dirty gases." The blower valves have a comparatively short life. When a valve is opened, there is a rush of abrasive laden gases through the valve opening so that the members providing the valve seat and the valve tappet tend to be cut and scored. When the valve is again closed, the cutting and scoring permits leakage of the gases. Once a blower valve begins to leak, the cutting action proceeds very quickly while the valve is closed due to the erosive effect of the abrasive materials entrained in the dirty gases. In modern blast furnaces operating on high top pressures, the cutting action is increased.

It is an object of the invention to provide a means and method for prolonging the useful service life of dirty gas blower valves and for minimizing leakage.

It is an object of the invention to provide a mode of operating the dirty gas blower valves which will very greatly prolong their service life.

It is an object of the invention to minimize leakage from dirty gas blower valves, not only by reducing the wear which has been described above, but also by providing, in one of the aspects of the invention, a sealing action which tends to close leakage orifices previously formed.

These and other objects of the invention which will be set forth hereinafter, or will be apparent to one skilled in the art upon reading these specifications, are accomplished by that structure and arrangement of parts of which certain exemplary embodiments will now be described.

Reference is made to the accompanying drawings wherein:

FIG. 1 is a top plan view of one form of blower valve.
FIG. 2 is a vertical sectional view thereof.
FIG. 3 is a vertical sectional view of another type of blower valve.
FIG. 4 is a diagrammatic view of the top portion of a blast furnace including uptakes, gas handling equipment including a solids separator and a gas washer, and a means for returning clean gas to the blower valves.

In FIG. 2 the upper end of an uptake is indicated at 1. The blower valve proper includes a bowl-shaped casting 2 having at the top a cast element 3 of annular form which serves as a valve seat. A shaft 4 is journaled in brackets 5 and 6 on the bowl; and it will be seen from FIGS. 1 and 2 that this shaft bears centrally a lever arm 7 which is connected to a valve disc or tappet 8. One end of the shaft 4 carries a lever arm 9 counterweighted as at 10 and provided at its opposite end with an operating cable 11. Within the bowl 2 there are guide elements 12 for the movement of the tappet 8.

It will be noted that the valve shown in FIGS. 1 and 2 is an inwardly opening valve. It must be operated by the cable 11 whenever relief of pressure is desired; and as is well known in the art, the operation can be accomplished either manually or by automatically acting means.

Another form of valve is shown in FIG. 3. This valve also has a bowl 13 located at the top of an uptake 14. There is a superstructure 15 on the top of the bowl, which provides support for a bracket 16, and which also carries a cast iron valve seat 17. The valve in this instance is an outwardly opening valve comprising a tappet 18 lying above the valve seat 17. An operating lever arm 19 is pivoted to the bracket 16 and also to a valve stem 20. The lever arm 19 is counterweighted as at 21 to hold the valve closed; and it will also be provided with an operating cable, not shown.

It is frequent in valves of this type to provide an inner bell-shaped valve guide 22 attached to the tappet. The bowl provides guides 23 for the valve bell which, in turn, keeps the valve tappet in alignment with the seat and which also tends to control the direction of the flow of gases through the valve. The type of valve shown in FIG. 3 is one which can act automatically to relieve the pressures above a certain value within the uptake, as determined by the counterweighting of the lever arm 19.

Other types of blower valves can be used, but the types shown in FIGS. 1, 2 and 3 are exemplary. It will be seen that when the tappet is opened in either type of valve, the rush of "dirty" abrasive laden gases through the space between the valve tappet and the valve seat will tend to cut, score and abrade both of these elements, with the result that leakage will develop. Thereupon, as explained above, the cutting action becomes channelled and is excessive, when the valve is closed, at the places where the leakage occurs, so that the valve seats and tappets have to be replaced at comparatively short intervals.

The primary objectives of this invention are attained by introducing into the bowl elements 2 and 13 such quantities of "clean" gas, i.e., gas free of abrasive entrainment, as to keep the dirty gases out of the bowl and away from the valve seat and tappet when the valve is closed. When a valve is opened to reduce the pressure within the furnace, dirty gases will issue to the atmosphere through the valve. But the introduction of clean gas into the bowl is a continuous operation, and as soon as the valve is again closed, the dirty gases will be swept out of the bowl and downwardly in the uptake. If some leakage has developed between the valve tappet and the valve seat, clean gases only will issue from the leakage openings because the clean gases are supplied to the bowl in sufficient volume to take care of such leakage. Thus, because the clean gases are substantially free from abrasive entrainment, the leakage openings will not tend to grow in size.

The gases introduced into the bowl may be from any available source of clean, compatible gas. By "compatible gas" is meant any gas which will not attack the apparatus elements or the furnace lining, and which will not react exothermically with the furnace gases. Thus, nitrogen, argon or the like can be used; but cost must be considered. The gas should be non-oxidizing. The introduction of air, for example, would create an explosion hazard. In both FIGS. 2 and 3 there is indicated a gas inlet conduit 24 and 25 having a control valve 26 or 27.

One source of clean compatible gas can be the furnace gases themselves after they have gone through a solids separator and a gas washer. In FIG. 4 there is shown diagrammatically a blast furnace 28 having uptakes 29 and 30 equipped with blower valves 32 and 31. The manifold mentioned above is indicated at 33, carrying the
furnace gases to a downcomer 34 which delivers them to a solids separator 35 of the usual type. The gases from the solids separator are carried by a conduit 36 to a gas washer 37; and the bulk of the treated furnace gases will be carried by a conduit 38 to places of use as is conventional in blast furnace design. Air is supplied to the pipe 39 which carry some of the clean gases back to the bleeder valves 31 and 32, as will be evident from the figure. A booster pump 40 must be included in the conduit 39 to raise the pressure of the clean gases to a value which is at least somewhat greater than the top pressure of the furnace.

It has been found also that steam from any available source serves excellently as a clean gas for introduction into the bowls of the bleeder valves. As has been indicated, the clean gas should be introduced into the bowl elements in such quantity as to keep the dirty gases from the furnace swept out of the bowl. This is easy to accomplish with clean gases having substantial pressure when the conduits 24 and 25 are of relatively small size, but the gas pressure and conduit size should be so related as to supply a sufficient volume of gas for the purposes herein set forth. The inflow of the clean gases is adjusted by the valves 26 and 27 so that the bowl is kept filled with the clean gases. The adjustment is not critical beyond the point just mentioned, because any excess gases so introduced will pass downwardly through the uptakes and downcomer and mingle with the furnace gases. As a consequence, while specific instructions cannot be given a general principle may be adopted: namely, the valves and the conduits 24 and 25 will cause these will vary with circumstances including size of the bleeder valve elements, the top pressure of the furnace, and other factors, a reasonably high pressure of the clean gas is desirable as minimizing the size of the conduits. By way of non-limiting example, steam, available at 150 p.s.i., has been employed with a 1½ in. diameter conduit 24. The actual adjustment is not difficult to accomplish. If the valve is leaking, the introduction of clean gas can be controlled until only clean gas is issuing from the leakage openings, as can be visually determined. In the case of a valve having a new tappet and seat, a condition of leakage can be simulated by slightly opening or “cracking” the valve.

The use of steam, however, has been found to have an additional and important advantage. There will be some small amount of condensation of the steam adjacent the valve parts, and the condensed moisture will tend to form any accumulation of abrasive substances adjacent or between the coating parts into a sort of sludge cake, the effect of which is to seal off leakage at the coating valve surfaces. Any excess moisture condensed in the valve presents no problem since it will pass downwardly in the uptakes to the furnace gas take-off point, be revaporized, and pass out of the system with the furnace top gases.

Even where other compatible gas is mainly employed for the purposes of this invention, the advantages of the caking action hereinabove described may be attained by mixing some steam with the other compatible gases, or by introducing some steam separately into the bleeder valve bowl.

It has been found that the use of the invention herein described sharply reduces the cutting action on the bleeder valve seat and tappet, and very greatly increases the useful life of these elements. Additionally, in the last mentioned phase of the invention, leakage is to all intents and purposes stopped, even though the disc and seat are cut and scored.

Modifications may be made in the invention without departing from the spirit of it. The invention having been described in certain exemplary embodiments, what is claimed as new and is desired to be secured by Letters Patent is:

1. In a blast furnace having at least one uptake for dirty gas, a dirty gas bleeder valve in connection with said uptake having a body, a valve seat, and a valve tappet at the upper end of said body, means for opening said valve, and a means opening into said body for introducing clean compatible gas into said body, said compatible gas being free of abrasive entrainment, in such quantity as to keep said valve body filled with said compatible gas during periods of time in which said valve remains in the closed position.

2. In a process of operating a blast furnace having bleeder valves, said bleeder valves each comprising a body, a valve seat, and a valve tappet, said body being located at the top of an uptake, the improvement comprising introducing into the body of the valve below said seat and tappet continuously a compatible gas free from entrainment of abrasive solids in such quantity as to keep dirty furnace gases swept out of said body at least when said valve seat and tappet are in the valve-closed position.

3. The process claimed in claim 2 wherein said compatible gas is steam.

4. The process claimed in claim 2 wherein said compatible gas is gas derived from a blast furnace, which gas has been freed from abrasive entrainment.

5. The process claimed in claim 2 in which said compatible gas is a mixture of steam and another gas free from abrasive entrainment.

6. The structure claimed in claim 1 wherein said means for introducing clean, compatible gas into said body is a means for introducing steam from a suitable source of supply.

7. The structure claimed in claim 1 wherein said means for introducing clean compatible gas into said body is a means for introducing top gases from said blast furnace, which top gases have been freed from solid particles, the said apparatus assembly including a booster pump for increasing the pressure of said top gases.

References Cited by the Examiner

UNITED STATES PATENTS

704,556 7/02 Meehan 266—26
903,425 11/08 Witting et al. 266—31
1,333,494 3/20 Haig 266—31
2,408,945 10/46 Mohr et al. 266—27
2,385,800 2/52 Le Viseur et al. 266—31 X

FOREIGN PATENTS

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