United States Patent

Schwerdtfeger et al.

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[54] **ADJUSTABLE IMPACT CASING FOR A SHAFT FURNACE**

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[51] **Int. Cl.**.....**F27b 1/12**

[58] **Field of Search** 263/29; 266/25, 31

[56] **References Cited**

UNITED STATES PATENTS

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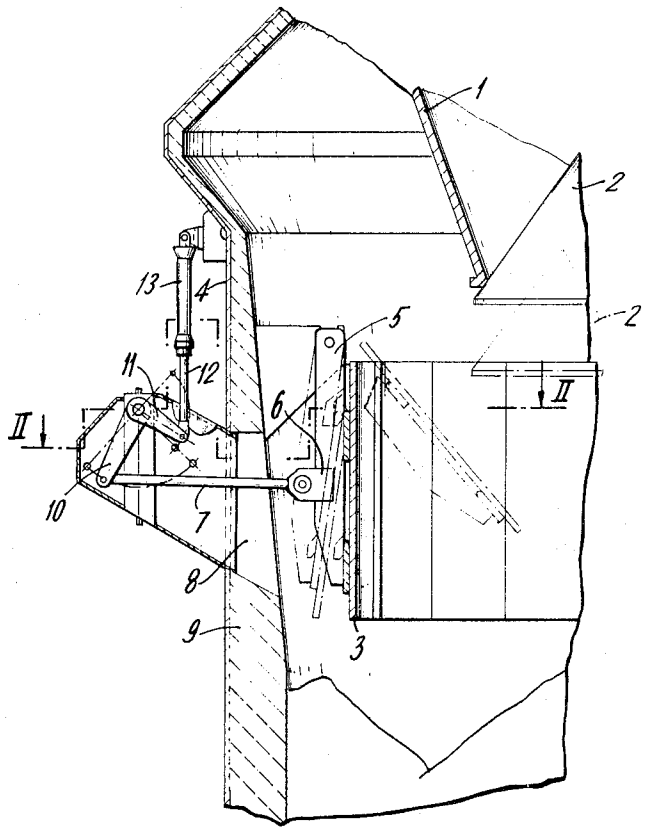
[57] **ABSTRACT**

An adjustable impact casing for use in a shaft furnace is formed of a plurality of upwardly extending segments. The segments are arranged into an inner circular row enclosed by an outer circular row. In each row, the segments are spaced angularly apart and are offset to the segments in the other row with their upwardly extending edges arranged in overlapping and substantially contacting relationship. The segments are pivotally supported about axes arranged transversely of the upright axis of the casing and the segments in the inner row are secured to one drive arrangement while the segments in the outer row are secured to another but similar drive arrangement. The two drive arrangements are controlled for moving the segments so that a time delay is provided between the movement of the segments in the inner row and the movement of the segments in the outer row.

6 Claims, 4 Drawing Figures



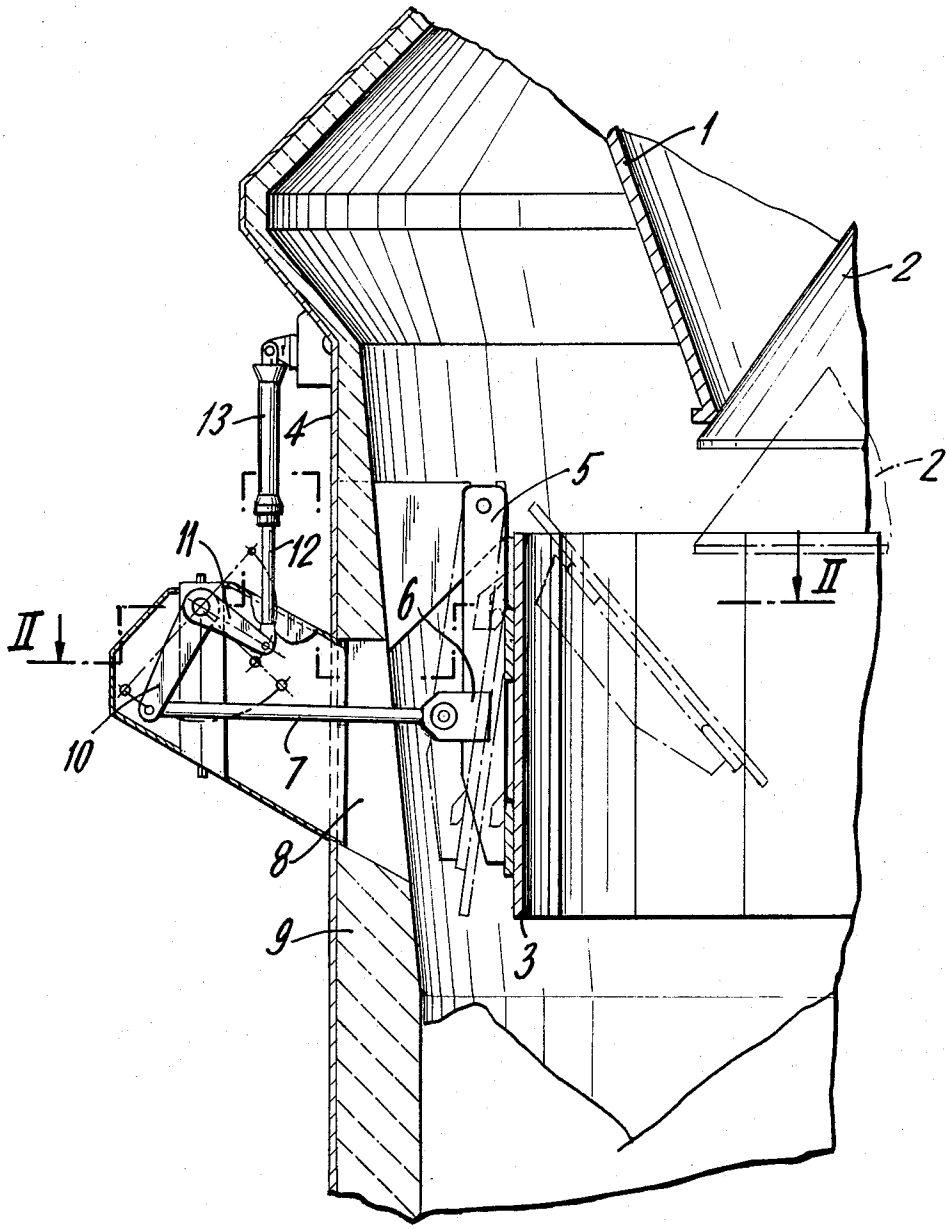


FIG. 1

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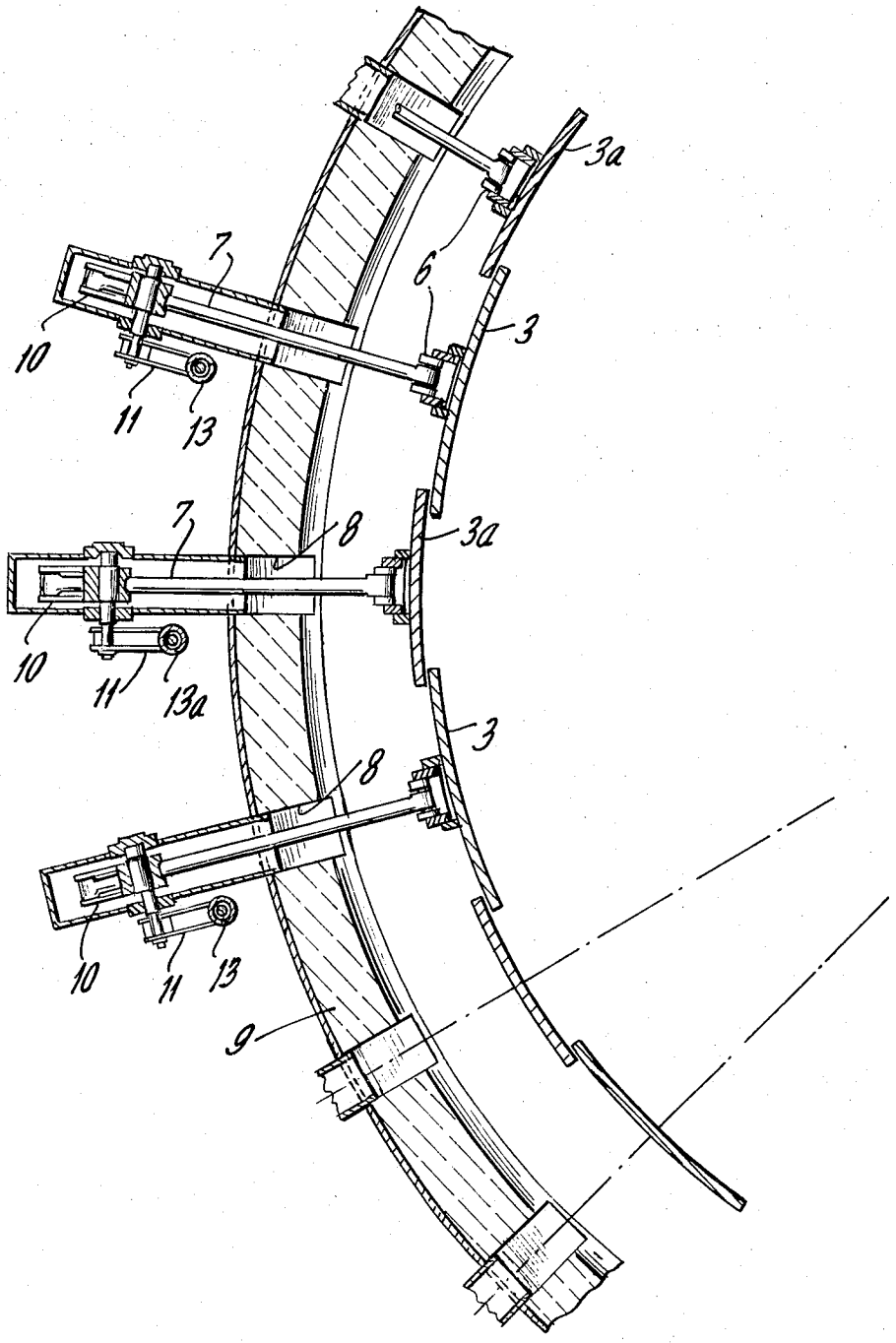

FIG. 2

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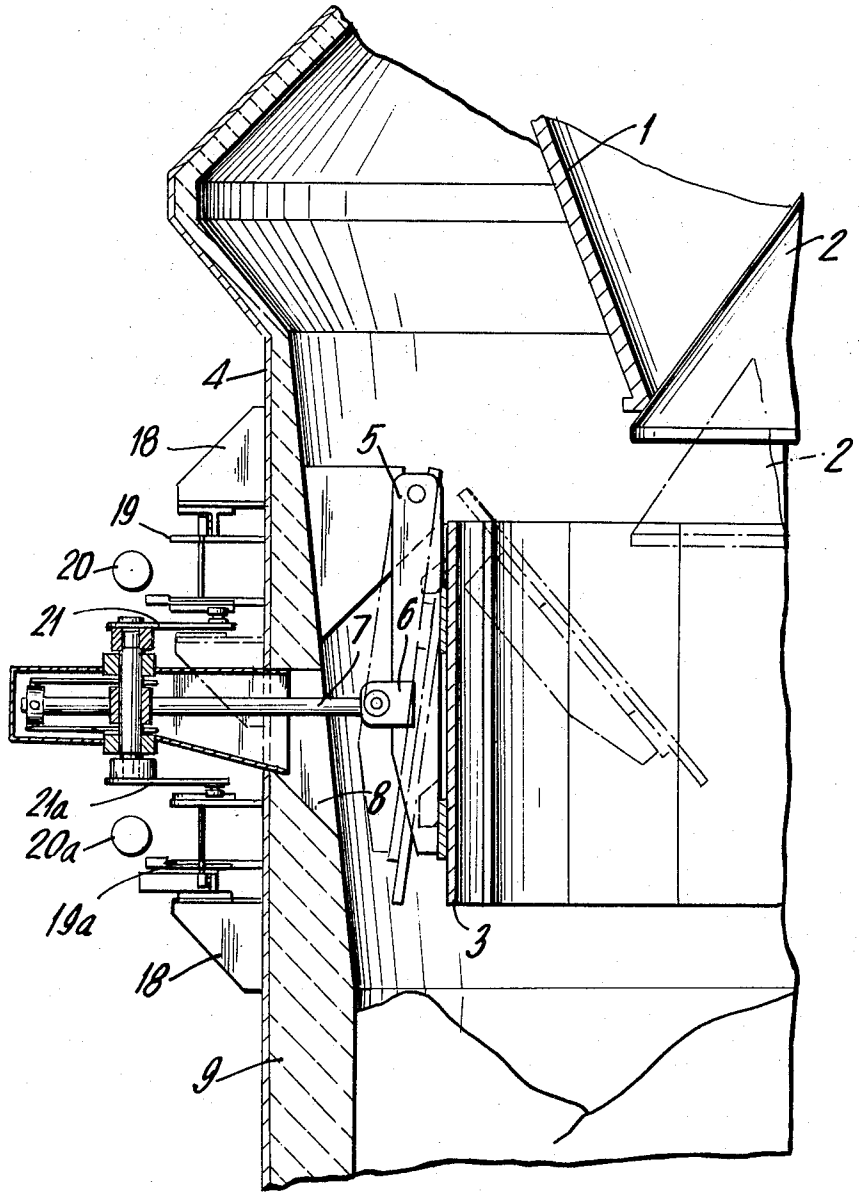

FIG. 3

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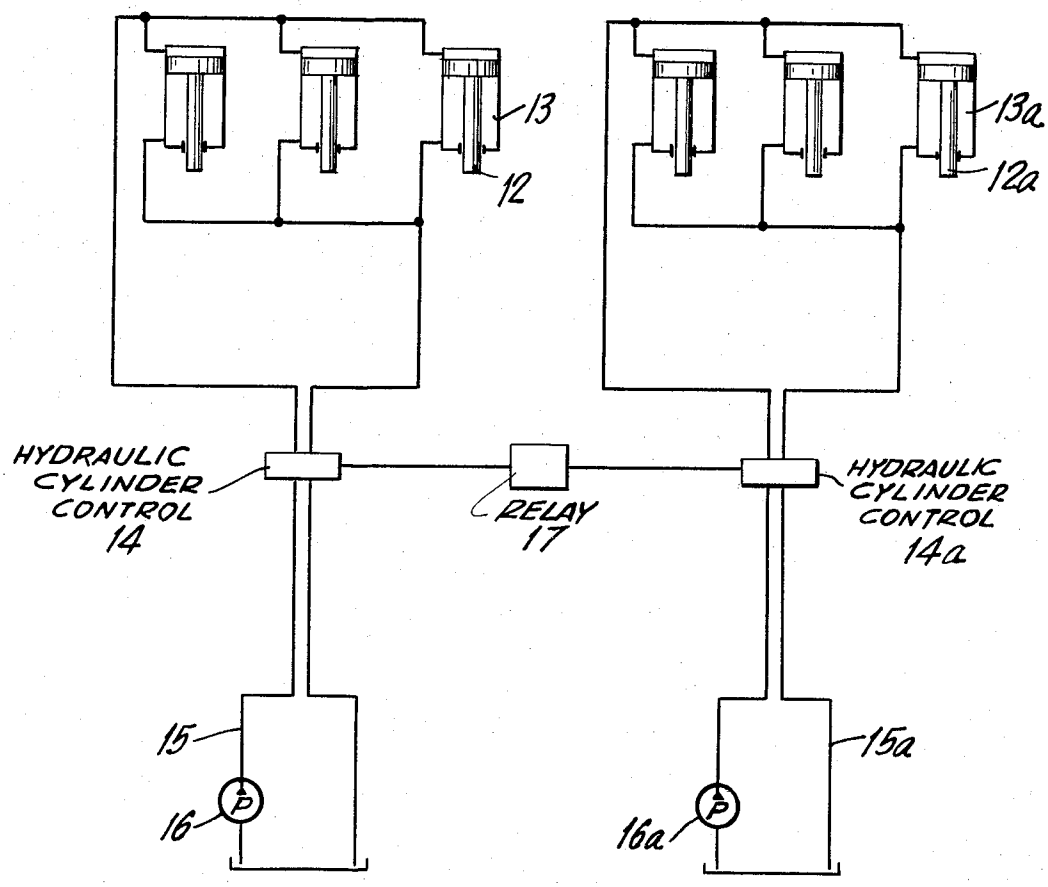

FIG. 4

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ADJUSTABLE IMPACT CASING FOR A SHAFT FURNACE

SUMMARY OF THE INVENTION

The present invention is directed to an adjustable protection or impact casing in a shaft furnace, particularly for use in blast furnaces, and, more especially, it concerns the arrangement of the casing made up of two circular rows of individual segments which are suspended for pivotal movement into a desired position.

In known arrangements of the impact or protection casing within shaft furnaces, the segments forming the casing are adjustable either individually or jointly. In such casings the segments can be adjusted to vary the diameter of the casing and the angular disposition of its surfaces so that the distribution of the furnace burden over the furnace cross section can be changed. The area that can be influenced, however, is small and involves essentially the annular area between the furnace wall and the outer edge of the furnace-top bell. In the circular area under the bell the distribution of the charge cannot be influenced. As a result, this space is filled in accordance with the slope angle of the materials charged into the furnace. As the size of furnace units become larger that portion of the area under the bell which cannot be influenced by the adjustable impact casing becomes increasingly larger relative to the total charge cross section in the furnace.

To overcome this drawback in adjustable impact casings, it might be suggested that the adjustment angle of the casing be simply increased, especially for use in large furnaces. With such an arrangement, the burden materials could be deflected into annular areas the diameter of which would be smaller than that of the furnace-top bell. However, difficulties are encountered with such wide angular adjustment ranges, since the segments of the casing are formed with a fixed radius. In adjusting the pivotally suspended segments toward the center of the furnace the radial clearance between the segments which overlap along their lateral edges, is decreased. To afford an adjustment of the segments over a wide range, in the position of the segments near the furnace wall the radial clearance must be increased as the range of adjustment is increased for the casing. In this regard the danger exists that the burden material may become jammed between the individual segments so that the adjustment of the casing is impeded. If the casing cannot be properly adjusted in position, then it will not be able to influence the charge in the furnace in the desired manner.

Therefore, it is the primary object of the present invention, to provide an adjustable impact casing such that the disadvantages mentioned above for casing segments formed with a fixed radius are eliminated and a relatively wide range of adjustment is afforded.

In accordance with the present invention, the segments forming the casing are arranged in an inner circular row located adjacent an outer circular row with the segments being controlled so that a time delay is provided between the segments in the inner row and in the outer row.

Based on this arrangement of the segments forming the casing, an inward adjustment can be made, first, by moving the segments in the inner row into the desired position and then moving the segments in the outer row. When the segments are displaced outwardly the positioning procedure is reversed. In this impact casing arrangement, a predetermined radial clearance between the segments in the inner row and outer row can be dispensed with, since in each position within the range of adjustment of the segments they can be arranged so that they meet or contact along their upright lateral edges. Accordingly, the difficulties experienced in the past in adjusting segments formed with a fixed radius are avoided, especially where a relatively wide range of adjustment is involved.

In this proposed arrangement, the segments within each of the rows can be operated individually or jointly, and controls of hydraulic, pneumatic or electrical types can be connected in combination with a time delay for moving the segments in one row before the segments in the other row can be moved. It is advantageous to connect the positioning drives for the segments of the inner row to one control unit and the positioning drives of the segments of the outer row to another control circuit and to interconnect the control circuits via a time-delay relay. As an alternative arrangement for positioning the segments, the individual positioning elements for each segment in one row can be connected to a ring-shaped member and the controls for the individual rings interconnected through a time-delay so that first the segments in one of the rows are positioned followed by the positioning of the segments in the other row.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a partial vertical cross sectional view of the top of a blast furnace incorporating the present invention;

FIG. 2 is a cross sectional view taken along the line II—II in FIG. 1;

FIG. 3 is a view similar to FIG. 1 but illustrating another embodiment of the invention; and

FIG. 4 is a schematic showing of the positioning arrangement in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In FIGS. 1 and 3, the upper part of a blast furnace is illustrated with an adjustable impact casing in accordance with the present invention. The charge is directed into the furnace through its throat 1 when the furnace-top bell 2 is lowered, note the closed position shown in full lines and the lowered or opened position shown in dot-dash lines. Based on the diameter of the casing and the angular disposition of its surface, the charge directed into the blast furnace is given a certain profile as indicated in FIGS. 1 and 3.

The impact casing is formed of an inner row of impact-resistant segments 3 having a fixed radius and an outer row of impact-resistant segments 3*a* of a fixed radius with the lateral upright edges arranged in overlapping relationship. As can be noted in FIG. 2, the

outer row of segments 3*a* is positioned contiguous to the inner row of segments. The fixed radius of the segments is determined based on the furnace radius for an intermediate position in the adjustment range of the segments.

Each of the segments 3, 3*a* is suspended within the shaft casing 4 of the blast furnace by means of rods 5 which are pivotally connected adjacent their upper ends of the inner surface of the shaft casing. On the outwardly facing side of the segments a mounting member 6 is positioned and a push rod 7 is connected to each mounting 6 in a pivotal manner. Furnace wall 9 of the shaft casing 4 disposed opposite the impact casing has a plurality of funnel-shaped openings 8 through which the push rod 7 extends outwardly. At its outer end, each push rod is secured, through a hinged joint, to one arm 10 of an angle lever and the other arm 11 of the angle lever is connected to the lower end of a piston rod 12. The piston rod is movably positionable within an hydraulic cylinder 13 supported on the exterior wall of the shaft casing. As indicated schematically in FIG. 4, the hydraulic cylinders 13 are operated by a control member 14. The segments 3 arranged in angularly spaced relationship within the inner row of the casing are adjusted in position by means of the piston rod 12, the arms 10, 11 of the angle lever, and the push rod 7 so that they can be pivotally displaced through the connection of the bar 5 to the interior of the shaft casing 4 for varying the angle of inclination of the segment to the vertical axis of the casing and also for varying the distance of the segment from the center of the shaft casing. Similar hydraulic cylinders 13*a*and controls 14*a* are provided for positioning the segments 3*a* arranged in angularly spaced relationship within the outer row of the casing.

In accordance with the present invention, the controls 14 for the hydraulic cylinders 13 of the segments 3 forming the inner row, are connected to the controls 14*a* for the hydraulic cylinders 13*a* of the segments 3*a* in the outer row so that a time differential is provided between the adjustment of the segments in one row as compared to those in the other. In FIG. 4, a circuit for operating the controls of the hydraulic cylinders 13, 13*a* is illustrated. For sake of clarity only three of each type of cylinders is shown in FIG. 4. The hydraulic cylinders 13 are connected in parallel within a control circuit 15 which consists of a hydraulic system. The control 14 for operating the hydraulic cylinders 13 is positioned within the control circuit 15. If control 14 receives a control pulse, the pressure medium is fed to the hydraulic cylinders 13 via a pump 16 for selectively displacing the piston rods 12 and adjusting the position of the segments 3 in the inner row of the casing. The hydraulic cylinders 13*a* are arranged in a similar control circuit 15a, as shown in FIG. 4. The controls 14, 14*a* are interconnected by means of a time-delay relay 17. By means of this relay 17, the hydraulic cylinders 13 can be actuated first for effecting the inward movements of the segments 3 in the inner row and, after they have been located in the desired position, the hydraulic cylinders 13*a* can be actuated so that the segments 3*a* in the outer row are moved into contacting engagement with the segments in the inner row. Though not shown in FIG. 4, the control circuits 15, 15*a* would include safety valves of the type well known in the art.

As shown in FIG. 1, to move the segments 3 from the position shown in solid lines into the position pivotally displaced inwardly or to the right as shown in dot-dash lines, the hydraulic cylinders 13 are operated by the controls 14 from a control console, not shown. As a result, the segments 3 are displaced inwardly into the desired position. After the time-delay or difference provided by the relay 17, the segments 3*a* are displaced inwardly until they contact the segments 3 in the inner row and are positioned as close together as is possible. In this arrangement for moving the segments 3, 3*a*, the possibility of the impact casing becoming jammed by burden materials is avoided. By means of this adjustment procedure, the impact shell can be movably adjusted without difficulty over a wide range, and the inclination of the segments can be provided with an angle of 45° or more to the vertical. Depending on the length of the segments, for a blast furnace having a shaft casing diameter of 11 m it is possible to provide an adjustment range of 1,900 mm.

In FIG. 3, another embodiment of adjusting apparatus is illustrated comprising a pair of ring-shaped members 19, 19*a* supported on brackets 18 on the exterior surface of the blast furnace wall. The member 19 is positioned above the push rod 7 while the member 19*a* is positioned below the push rods. Each of the rings 19, 19*a* can be rotated about the shaft casing of the furnace by means of one or several hydraulic drives, 20, 20*a* respectively, which are also mounted on the exterior of the shaft casing in a manner not illustrated. All of the push rods 7 connected to the segments in the inner row are connected to one of the rings 19, 19*a* and the push rods for the other row of segments are connected to the other one of the members 19, 19*a*. Linkage arrangements 21, 21*a* are provided between the rings 19, 19*a* respectively, and their corresponding push rods for transmitting the rotational movement of the rings to the push rods and, in turn, to the segments in the inner and outer rows. The rings 19, 19*a* are controlled by an arrangement similar to that shown in FIG. 4, and when one ring is rotated or moved angularly about the furnace, each of the segments connected to its through the push rods is, accordingly, selectively positioned. By means of the time-delay device, as shown in FIG. 4, the segments in one row can be positioned relative to those in the other row with a time differential.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. An adjustable impact casing for use in a shaft furnace, particularly for a blast furnace, said casing having an upright axis and comprising a plurality of angularly spaced apart first arcuate segments forming an inner row about the casing axis, a plurality of angularly spaced apart second segments forming an outer row about the casing axis and disposed contiguous to said inner row, the axis of said first segments and second segments extending in the direction of the casing axis being offset relative to one another and with their lateral edges extending in the direction of the casing axis being arranged in overlapping substantially contacting relationship so that said inner row and outer

row of segments form a continuous casing surface, means for supporting said first and second segments, each of said first and second segments being pivotally mounted on said means adjacent the upper end of the segment, a plurality of push rods extending transversely of the casing axis and each said push rod being secured to a different one of said first and second segments, means attached to each said push rod for displacing said push rod transversely of the casing axis and for pivoting said segments attached thereto, a first control device secured to said means for displacing said push rods secured to said first segments, a second control device secured to said means for displacing said push rods secured to said second segments, and means interconnecting said first and second control devices for effecting the displacement of said first and second segments with a time-delay between the movement of the inner row of said first segments and the outer row of said second segments.

2. An adjustable impact casing, as set forth in claim 1, characterized therein that said push rods being secured to said first and second segments at positions spaced downwardly from the location of the mounting of said segments.

3. An adjustable impact casing, as set forth in claim 1, characterized in that said first control device comprises a first control circuit interconnecting each of said means for displacing said push rods secured to said first segments, a first control located in said first control circuit, said second control device comprises a second control circuit interconnecting each of said means for displacing said push rods secured to said second segments, a second control located within said second control circuit, and said means interconnected between said first and second control devices comprises a time-delay relay interconnecting said first control and said second control.

4. An adjustable impact casing, as set forth in claim 1, characterized in that said means for displacing said push rods transversely comprising a first ring member located about and outwardly from said casing, a first drive member secured to said first ring member for rotating it about its central axis, first means connected to said first ring member and to said push rods secured to said first segments for transmitting the movement of said first ring member to said first segments for pivotally displacing said first segments, a second ring member located about and outwardly from said casing, a second drive member secured to said first ring member for rotating it about its central axis, second means connected to said second ring member and to said push rods secured to said second segments for transmitting the movement of said second ring member to said second segments for pivotally displacing said second segments.

5. An adjustable impact casing, as set forth in claim 1, characterized in that said means for displacing said push rods transversely of the axis of said casing comprising first hydraulic cylinders for said push rods connected to said first segments, second hydraulic cylinders for said push rods connected to said second segments, linkages provided between said first and second hydraulic cylinders and said push rods for transmitting the movement of said hydraulic cylinders to said push rods and in turn for pivoting said first and second segments.

6. An adjustable impact casing, as set forth in claim 1, characterized in that a furnace wall being laterally disposed about and spaced outwardly from said casing, said furnace wall having a plurality of openings therein forming passages for said push rods extending outwardly from said segments, said means for supporting said first and second segments being fixed to the interior of said furnace wall above the openings through said wall, and said means openings displacing said push rods tranversely of the casing axis being located on the exterior surface of said furnace wall.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,693,952 Dated September 26, 1972

Inventor(s) GUNTER SCHWERDTFEGER and BRUNO KAMMERLING

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent, insert:

--[73] Assignee: Gutehoffnungshuette Sterkrade A.G., Oberhausen-Sterkrade, Germany--

Signed and sealed this 1st day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.