This invention relates to an apparatus for operating a pair of blast furnace bells from a single bell beam.

High pressure operation of iron blast furnaces has made the problem of erosive wear due to leakage of dust-laden gases more troublesome, and the use of additional bells in the charging top has been proposed as a more effective seal against such leakage. To avoid further crowding of the available space at the top of the furnace, the top platform in particular, the desirability of operating an additional bell without adding an additional bell beam to the already over-crowded top platform is indicated. An object of this invention, accordingly, is to provide an apparatus which will render a single bell beam effective to operate a pair of bells.

Other objectives and advantages of the invention will become apparent from the following description and the accompanying drawings in which:

FIGURE 1 is a view, partly in elevation and partly in vertical section, showing a pair of blast furnace bells equipped with the operating apparatus of this invention;

FIGURE 2 is a fragmentary and somewhat diagrammatic view of a preferred embodiment of the motion transmitting mechanism of this invention;

FIGURE 3 is a view taken in a direction looking from the of FIGURE 2 which shows the manner in which one of the cable sheaves of the motion transmitting mechanism is suspended from one of the bell beam hangers; and

FIGURE 4 is a side elevation view of the bell beams that are used to operate the bell beam hangers shown in FIGURE 1.

The top charging apparatus shown in the drawings comprises the usual large hopper 1 and large bell 2 for feeding stock to an iron blast furnace 3. The bell 2 is suspended from the lower end of a bell rod 5 which has a yoke 6 at its upper end that is connected by laterally spaced hangers in the form of cables 7 for operation by a large bell beam 8. Operation of the beam 8 controls the downward movement of the bell 2 to open position for releasing stock in the hopper 1 for gravitation into the furnace 3 and its upward movement to the closed position shown in the drawings.

Such apparatus further includes a revolving hopper 9 which is operated to feed the furnace stock materials to the large hopper 1. Movement of the stock from the revolving hopper 9 into the large hopper 1 is controlled by a small bell 10 which is suspended from a lower end of a tubular bell rod 11 and is shown in its upper or closed position seated against the lower edge of revolving hopper 9. The upper end of the bell rod 11 is rotatably suspended on a yoke 12 which has end portions 13 that are connected in a manner to be described with a pair of laterally spaced bell beam hangers 14. The upper ends of the hangers 14 are connected by cables 15 to a small bell beam 16 on the charging platform (not shown) at the top of the furnace. The beam 16 operates to control the downward opening movement of the small bell 10 from the closed position shown in the drawings to release the stock in the revolving hopper 9 for movement into the large hopper 1. The stock is delivered to the revolving hopper 9 by a skip hoist and a receiving hopper (not shown) that is mounted concentrically with respect to the bell rods and in the space between the hopper 9 and small bell yoke 12.

An intermediate bell 20, spaced vertically below the small bell 10, provides a seal against leakage of gas from the large hopper 1. In its upper or closed position, as shown in the drawings, the bell 20 seats against the bottom of a flange 21 that projects downwardly from the upper end of a gas sealing hood 22 over the hopper 1. The bell 20 is suspended from the lower end of a tubular bell rod 23 that is arranged concentrically between the large bell rod 5 and the small bell rod 11 and has an operating yoke 24 at its upper end. The yoke 24 is spaced vertically above the small bell yoke 12 and has opposite end portions or arms 25 that are parallel to the similar arms 13 of the yoke 12 to provide for connection to the operating mechanism of this invention in a manner to be described. The small bell beam 16 operates to control movement of the bell 20 downwardly from the closed position shown in solid lines to its open position shown in dotted lines and its return movement to closed position.

As indicated above, this invention provides for operation of two blast furnace bells from a single bell beam. The apparatus for this purpose comprises a motion transmitting mechanism of the type designated by the letter A in FIGURE 1 or the type designated by the letter B in FIGURE 2. Each of the mechanisms A and B provides for operation of the small bell 10 and the gas sealing bell 20 to and from their closed positions by the small bell beam 16. More specifically, each of the mechanisms A and B renders operation of the small bell beam 16 in a clockwise direction as viewed in FIGURE 4 effective first to move one of the bells 10 or 20 to its closed position, to thereafter move the other of such bells to its closed position, and finally to distribute its upward closing force between both of such bells. To effect this operation of the bells 10 and 20, the mechanisms A and B each provide in a manner to be described for relative vertical movement of the bells 10 and 20 with respect to each other and with respect to the hanger elements 14.

The motion transmitting mechanism A is a mechanical linkage system that comprises a pair of equalizing links 26 that are suspended respectively by central pivotal connections 27 from the lower ends of the bell rod hangers 14. Adjacent ends of the equalizing links 26 have pivotal connections 28 with the upper ends of small links 29 that are connected at their lower ends by pivots 30 to the outer ends of the yoke arms 25 for operation of the intermediate bell 20. The opposite ends of the equalizing links 26 have pivotal connections 31 to the upper ends of large links 32, the lower ends of which are connected by pivots 33 to the outer ends of yoke arms 13 for operation of the small bell 10. Stops 34 on the beam hangers 14 limit pivotal movement of the underlying equalizing links 26 to prevent their movement to a
vertical position when the bell beam 16 is operated to lower the bells 10 and 20 to their open positions.

When the bell beam 16 is operated to move the bells 10 and 20 upwardly to their closed positions, both bells will move upwardly until one moves into its closed position. Assuming that the bell 20 moves initially into seating engagement with the flange 21 and thus to its closed position in this manner, continued closing movement of the bell beam 16 will result in continued upward movement of the small bell 10 to its closed position in which it engages with the lower end of the revolving hopper 9. After movement of the bells 10 and 20 to their closed positions, the link 26 operates to distribute the closing force applied by the bell beam 16 between the bells 10 and 20 for holding them in their respective closed positions.

The mechanism B shown in FIGURE 2 operates in the same manner to move the bells 10 and 20 between their open and closed positions in response to operation of the small bell beam 16. For this purpose, and in place of the equalizing links 26 of the mechanism A, the mechanism B comprises a pair of equalizing cables 36 that have their central portions trained over equalizing sheaves 37. Each cable 36 has one end connected at 38 to the outer end of one of the arms 13 of the yoke 12 for actuation of the bell rod 11 and operation thereby of the small bell 10. The sheaves 37 are suspended from the lower ends of the bell hangers 14 by stirrups 40 which support them for rotation about spaced parallel and horizontal axes. In operation, the mechanism B, like the mechanism A, provides for relative vertical movement of the bells 10 and 20 with respect to each other and with respect to the beam hangers 14. Also in like manner, initial upward movement of the sheaves 37 by the hangers 14 will move both bells 10 and 20 toward their closed positions. Movement of one of such bells into its closed position serves as an anchor so that continued upward movement of the sheaves 37 will move the other of such bells to its closed position. Thereafter, the force supplied by the small bell beam 16 and the hanger rods 14 will be distributed by the equalizing action of the sheaves 37 and cables 36 between the bells 10 and 20 and will thus operate to hold both of such bells tightly in their respective closed positions.

While the above description of my invention has been shown and described it will be apparent that other embodiments and modifications may be made without departing from the scope of the following claims.

1. Apparatus for operating a pair of blast furnace bells between open and closed positions comprising a vertically movable bell beam hanger, and means for suspending both of said bells from said hanger for movement thereby to and from said closed position, said suspending means including motion transmitting means providing for relative movement of said bells with respect to each other and with respect to said hanger, said motion transmitting means operating upon movement of one of said bells by said hanger to its said closed position to render continued movement of said hanger effective to move the other of said bells to its closed position, and for thereafter distributing the closing force applied by said hanger to both of said bells.

2. A blast furnace bell operating apparatus as defined in claim 1 characterized by said transmitting and suspending means comprising a cable having opposite ends thereof operatively connected with said bells, a sheave over which said cable is trained, and means supporting said sheave on the said end of said hanger for rotation about a horizontal axis.

3. Blast furnace bell operating apparatus as defined in claim 1 characterized by said transmitting and suspending means comprising an horizontal equalizing link having a pivotal connection at a point intermediate its ends with said hanger, and a pair of vertical links having pivotal operating connections at their upper ends respectively with opposite ends of said equalizing link and at their lower ends with said bells.

4. Apparatus for operating a pair of blast furnace bells between open and closed positions comprising a motion transmitting means having spaced connections from which said bells are suspended, a vertically movable bell hanger, and means operating in conjunction with said motion transmitting means to support said bells on said hanger for movement thereby to and from said closed position, said motion transmitting means including means providing for relative movement of said bells with respect to each other and with respect to said hanger and operating in response to movement of one of said closed position to render continued upward movement of said hanger effective to move the other of said bells to its said closed position, said motion transmitting means being further effective after movement of both of said bells to closed position for distributing the closing force applied by said hanger between said bells.

5. In an apparatus for operating a pair of blast furnace bells comprising a centrally located bell yoke 12 for suspension thereon of said blast furnace bells, a pair of vertical links 26 having pivotal connections at their upper ends with said blast furnace bells, a pair of bell hangers 14 movable vertically in unison, of a pair of identical motion transmitting means connecting said hangers respectively with said bell yokes to suspend said bell hangers for movement thereby between open and closed positions, each of said transmitting means including means providing for relative vertical movement of said bell hangers with respect to each other and with respect to said blast furnace bells and operating in response to movement of one of said blast furnace bells by upward movement of said blast furnace bells to its closed position to render continued upward movement of said bell hangers effective to move the other of said blast furnace bells to its said closed position and for thereafter distributing the closing force applied by said bell hangers to both of said blast furnace bells.

6. A blast furnace bell operating apparatus as defined in claim 5 characterized by each of said motion transmitting means comprising a cable having opposite ends thereof connected to the said yokes on the upper ends of said bell rods, a sheave over which said cable is trained, and means supporting said sheave on one of said hangers for vertical movement therewith and for rotation about a horizontal axis.

7. A blast furnace bell operating apparatus as defined in claim 5 characterized by each of said motion transmitting means comprising an horizontal equalizing link having a pivotal connection at a point intermediate its ends with one of said hangers, and a pair of vertical links having pivotal connections at their upper ends with opposite ends of said equalizing link and at their lower ends with said bell yokes.

8. A common operating mechanism for a pair of vertically spaced blast furnace bells having concentric bell rods projecting upwardly therefrom comprising a pair of vertically spaced yokes secured respectively to the upper ends of said bell rods, said yokes being parallel and having horizontal end portions that project different distances in opposite directions from said bell rods, a pair of laterally spaced bell hangers movable vertically in unison and arranged respectively in positions vertically above said opposite yoke end portions, and identical motion transmitting means connecting each of said bell hangers respectively with said bell yokes to suspend said bell hangers for movement thereby between open and closed positions, each of said motion transmitting means having spaced connections with said horizontal yoke end portions at one of its ends and includ-
movement of one of said bells by upward movement of said hangers to its closed position to render continued upward movement of said hangers effective to move the other of said bells to its said closed position.

9. In an apparatus for operating a pair of blast furnace bells from a single bell beam, the combination with a vertically movable bell hanger connected for operation by said bell beam, of means suspending both of said bells from said hanger for movement thereby between opened and closed positions, said suspending means including means mounting said bells for movement with respect to each other and with respect to said hanger, and a motion transmitting connection between said bells operating upon upward movement of one of said bells by said hanger to its closed position and in response to continued upward movement of said hanger to move the other of said bells relative to said hanger and said one bell, and to thereby move said other bell to its closed position.

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