H. C. WOLLE & J. V. SYMONS.

BLAST FURNACE APPARATUS.

APPLICATION FILED NOV. 19, 1910.

992,838. Patented May 23, 1911.

Fig. 3.

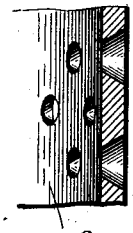


Fig. 1.

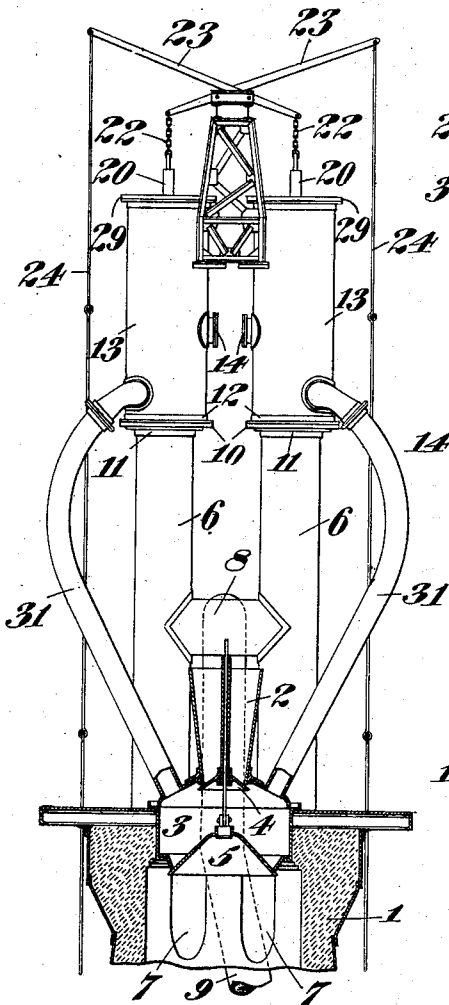
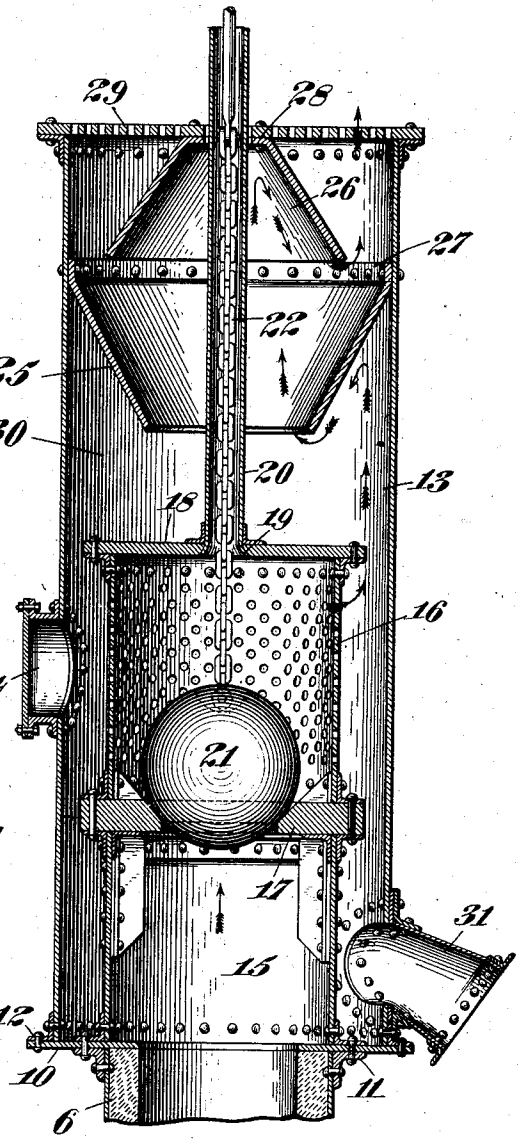


Fig. 2.



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UNITED STATES PATENT OFFICE.

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BLAST-FURNACE APPARATUS.

992,838. Specification of Letters Patent. Patented May 23, 1911.

Application filed November 19, 1910. Serial No. 593,129.

To all whom it may concern:

Be it known that we, HARTLEY C. WOLLE and JOHNSON V. SYMONS, citizens of the United States, residing in the borough of Westmont, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Blast-Furnace Apparatus; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to apparatus adapted for use in connection with the blow-off pipes of blast furnaces and the like, with particular reference to what are known as the bleeders or bleeder-pipes of a blast furnace, which are ordinarily mounted on the top thereof for the purpose of discharging excess or waste gases, etc., therethrough.

Although we may adapt our apparatus for use in other connections, we will herein, for the sake of simplicity of description and illustration, confine ourselves to its application to the bleeder-pipe of a blast furnace.

In operating a blast furnace it frequently occurs that the interior and top portion thereof are subjected at times to excessive pressures of the gases, etc., contained therein, which is produced by slips or other causes. To protect the structure of the blast furnace from these excessive pressures, which are sometimes of explosive character, it has been customary to provide explosion doors around the top of a blast furnace, or large relief valves on top of the bleeder-pipes which automatically open under excess of pressure, thus permitting the discharge of the gases to the atmosphere and reducing the internal pressure in the furnace. When an excess of pressure of an explosive character takes place, this also frequently results in discharging from the furnace, a considerable quantity of coke, ore, limestone, or other materials comprising the charge, thus endangering life and leading to considerable expense by waste of materials, and by the labor required to partially recover the same. The rapid discharge of the gases under pressure also causes a loud, roaring noise which continues until the pressure within the furnace has become reduced to such an extent as to allow the valves to close, and this frequently extends over a considerable period of time. The roaring noise is not only annoying to the workmen and others in the neighborhood, also disturbing necessary conversations, giving of signals, instructions, etc., but is dangerous for the reason that while it continues, it is impossible to hear any other sounds, and there are certain dangerous occurrences around blast furnaces that can only be detected by the noise-warning thereof.

One of the objects of our invention is to provide an apparatus for use in connection with a blast furnace, or with the bleeder or blow-off valves thereof, whereby the sound resulting from the rapid discharge of the gases will be eliminated or reduced to the minimum.

Another object of our invention is to prevent the discharge of the ores, coke, limestone and other portions of the charge, due to excess of pressures, or explosions in the furnace.

The ordinary bleeder-pipes and explosion doors as now constructed give free and substantially direct access from the interior of the furnace to the outer air, thereby permitting the discharge thereto of portions of the furnace charge together with the excess gases, whereas our apparatus only permits the escape of excess gases, while returning the ejected solid portions of the furnace charge to the interior of the furnace.

With these objects in view we have provided an apparatus which is simple and economical of construction and one that satisfactorily overcomes the objectionable features of prior practice hereinbefore mentioned.

Referring now to the sheet of drawings forming part of this specification and in which like characters of reference indicate like parts:—Figure 1 is a central vertical cross-sectional elevation of the top of an upright blast furnace showing the bleeder-pipes and our apparatus in elevation thereon. Fig. 2 is a vertical central section of our apparatus mounted on the top of a blast furnace bleeder pipe. Fig. 3 is a vertical section of a portion of the perforated pipe 16 showing our preferred form of conical or countersunk perforations therein.

Referring to the various characters of reference on the drawings:—1 indicates the upper part of an upright blast furnace such as is used for smelting iron ores, etc.; 2 is the upper distributing hopper; 3 is the lower

or charging hopper; 4 is the upper or distributing bell, and 5 is the lower or charging bell.

Two bleeder-pipes are indicated by 6, the interiors of which are directly connected with the interior of the top of the blast furnace through the elongated openings 7.

A cross pipe or connection between the bleeder-pipes 6 is shown at 8 to which latter is connected the usual gas pipe or downcomer 9.

In Fig. 1 of the drawings two bleeder-pipes are shown, although in this form of construction and arrangement two others are used symmetrically disposed on the opposite side of the furnace, but we may use any number of bleeder-pipes as may be readily understood, but for ease of description we will refer to our apparatus in connection with only one of said pipes.

The bleeder-pipe 6 is provided with a plate 10 secured to the bleeder shell by means of an angle ring 11 as shown, this plate also serving as the base plate of our apparatus and connected to the shell 13 thereof by means of angles or angle rings 12. The base plate 10 is provided with a central hole registering with the opening in the bleeder-pipe and our apparatus mounted thereon is preferably of greater cross-sectional area than that of the bleeder-pipe.

The outside casing or shell 13 of our apparatus is provided with a cleaning-hole or man-hole 14 and a removable cover therefor as shown.

15 is the lower inlet pipe section of our apparatus preferably of diameter and cross-sectional area less than the outer shell or casing 13, the upper end of said pipe 15 being provided with a partial closure comprising the disk or plate 17 having an opening and valve seat therein of diameter somewhat less than that of the pipe 15. On top of the disk 17 is mounted a perforated pipe section 16 of approximately the same diameter as that of the pipe 15, the perforations in said pipe 16 being either cylindrical holes as shown in Fig. 2, or, in order to avoid dust accumulation, are countersunk on the exterior as shown in Fig. 3 to allow any dust deposited on the lower surface thereof to be discharged outwardly into the annular space between said perforated pipe 16 and the exterior casing 13. 18 is another disk mounted on the upper end of the perforated pipe 16 and secured thereto as shown, said disk having a small central hole 19 therethrough in which is secured a pipe 20 extending upwardly therefrom for the purpose of providing a passage for the flexible connection 22 of the ball valve 21 which latter normally rests in the seat therefor provided in the disk 17.

23 are levers of usual construction connected with the valve 21 by the flexible connections 22, the other end of said levers being provided with operating-rods 24 which extend downward to the base of the furnace or other convenient location for hand or mechanical operation.

Within the outer shell or casing 13 and near the upper portion thereof, we provide a lower baffle 25 composed of an inverted hollow conical frustum, the lower opening thereof being preferably of somewhat smaller area than the cross-section of the pipes 15 and 16 and mounted above same is an upper baffle 26 comprising a smaller hollow conical frustum, the upper end of which, however, is substantially closed as indicated, these two baffles forming a pair. The lower baffle 25 is secured to the outer shell 13 by means of its flanges 27, and the upper baffle 26 is secured to the top perforated plate 29 by means of the flanges or flattened upper portions 28. The top plate 29 forms the upper portion of our apparatus through the perforations of which the gases finally issue to the atmosphere. Within the outer shell or casing and surrounding the baffles is the so-called dead-air space 30, while 31 represent down-pipes or chutes connecting the lower interior portions of the shell or casing of our apparatus with the lower or charging hopper of the blast furnace, whereby the dust or other materials accumulating in the casing of our apparatus are discharged into the furnace.

Although we have shown our apparatus with a hollow cylindrical shell or casing and with other portions of cylindrical cross-section, we may make these of square, rectangular, oval or other shapes, as expedient or desired, and we may also omit certain portions and may vary the number, position and arrangement of the various parts.

The operation of our apparatus is as follows:—The apparatus having been mounted on a blast furnace, or the bleeder or blow-off pipe thereof, the ball valve 21 is usually at rest on its seat, thereby closing this communication between the interior of the blast furnace and the outer air during such times when the interior pressure of gases is normal. If, however, a slip or slight explosion takes place within the furnace, thereby causing excess of pressure, the ball valve 21 is lifted thereby and the gases then flow through our apparatus in the directions as indicated by the arrows in Fig. 2. Those portions of the disk 17 which project inwardly over the edges of the pipe 15 will serve to stop the movement of the solid particles of the charge which impinge against them and thereby cause the same to drop back into the furnace, this portion and the valve itself thus acting as deflectors. Similarly, any large particles which may be projected through the openings in the disk 17,

will be stopped by the upper disk 18 or the sides of the pipe 16, and will ordinarily drop back into the furnace through the opening in said disk. Similarly, particles of dust which may issue through the perforations of the pipe 16 will, in a large measure, settle to the bottom of the annular space between the pipes 15 and 16 and the outer shell or casing 13, and after this accumulates to a certain extent, gravity will cause the downward movement of said dust particles through the pipe 31 whence they will be discharged into the lower charging hopper 3 of the blast furnace and thence, in due course of operation, into the furnace again. During the continuance of excess of pressure in the blast furnace, the ball valve 21 will continue to remain open and the gases will escape around the same into the pipe 16, where, by reason of the whirling action and expansion, a portion of their energy and velocity will be dissipated, after which the gases pass through the perforations in the pipe 16 into the annular space between same and in the outer shell 13, whereby a change of direction and another expansion is occasioned, after which, passage is made into the dead-air space 30 with still further expansion and lessening of velocity, and issue thence into the annular space of triangular section between the exterior of the conical frustum 25 and the outer shell and are there deflected downward and through the opening in the lower portion of said conical frustum, after which part of the gases impinge against the interior surface of the upper baffle 26 and are then deflected downward and outward into the space surrounding the same, and finally pass to the outer atmosphere through the perforations in the top plate 29. By this time the energy and velocity of the gases are largely dissipated, causing thereby gradual and quiet flow into the outer air, while the solid particles and a considerable proportion of the dust is projected downward and returned to the blast furnace through the pipes 15 and 31 as hereinbefore mentioned.

The ball valve 21 is made of such weight that it remains closed when the interior pressure in the furnace is normal, but is raised from its seat when the pressure becomes excessive.

When, for any reason, the apparatus is to be used as an ordinary bleeder, the ball valve may be raised by pulling down on the operating-rod 24, and the apparatus will quietly discharge the gases and return the dust to the furnace, and on releasing the rod, the valve will seat itself by gravity and stop the flow.

Although in our apparatus we have shown only one pair of baffles composed of hollow conical frusta, we may use two or more pairs of these, as desired, and may also omit the upper perforated plates or other parts, if expedient.

Although we have shown and described our invention in considerable detail, we do not wish to be limited to the exact and specific details shown and described, but may use such substitutions, modifications or equivalents thereof as are embraced within the scope of our invention and pointed out in the claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:—

1. The combination with a blast furnace, of an apparatus mounted thereon comprising a tubular casing having an inlet of smaller cross-sectional area, a relief valve mounted on said inlet, the interior of said casing being provided with one or more baffles and an outlet beyond the same, whereby the gases which pass therethrough, are subjected to eddying, contraction and expansion, thereby lessening the energy and velocity thereof.

2. The combination with a blast furnace, of an apparatus mounted thereon comprising a tubular casing having an inlet of smaller cross-sectional area, an automatic relief valve mounted on said inlet, a tube of approximately the same diameter as said inlet mounted above and surrounding said valve, said tube having an upper closure, and side perforations communicating with the interior of said casing, one or more baffles positioned beyond said tube, whereby the gases which pass therethrough, are subjected to eddying, contraction and expansion, thereby lessening the energy and velocity thereof.

3. The combination with a blast furnace, of an apparatus comprising a tubular casing having an inlet of smaller cross-sectional area, an automatic relief valve mounted on said inlet, a tube of less diameter than said casing mounted above and surrounding said valve, said tube having an upper closure with side perforations communicating with the interior of said casing, one or more baffles positioned within said casing, beyond said tube, whereby the gases which pass therethrough, are subjected to eddying, contraction and expansion, thereby lessening the energy and velocity thereof.

4. In an apparatus of the character described, a tubular casing, having an inlet pipe of smaller cross-sectional area, a valve, mounted on said inlet, and provided with means for lifting the same, the interior of said casing beyond said valve being provided with one or more baffles; and an outlet beyond said baffles, whereby the gases which pass through said apparatus are subjected to eddying, contraction and expansion, thereby lessening the energy and velocity thereof.

5. In apparatus of the character described, a tubular casing having a pipe inlet of less

cross-sectional area mounted therein, a top closure for said inlet comprising a plate or disk having a hole therethrough of less diameter than said inlet, an automatic relief valve mounted in and above said opening, and one or more baffles within said casing beyond the valve aforesaid, whereby the gases which pass through said apparatus are subjected to loss of energy and velocity thereof, and the solid particles which impinge against the lower surface of said disk and valve are deflected backward whence they came.

6. The combination with a blast furnace, of a tubular casing having an inlet pipe of less cross-sectional area mounted therein at the base thereof, a top for said inlet comprising a plate or disk having an opening therethrough of less diameter than said inlet, an automatic relief valve mounted above said plate in said opening, one or more baffles within said casing beyond the valve aforesaid, and a down-pipe or chute connecting the lower portion of said casing with the blast furnace top; whereby the gases which pass through said apparatus are subjected to loss of energy and velocity, the solid particles which impinge against the lower surface of said valve and plate are deflected backward into the furnace, and the smaller solid particles are discharged from the casing to the furnace through the down-pipe or chute aforesaid.

7. In apparatus of the character described, a tubular casing having an inlet pipe of less cross-sectional area mounted therein near the base thereof, a top for said inlet comprising a plate or disk having an opening therethrough of less diameter than said inlet, an automatic relief valve mounted above said plate in said opening, a baffle located within said casing beyond the valve aforesaid consisting of an inverted hollow conical frustum, another baffle beyond the same consisting of an oppositely disposed, smaller, hollow, conical frustum with closed top, whereby the gases which pass through said apparatus are subjected to loss of energy and velocity.

8. The combination with a blast furnace of an apparatus of the character described, comprising a tubular casing having an inlet pipe of less cross-sectional area mounted therein near the base thereof, a top for said inlet comprising a plate or disk having an opening therethrough of less diameter than said inlet, an automatic relief valve mounted above said plate in said opening, a pair of baffles located within said casing beyond the valve aforesaid consisting of an inverted hollow conical frustum, and another oppositely disposed, smaller, hollow, conical frustum with closed top, a down-pipe or chute connecting the lower interior portion of the shell with the top of the blast furnace; whereby the gases which pass through said apparatus are subjected to loss of energy and velocity, and both the large and small, solid particles are returned whence they came.

9. The combination with the bleeder-pipe of a blast furnace, of an apparatus mounted thereon comprising a tubular casing having an inlet pipe of less cross-sectional area mounted therein near the base thereof, a plate or disk mounted on said inlet and having an opening therethrough of less diameter than the inlet pipe aforesaid, an automatic relief valve mounted above said plate in said opening, a baffle located within said casing beyond the valve aforesaid, consisting of an inverted hollow conical frustum, another baffle beyond the same consisting of an oppositely disposed, smaller, hollow, conical frustum with closed top, an upper plate secured to the top of said casing and provided with perforations through which the gases finally pass into the atmosphere, meanwhile being subjected to loss of energy and velocity in said apparatus.

10. In apparatus of the character described, a tubular casing having an inlet pipe of less cross-sectional area mounted therein near the base thereof, a plate or disk mounted on said inlet and having an opening therethrough of less diameter than said inlet pipe, an automatic relief valve mounted above said plate and within said opening, a tube of less diameter than said casing mounted within the same above and surrounding said valve, the said tube having an upper closure and side perforations communicating with the interior of said casing, a baffle located within said casing beyond the tube aforesaid consisting of an inverted hollow conical frustum, another baffle beyond the same, consisting of an oppositely disposed, smaller, hollow, conical frustum with closed top, whereby the gases which pass through said apparatus are subjected to loss of energy and velocity.

11. In apparatus of the character described, a tubular casing having an inlet pipe of less cross-sectional area mounted therein near the base thereof, a plate or disk mounted on said inlet and having an opening therethrough of less diameter than the said inlet pipe, an automatic relief valve mounted above said plate and within said opening, a tube of less diameter than said casing mounted within the same above and surrounding said valve, the said tube having an upper closure and side perforations communicating with the interior of said casing, a baffle located within said casing beyond the tube aforesaid consisting of an inverted hollow conical frustum, another baffle beyond the same, consisting of an oppositely disposed, smaller, hollow, conical frustum with closed top, a top plate mounted on said casing and provided with perforations there-

through, whereby the gases which pass through said apparatus are discharged into the atmosphere, meanwhile being subjected to loss of energy and velocity within said apparatus.

12. The combination with a blast furnace of an apparatus of the character described, a tubular casing having an inlet pipe of less cross-sectional area than the same and mounted therein near the base thereof, a plate or disk mounted in said inlet and having an opening therethrough of less diameter than said inlet, an automatic relief valve mounted above said plate in said opening, a tube of less diameter than said casing mounted within the same above and surrounding said relief valve, said tube being closed at its top and provided with side perforations communicating with the interior of said casing, a baffle located within said casing beyond the tube aforesaid, consisting of an inverted hollow conical frustum, another baffle beyond the same consisting of an oppositely disposed, smaller, hollow, conical frustum with closed top, a down-pipe or chute connecting the lower interior portion of said casing with the top of the blast furnace, all so arranged and adapted that the gases which pass through said apparatus are subjected to loss of energy and velocity, and the solid particles carried thereby are returned whence they came.

13. The combination with a blast furnace, of an apparatus mounted thereon comprising a tubular casing of comparatively large cross-sectional area, an inlet pipe, near the base thereof, of less cross-sectional area, an automatic relief valve mounted within an opening at the upper end of said inlet pipe, a series of baffles positioned within said casing, and a down-pipe or chute connecting the lower end of said casing with the interior of the blast furnace, whereby the gases passed through said apparatus are subjected to eddying, contraction and expansion, thereby lessening the energy and velocity thereof, and the solid particles carried thereby are returned whence they came.

14. The combination with a blast furnace, of an apparatus mounted on the bleeder-pipe or outlet thereof, comprising a tubular casing of larger area than said bleeder-pipe, said casing having an inlet of smaller cross-sectional area, an automatic relief valve mounted on said inlet, a tube of less diameter than said casing mounted above and surrounding said valve, said tube having an upper closure and provided with side perforations communicating with the interior of said casing, one or more baffles within said casing beyond said tube, and a down-pipe or chute connecting the lower portion of said casing with the blast furnace charging hopper, all so adapted and arranged that the gases which pass through said apparatus are subjected to eddying, contraction and expansion; thereby lessening the energy, velocity, carrying capacity and noise thereof, and returning the solid and dusty particles to the blast furnace.

In testimony whereof we hereto affix our signatures in the presence of two witnesses.

HARTLEY C. WOLLE.
JOHNSON V. SYMONS.

Witnesses:
ELMER SEAVEY,
ROBERT A. BEERS.