

Sept. 24, 1940.

H. W. JOHNSON

2,215,879

BLAST FURNACE BELL

Filed Aug. 29, 1938

2 Sheets-Sheet 2

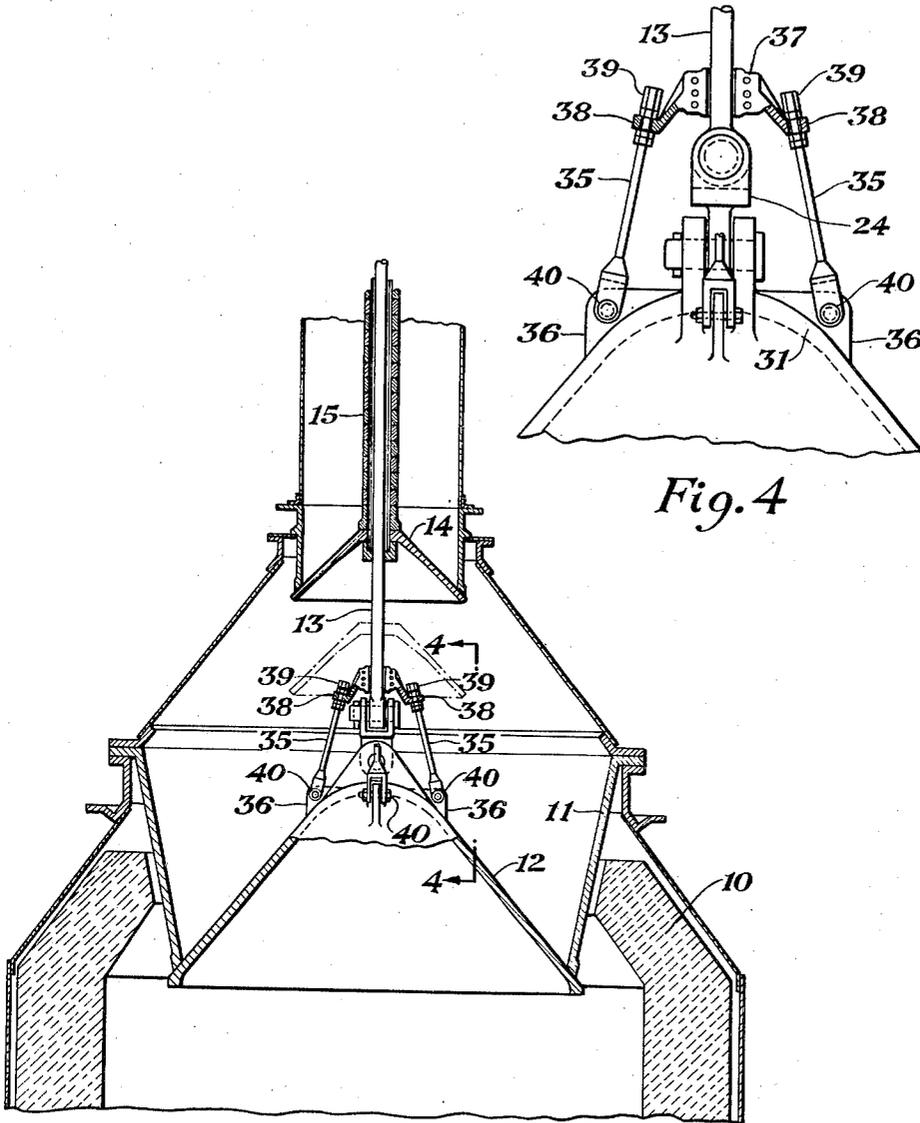


Fig. 4

Fig. 3

INVENTOR.
Hjalmar W. Johnson
BY
William H. Byrnes & Dwight
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,215,879

BLAST FURNACE BELL

Hjalmar W. Johnson, Chicago, Ill.

Application August 29, 1938, Serial No. 227,297

7 Claims. (Cl. 214—36)

The present invention relates to improvements in blast furnace bells.

It is common in blast furnace construction to provide a pair of bells in series, usually called the large bell and the small bell. The general purpose of these bells is to permit the introduction of solid materials into the furnace without permitting the escape of gas. The solid materials should be introduced into the furnace in such a way as to distribute them uniformly when they reach the interior of the furnace. If this is not done, the furnace operation suffers both from the standpoint of daily production and the standpoint of economy and ease of operation.

Heretofore, it has been customary to mount the large bell in a way which permits said large bell to swing. The reason for this is that occasional violent conditions in the top of a blast furnace, such as a "slip" or heavy surge of gas, may cause lateral movement of the bell; or the bell may be very unevenly loaded with solid materials for delivery into the blast furnace, and this unbalance of weight may tend to move the large bell laterally. According to prior constructions, if the bell is rigidly connected to its supporting rod, a tendency toward lateral movement of the bell would be liable to cause the bending of the supporting rod of the large bell.

The swinging suspension above referred to, has the advantage that the large bell is permitted to swing under the influence of lateral stresses, thereby preventing the bending of the supporting rod for said bell. However, in swinging, the large bell loses one of its very important functions, to wit, the even distribution of the charge into the furnace. In some cases where rigidly suspended bells have been used, the results have been the bending of the supporting rod.

An object of the present invention is to provide a bell suspension which is normally rigid but which can revert to the flexible or double-link suspension type under stresses which might tend to bend the supporting rod for the bell or otherwise jeopardize the bell rigging.

A further object is to provide a supporting means for a blast furnace bell which has the advantages of a rigid suspension in so far as load distribution is concerned, but which is permitted to swing when stresses are encountered that might bend the supporting rod for said bell.

A further object is to provide a bell suspension well adapted to meet the needs of commercial operation.

Other objects will appear as the description proceeds.

Referring to the drawings—

Figure 1 is a vertical sectional view of the top of a blast furnace illustrating one embodiment of the present invention.

Figure 2 is a sectional view taken along the plane indicated by the arrows 2—2 of Figure 1.

Figure 3 is a sectional view illustrating a modified construction; and

Figure 4 is a sectional view taken along the plane indicated by the arrows 4—4 of Figure 3.

The numeral 10 indicates the wall of a blast furnace, at the top of which is the hopper 11 having a lower surface adapted to cooperate with the large bell 12. Said large bell 12 is supported by the rod 13. Coaxially disposed relative to the large bell is a small bell 14, which small bell is supported by the tube 15. The supporting rod 13 and the tube 15 may be independently operated by mechanisms not shown.

Supported from the underside of the small bell 14 is the bearing 16, carried by a plurality of struts 17 united to the underside of the small bell 14. Said bearing 16 is spaced below the apex of the small bell 14 and serves to guide the supporting rod 13.

The lower end of the supporting rod 13 for the large bell is forged out rather broadly to a flat section indicated by the numeral 18. A hole 19 is provided in said flat section 18, which hole carries a transverse suspension pin 20. Said suspension pin 20 may be provided with the head 21 at one end thereof and may be slotted adjacent to its other end for the reception of a locking key 22. The flat section 18 of the supporting rod 13 is disposed between the two upper ears 23—23 of a clevice-like yoke 24. Said ears 23—23 are provided with apertures for the reception of the transverse suspension pin 20, which pin 20 serves to swingingly couple the yoke 24 to the supporting rod 13. A sufficient amount of play for such swing should be provided for between the bottom of the supporting rod 13 and the top of the yoke 24 between the ears 23—23.

The yoke 24 is provided with a downwardly extending ear 25 on its under side. The ear 25 extends in the same direction as the axis of the pin 20. In other words, said ear 25 is disposed at right angles to the upper ears 23—23 of said yoke 24. Said ear 25 is provided with aperture 26 for the reception of the lower suspension pin 27. Said lower suspension pin 27 is provided with a head 28 and is slotted adjacent to its opposite ex-

tr extremity for the reception of a locking key 29. Said downwardly extending ear 25 of the yoke 24 is disposed between two lugs 30—30 which form part of a bracket 31 rigidly connected with the upper part of the large bell 12.

The construction thus far described provides a double-link bell suspension with the wide flat section 18 swingingly disposed between the ears 23—23 of the yoke 24 and with the downwardly extending ear 25 of the yoke 24 swingingly disposed between the upstanding lugs 30—30 rigid with the large bell 12.

In order to prevent undesired lateral movement of the large bell 12, yieldable means are provided for preventing such movement of the large bell except when forces are encountered of a magnitude which might bend the supporting rod 13. For this purpose, shear bolts or pins 32—32 are provided which extend through the flat section 18 and the ears 23—23 in positions parallel with the axis of suspension pin 20. Also, shear bolts 33—33 are provided which extend through the downwardly extending ear 25 of the yoke 24 and through the upstanding lugs 30—30 of the bracket 31. Said shear bolts or pins 33—33 are disposed in substantially parallel relationship with the axis of the lower suspension pin 27. Said shear bolts or pins should be made of rather brittle material, such as brittle steel. They will ordinarily prevent any swinging action of the yoke 24 with respect to the supporting rod 13 or of the bell 12 relative to the yoke 24, but should there be a violent action such as a surge of gas in the top of the furnace when the large bell is in lowered position, or in the process of raising or lowering the bell, or should there be a greatly unbalanced load on the bell, or should there be any other condition which would tend to tilt the bell and thereby bend the supporting rod 13, the brittle shear bolts or pins 32—32 and/or the brittle shear bolts 33—33 will snap and allow the large bell 12 to swing, thereby avoiding the bending of the supporting rod 13.

In order to promote the functions of the shear bolts 32 and 33, the holes for receiving said bolts, instead of being cylindrical, can be tapered inwardly from both sides of the ears 23—23, the flat section 18, the lugs 30—30 and the downwardly extending ear 25. Broken lines indicated by the numeral 34 in Figure 2 show the construction referred to. By reason of such construction, the shear bolts 32—32 and 33—33 fit tightly only near the half-depth of the flat section 18, the ears 23—23, the downwardly extending ear 25 and the upstanding lugs 30—30. By reason of this construction, the failure of the shear bolts is provided for not only by reason of a strong shearing action but by reason of a bending action as well. Furthermore, this construction permits the broken shear bolts to be removed and replaced readily, whereby rigid conditions may be re-established.

By reason of the construction illustrated, the large bell 12 is suspended rigidly under all normal conditions but is permitted to revert to a flexible suspension under heavy stresses to prevent damage.

The construction illustrated in Figures 3 and 4 is similar in many respects to that described above in connection with Figures 1 and 2, but differs from the construction of Figures 1 and 2 in that the shear bolts 32—32, 33—33 are omitted and in their stead clevice bolts 35—35 are provided. Said clevice bolts 35—35 are swingingly

supported on brackets 36—36 rigidly secured to the upper extremity of the large bell 12. A plurality of said clevice bolts 35—35 are provided, spaced around the axis of the supporting rod 13. Disposed in encircling relationship with the lower extremity of the supporting rod 13 above the flat section 18, is the split collar 37 having outwardly extending arms 38—38. Said arms 38—38 are provided with apertures for receiving said clevice bolts 35—35. Nuts 39—39 are provided for the upper extremities of the clevice bolts 35—35, which nuts will be turned down to a point whereby the clevice bolts 35—35 will hold the large bell 12 in rigid relationship with the supporting rod 13. The upper extremity of the large bell 12 will be provided with a bracket 31 similar to that illustrated in Figures 1 and 2, which bracket will cooperate with the yoke 24 and the supporting rod 13, as illustrated in Figures 1 and 2.

The clevice bolts 35—35 are secured to the brackets 36—36 through shear bolts or pins 40—40 which, in general, will conform to the description given above of the shear bolts 32 and 33. The shear bolts 40—40 will break when the large bell 12 is subjected to excessive stresses tending to swing said bell in the lateral direction, after which the bell may swing, thereby avoiding the breaking of the supporting rod 13.

The bearing 16 functions to prevent excessive swing of the supporting rod 13. Even though the large bell 12 be rigidly connected with the supporting rod 13, a considerable swing can occur, due to the bending of the supporting rod 13, unless means are provided for stopping such bending. In other words, according to prior constructions, no matter how rigidly the large bell and its supporting rod may be connected together, the large bell has been able to swing through a considerable arc, thus bringing about a very uneven distribution of material within the furnace. The incorporation of the bearing 16, attached to and extending downwardly from the lower side of the small bell 14, is effective in steadying the large bell.

Though certain embodiments of the present invention have been described in detail, many modifications will appear to those skilled in the art. It is intended to cover all such modifications that fall within the scope of the appended claims.

What is claimed is:

1. In combination, a blast furnace bell, a supporting rod therefor, means connecting said bell with said supporting rod adapted to permit swinging of said bell laterally with respect to the axis of said rod under predetermined conditions, and means for preventing such swinging movement, said means adapted to fail when predetermined lateral stresses are applied to said bell.

2. In combination, a blast furnace bell, a supporting rod therefor, a member supported by said rod, said member being swingable relative to said rod under predetermined conditions, means for connecting said member to the upper extremity of said bell, said bell being swingable relative to said member under predetermined conditions, the direction of swing of said member relative to said rod being at right angles to the direction of swing of said bell relative to said member, breakable pin members for preventing the swinging of said member relative to said supporting rod and for preventing the swinging of said bell relative to said member.

3. In combination, a blast furnace bell, a supporting rod therefor, a connection between said rod and said bell for permitting the swinging of said bell relative to said rod under predetermined conditions, and means for preventing said swinging, said means including members adapted to fail when a predetermined lateral stress is applied to said bell.

4. In combination, a blast furnace bell, a supporting rod therefor, means providing a connection between said rod and said bell, bolt means for holding said bell in nonswinging relationship with said supporting rod except under predetermined conditions, and shear bolts cooperatively associated with said bolt means, said shear bolts being adapted to fail when a predetermined lateral force is applied to said bell.

5. In a blast furnace bell installation, a bell, a supporting rod, means providing a hinged connection between said bell and said rod, and means including shear members for preventing swinging of said bell relative to said supporting rod except under predetermined conditions, said members being disposed in aligned holes in portions of said installation adapted under said conditions to have swinging relationship with each other, said members fitting said holes throughout only a portion of the length of said holes, whereby said members are subjected not only to shearing action but to bending action as well when stresses are applied tending to move one of said portions relative to the other of said portions.

6. In a blast furnace bell installation, in combination, means providing a connection between a blast furnace bell and the supporting rod therefor whereby said bell may swing relative to said rod under predetermined conditions, said means including spaced ears rigid with one of said members and an interposed tongue rigid with the other of said members, said tongue and ears having aligned holes, a shear bolt disposed within said aligned holes, said holes being so shaped that said bolt fits said holes throughout only a portion of the length of said holes, whereby when bending stresses are applied tending to cause relative movement between said ears and said tongue, said bolt will be subjected not only to a shearing stress but to a bending stress as well.

7. In a blast furnace installation, in combination, a large bell, a small bell, a supporting rod for said large bell extending through said small bell, and a bearing for said supporting rod disposed below said small bell and carried by said small bell, said supporting rod having a hinged connection with said large bell whereby said large bell under predetermined conditions is capable of swinging laterally with respect to said supporting rod and means for holding said large bell against swinging movement with respect to said supporting rod except when a sufficient lateral stress is applied to said large bell to break said means.

HJALMAR W. JOHNSON.